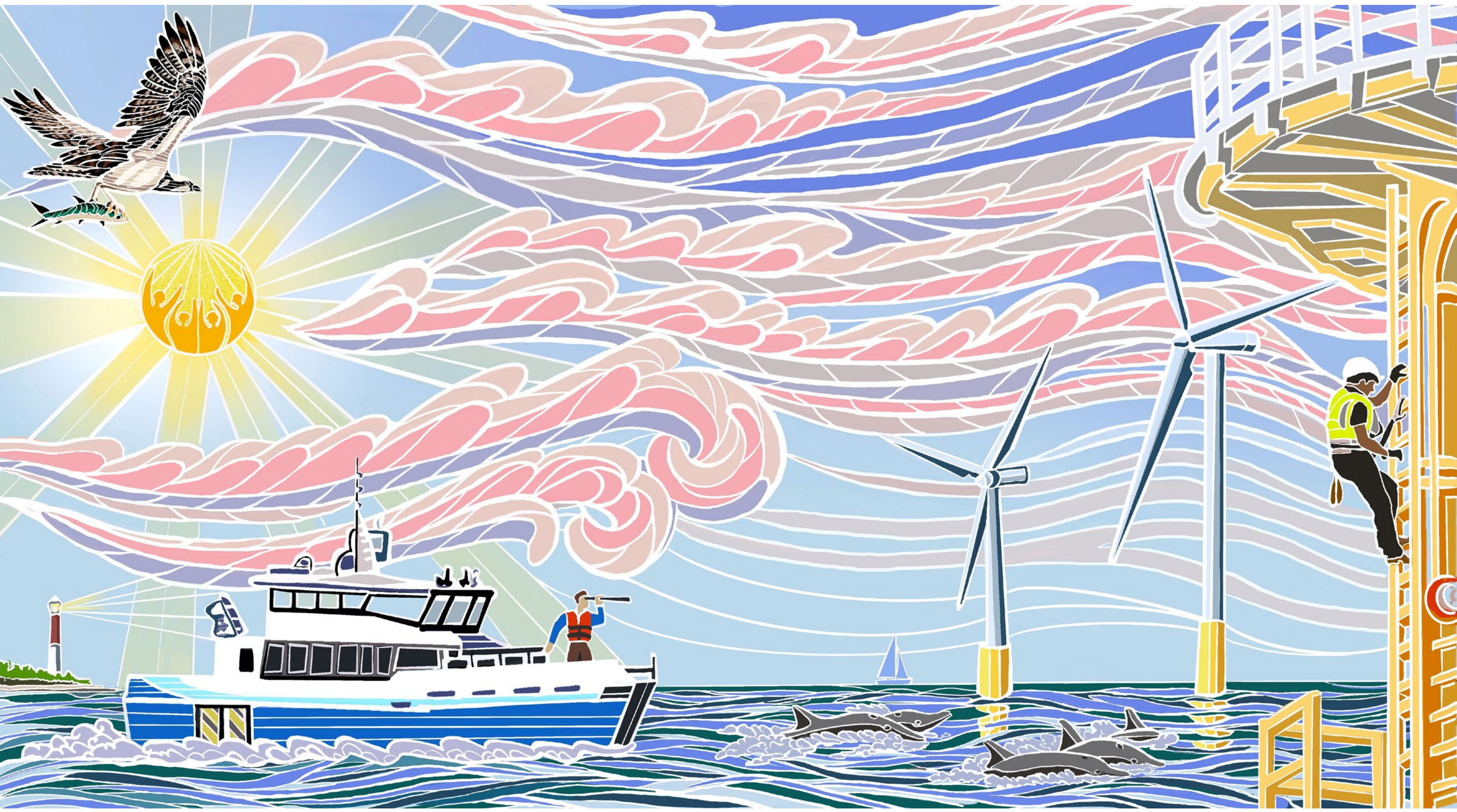
# Atlantic Shores Offshore Wind
## Construction and Operations Plan

Lease Area OCS-A 0549



## Volume II: Affected Environment

**Submitted by:**

ATLANTIC SHORES offshore wind

**Submitted to:**

BOEM Bureau of Ocean Energy Management

**Prepared by:**

EDR a better environment

Epsilon Associates Inc.

**March 2024**

# CONSTRUCTION AND OPERATIONS PLAN

Lease Area OCS-A 0549

Atlantic Shores North

Volume II Affected Environment

*Submitted to:*

Bureau of Ocean Energy Management
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March 2024

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## Acronyms and Abbreviations

| | |
|---|---|
| °C | Celsius |
| °F | Fahrenheit |
| μPa | micropascal |
| ADLS | Aircraft Detection Lighting System |
| AMS | Accelerator Mass Spectrometer |
| AQRV | air quality related value |
| BGEPA | Bald and Golden Eagle Protection Act |
| BMP | best management practice |
| BOEM | Bureau of Ocean Energy Management |
| BSEE | Bureau of Safety and Environmental Enforcement |
| CBRA | Cable Burial Risk Assessment |
| CER | Certified Emission Reduction |
| CLCPA | Climate Leadership and Community Protection Act |
| CMECS | Coastal and Marine Ecological Classifications Standards |
| CO | carbon monoxide |
| $CO_2e$ | carbon dioxide equivalents |
| COP | Construction and Operations Plan |
| CTV | crew transfer vessel |
| dB | decibel(s) |
| DHS | Department of Homeland Security |
| DIN | dissolved inorganic nitrogen |
| DIP | dissolved inorganic phosphorus |
| DMA | Dynamic Management Area |
| DO | dissolved oxygen |
| DoD | Department of Defense |
| DPS | distinct population segments |
| ECC | Export Cable Corridor |
| ECC | export cable corridor |
| ECL | Environmental Conservation Law |
| EEZ | Exclusive Economic Zone |
| EFH | Essential Fish Habitat |
| EMF | electromagnetic fields |
| ENSP | Endangered and Non-Game Species Program |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| FAA | Federal Aviation Administration |
| FIR | Fabrication and Installation Report |
| ft | foot/feet |
| $ft^3$ | cubic foot/feet |
| G&G | geophysical and geotechnical |
| GBS | gravity-based structure |
| GHG | greenhouse gas |
| GWP | Global Warming Potential |
| GWRA | Global Warming Response Act |
| HAPC | habitat areas of particular concern |
| HDD | horizontal directional drilling |
| HF | high frequency |
| HRG | high-resolution geophysical |
| HVAC | high voltage alternating current |
| HVDC | high voltage direct current |
| IPF | impact-producing factor |
| IWC | International Whaling Commission |
| kHz | kilohertz |
| km | kilometer(s) |
| $km^2$ | square kilometer(s) |
| KOP | key observation point |
| kV | kilovolt(s) |
| kya | thousand years ago |
| LCA | Landscape character area |
| Lease Area | Lease Area OCS-A 0549 |
| LGA | Last Glacial Maximum |
| m | meter(s) |
| m/s | meters per second |
| $m^3$ | cubic meter(s) |
| MBTA | Migratory Bird Treaty Act |
| mG | milligauss |
| mi | mile(s) |
| $mi^2$ | square mile(s) |
| mph | miles per hour |
| MW | megawatt |
| mya | million years ago |
| N.J.A.C. | New Jersey Administrative Code |
| NAAQS | National Ambient Air Quality Standards |
| NARW | North Atlantic right whales |
| NAS | noise abatement systems |
| NEFSC | Northeast Fisheries Science Center |
| NESHAPs | National Emissions Standards for Hazardous Air Pollutants |
| NJDEP | New Jersey Department of Environmental Protection |
| NJPDES | New Jersey Pollutant Discharge Elimination System |
| NJWP | New Jersey Wind Port |
| nm | nautical mile(s) |
| NMFS | National Marine Fisheries Service |
| $NO_2$ | nitrogen dioxide |

| | |
|---|---|
| NOAA | National Oceanic and Atmospheric Administration |
| NSPS | New Source Performance Standards |
| NSR | New Source Review |
| NSSP | National Shellfish Sanitation Program |
| NYCDCP | New York City Department of City Planning |
| NYS | New York State |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOS | New York State Department of State |
| NYSDPS | NYS Department of Public Service |
| O&M | operations and maintenance |
| $O_3$ | ozone |
| OCA | Ocean character area |
| OCS | Outer Continental Shelf |
| OE/AA | Obstruction Evaluation/Airspace Analysis |
| OSAP | Ocean Stock Assessment Program |
| OSRP | Oil Spill Response Plan |
| OSS | offshore substation |
| PAPE | Potential area of potential effects |
| Pb | lead |
| PDE | Project Design Envelope |
| $PM_{10}$ | particulate matter with a diameter smaller than 10 microns |
| $PM_{2.5}$ | particulate matter with a diameter smaller than 2.5 microns |
| ppm | parts per million |
| PSD | Prevention of Significant Deterioration |
| PTE | Potential to Emit |
| RFC | Reliability First Corporation |
| ROV | remotely operated vehicle |
| ROW | right-of-way |
| RSZ | rotor swept zone |
| SCA | Seascape character area |
| SEL | sound exposure level |
| $SO_2$ | sulfur dioxide |
| SOTA | State of the Art |
| SOV | service operation vessel |
| SPDES | State Pollutant Discharge Elimination System |
| SWPPP | Stormwater Pollution Prevention Plan |
| UAV | unmanned aerial vehicle |
| USACE | U.S. Army Corps of Engineers |
| USCG | U.S. Coast Guard |
| USFWS | United States Fish and Wildlife Service |
| VMS | vessel monitoring system |
| VTR | vessel trip report |
| WTG | wind turbine generator |

# 1.0 Introduction

Atlantic Shores Offshore Wind, LLC (Atlantic Shores) is a 50/50 joint venture between EDF-RE Offshore Development, LLC (an indirect wholly owned subsidiary of EDF Renewables, Inc. [EDF Renewables]) and Shell New Energies US, LLC (Shell). Atlantic Shores is submitting this Construction and Operations Plan (COP) to the Bureau of Ocean Energy Management (BOEM) for the development of an offshore wind energy generation project (Project) within Lease Area OCS-A 0549 (the Lease Area or Atlantic Shores North).

The purpose of the Project is to develop an offshore wind energy generation facility in the Lease Area to provide clean, renewable energy to the northeastern United States by the mid-to-late 2020s. The Project will help the United States, New Jersey and/or New York achieve their renewable energy goals, diversify electricity supply, increase electricity reliability, and reduce greenhouse gas emissions. The Project will also provide numerous environmental, health, community, and economic benefits including the creation of substantial new employment opportunities. This COP is organized into two volumes:

- Volume I provides detailed descriptions of the offshore and onshore facilities for the Project and how Atlantic Shores plans to construct, operate, and decommission those facilities.
- Volume II provides a comprehensive assessment of the Project's potential impact-producing factors (IPFs) to physical, biological, visual, cultural, and socioeconomic resources and describes the numerous environmental protection measures (EPMs) that Atlantic Shores will employ to avoid, minimize, and mitigate those potential effects. Volume II also characterizes the environmental setting.

The resources discussed in Volume II were identified through consultation and coordination with Federal and State agencies and tribes; desktop assessments; site-specific field studies; and stakeholder outreach. Atlantic Shores is in the process of executing seasonally driven site-specific field and constructability surveys (e.g., benthic studies, wetland delineation, and habitat characterization). These survey activities are being executed based on applicable Federal and State guidance as well as agency consultations and lessons learned from Atlantic Shores ongoing development efforts and jurisdictional agency engagements regarding the two projects currently under review within Lease Area OCS-A 0499.

The site characterization and assessment is structured in accordance with 30 CFR Parts 585.626(a) and (b) and the BOEM guidelines on the information requirements for a COP for OCS renewable energy activities on a commercial lease (BOEM 2020). The approach also considers the additional detailed information and certifications, as specified under 30 CFR Part 585.627, which support BOEM's compliance with National Environmental Policy Act regulations as well as other applicable laws and regulations, including, but not limited to, the Endangered Species Act, Clean Air Act, and the Marine Mammal Protection Act. The information in Volume II also supports ongoing agency consultations and serves as the foundation and input for any Federal and State permits Atlantic Shores will be required to file.

Volume II is organized by resource area as follows:

- Environmental Setting
- Geology
- Physical Oceanography and Meteorology
- Physical Resources
- Air Quality
- Water Quality
- Biological Resources
- Wetlands and Waterbodies
- Coastal and Terrestrial Habitat and Fauna
- Birds
- Bats
- Benthic Resources
- Finfish, Invertebrates, and Essential Fish Habitat
- Marine Mammals
- Sea Turtles
- Visual Resources
- Cultural Resources
- Aboveground Historic Properties
- Terrestrial Archaeological Resources
- Marine Archaeological Resources
- Socioeconomic Resources
- Demographics, Employment, and Economics
- Environmental Justice
- Recreation and Tourism
- Commercial Fisheries and For-Hire Recreational Fishing
- Land Use and Coastal Infrastructure
- Navigation and Vessel Traffic
- Other Marine Uses and Military Activities
- Aviation and Radar
- Onshore Transportation and Traffic

- In-Air Noise and Hydroacoustics
- Public Health and Safety

Within Volume II, the Atlantic Shores Project Area (Project Area) refers to the footprint of all offshore and onshore facilities, including areas affected by construction, operations, and maintenance (O&M), and decommissioning. A detailed description of the Project is provided in Volume I Project Information. Figure 1.0-1 provides an overview of the Project. As applicable, the Project Area is defined in each resource section as the Offshore Project Area or Onshore Project Area as follows:

- Offshore Project Area – The Offshore Project Area includes the Federal and State waters and underlying seabed associated with the Lease Area and the Monmouth Export Cable Corridor (ECC) and the Northern ECC. Offshore Project components include up to 157 wind turbine generators (WTGs), up to 8 offshore substations (OSSs), and up to one permanent meteorological (met) tower. Energy from the OSSs will be delivered to the landfall sites in New Jersey and/or New York via 230 kV to 275 kV high voltage alternating current (HVAC) and/or 320 (kilovolt) kV to 525 kV high voltage direct current (HVDC) export cables. Energy delivery to New Jersey would be made via HVAC and/or HVDC export cables, while delivery to New York would be made via HVDC export cables only. These offshore facilities are described in detail in Sections 4.1 through 4.6 of Volume I.

- Onshore Project Area – The Onshore Project Area includes the area associated with onshore infrastructure from the landfall sites to the points of interconnection (POIs). Potential POIs have been identified in both New Jersey and New York. These POIs are existing electric transmission substations with direct connectivity into the electric grid. The POIs currently under consideration are the Larrabee and Atlantic Substations in Monmouth County, New Jersey and the Fresh Kills, Goethals and Gowanus substations in Richmond and Kings Counties, respectively, in New York. Atlantic Shores has identified potential landfall sites in southern Monmouth County, New Jersey; in the vicinity of Asbury in northern Monmouth County, New Jersey; on southwest Staten Island, New York; on northeast Staten Island and in Brooklyn, New York to enable access to these POIs. These onshore facilities are described in detail in Sections 4.7 through 4.9 of Volume I.

The environmental setting for each resource (titled the "affected environment" in each section) is described based on available scientific literature, site-specific environmental survey data, ongoing Federal and State agency consultations, and public outreach. Results of these site surveys and assessments have been included as supporting technical appendices to this COP.

Atlantic Shores is requesting review and authorization of the Project using a Project Design Envelope (PDE) approach as outlined in BOEM's 2018 draft PDE guidance. According to BOEM (2018), "A PDE approach is a permitting approach that allows a project proponent the option to submit a reasonable range of design parameters within its permit application, allows a permitting agency to then analyze the maximum impacts that could occur from the range of design parameters, and may result in the approval of a project that is constructed within that range." The PDE approach allows Atlantic Shores design flexibility and an ability to respond to advancements in industry technologies and techniques.

Impacts include both beneficial and detrimental effects that result from the interaction between a resource and an IPF. BOEM (2018) states, "IPFs identify the cause-and-effect relationships between actions (e.g., a wind energy project) and relevant physical, biological, economic, or cultural resources. They define the particular ways in which an action or activity affects a given resource. It is common that multiple IPFs affect the same resource."

In order to avoid, minimize, and/or mitigate the effects of IPFs on physical, biological, visual, cultural, and socioeconomic resources, each resource section also includes EPMs. EPMs are made up of studies, assessments, design elements, best management practices, and potential mitigations. Some EPMs have already been completed (i.e., project design considerations), while others will occur during and after construction. Similarly, some IPFs have been avoided and/or minimized due to factors such as Project siting decisions and execution strategies. A summary of the proposed EPMs is provided at the end of each section.

The IPFs and the associated EPMs were developed based on the PDE and could be refined as the Project evolves through ongoing consultation, stakeholder outreach, and final engineering design. Atlantic Shores will continue to work with the appropriate agencies and stakeholders to identify practical EPMs that meet regulatory requirements and best industry standards. Final EPMs will be provided for review and approval prior to construction as part of Atlantic Shores' Facility Design Report and Fabrication and Installation Report as appropriate in accordance with 30 CFR Parts 585.701 and 702.

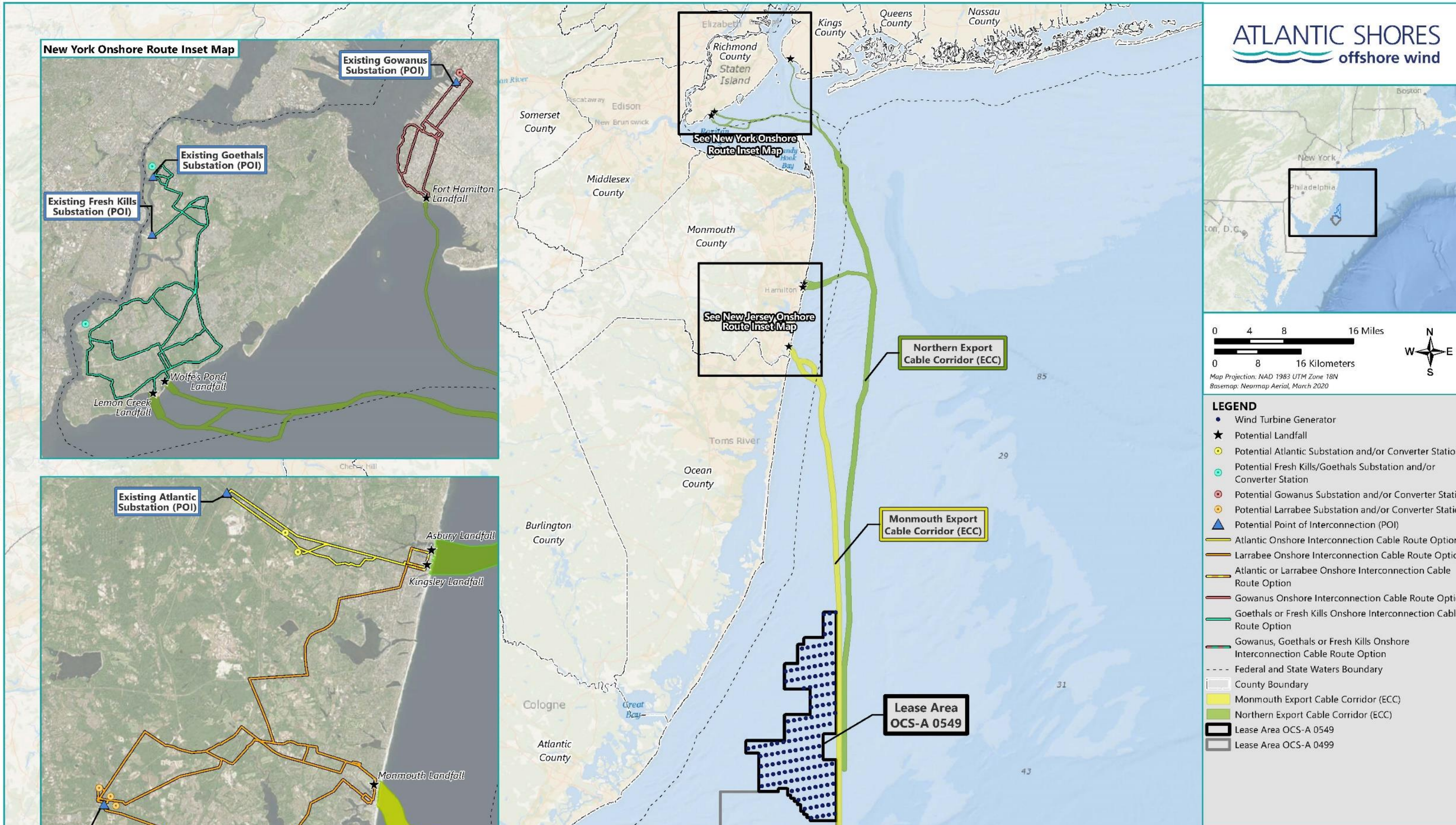



**Figure 1.0-1**

*Project Overview*

3/15/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\1.0 Project Overview\MXD\Figure 1.0 1 Project Overview.mxd

# 2.0 Environmental Setting

This section provides a detailed description of the general environmental setting including geologic, meteorologic, and physical oceanic conditions within the Project Area.

## 2.1 Geology

This section provides an overview of the regional geologic setting and geologic conditions in the Onshore and Offshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects during construction, operations and maintenance (O&M), and decommissioning. Geologic conditions in the Onshore and Offshore Project Area, including potential natural and anthropogenic (human-made) hazards, guide and inform the design, siting, and engineering of the Project. Key geologic datasets are gathered during multi-season geophysical and geotechnical (G&G) survey programs. Results of these investigations are utilized to ensure all aspects of the Project are compatible with site-specific geologic conditions.

In 2019, Atlantic Shores acquired a reconnaissance geophysical survey across the combined Lease Areas OCS-A 0499 and OCS-A 0549 to initially characterize the seabed, the shallow subsurface, and geohazards within the Offshore Project Area (Terrasond 2020).

This survey has since been superseded by additional geophysical and geotechnical (G&G) survey campaigns conducted in 2020, 2021 and 2022 that included the Lease Area, Monmouth export cable corridor (ECC), and the Northern ECC. The results of these additional survey activities have been incorporated into a series of reports and are included as Appendices II-A1a-A1f, Appendices II-A2a-A2f, and Appendices II-A3a-A3i. Together, the results of these studies document the geologic conditions within the Offshore Project Area.

### 2.1.1 Affected Environment

The affected environment includes the existing geology within the Project Region and within the Offshore and Onshore Project Areas including Monmouth County in New Jersey and Richmond and Kings Counties in New York. The geologic information in this section is based on published data as cited herein as well as site-specific offshore and onshore surveys and reports previously conducted for the COP associated with Lease Area OCS-A 0499 and the associated Monmouth ECC (Appendix II-A1 through II-A6) including:

- **Marine Site Investigation Reports (MSIRs) (Appendix II-A1 (II-A1a-A1f)**: These reports together provide the Marine Site Investigation Reports for the Project Lease Area and ECCs.
- **Factual Geophysical Reports (Lease Area 0549, Monmouth ECC and Northern ECC) (Appendix II-A2 (A2a-A2f))** These reports provide factual geophysical reports for both the Lease Area OCS-A 0549, Monmouth, and the Northern ECCs.

- **Measured and Derived Geotechnical Parameters and Final Results (Appendix II-A3 (3a-A3i))** These reports provide the parameters and final results of the factual geotechnical reports for the Lease Area OCS-A 0549, Monmouth, and the Northern ECCs, as well as previously provided reports for Lease Area OCS-A 0499.

- **Cable Burial Risk Assessment (CBRA) Report for the Lease Area OCS-A 0549 and Monmouth ECC (Appendix II-A4):** This assessment provides the initial cable burial risk assessment for the Lease Area OCS-A 0549 and Monmouth ECC. The CBRAs for the Northern ECCs will be provided at a later date.

- **Atlantic Shores Offshore Wind Munitions and Explosives of Concern (MEC) Hazard Assessment (2023) (Appendix II-A5):** This assessment identifies and assesses MEC that would present potential shallow anthropogenic hazards in and near the Lease Area. The assessment included the potential categories of MEC hazards and the likelihood of encounter.

- **Atlantic Shores Offshore Wind Munitions and Explosives of Concern (MEC) Risk Assessment (2023) (Appendix II-A6):** This assessment evaluated the risk that any identified MEC pose to the Project structures and activities and recommended measures to reduce MEC risk.

- Natural Resources Conservation Service (NRCS) Mapped Soils Report New Jersey (2022) (Appendix II-A7a) and New York (2022) (Appendix II-A7b): This report provides the soil data derived from the NRCS database for the New Jersey and New York landfall sites, onshore interconnection routes, and POIs.

Information from existing G&G technical reports (NYSERDA 2019) as well as G&G technical reports submitted as appendices in the COP for Lease Area OCS-A 0499 (Atlantic Shores 2021) were also incorporated into this document.

#### 2.1.1.1 Regional Geology Setting

The Lease Area is located approximately 8.4 miles (mi) (13.5 km) east of the New Jersey coast and approximately 60 mi (96.6 km) from the New York State (NYS) coast, on the submerged shallow portion of the Outer Continental Shelf (OCS) of the Western Atlantic continental margin. The continental shelf extends eastward from the New Jersey coast for about 87 mi (140 km) to the continental slope break (see Appendix II-A1). The offshore setting is known as the Mid-Atlantic Bight (also the New York Bight), due to its position within the open arc of the New Jersey-New York coastline.

The Lease Area is located along the Western Atlantic continental margin, which is known as a passive margin, as there is no nearby active tectonic plate boundary. Passive continental margins are considered zones of lower seismicity than active plate boundaries, such as along the California and southern Alaska coasts (USGS 2021a).

The geology of the region surrounding the Lease Area is comprised of a thick wedge of coastal plain sediments interbedded with marine sediments. The deepest sediments underlying the Lease Area region may date to the late Mesozoic Era (older than approximately 66 million years ago [mya]) (USGS 2021b). During the more recent Pleistocene Epoch (approximately 1.8 mya to 12 thousand years ago [kya]) to the Holocene Epoch (approximately 12 kya to the present), the Atlantic continental margin experienced multiple global glaciations, resulting in a series of sea level fluctuations caused by the southerly advance and northerly retreat of glacial ice. While past glacial maximums are not believed to have extended as far south as the Lease Area, the continental shelf was affected by these geologically recent glacial and post-glacial processes. During glacial maximums, when higher volumes of global water were contained in glacial ice, sea levels were lower exposing more of continental shelves to erosive processes than present.

During the most recent glacial advance in the Late Wisconsin period, the Last Glacial Maximum (LGM) occurred approximately 25 to 15.7 kya (see Appendix II-A1). At the LGM, the southerly position of the ice sheets was approximately 54 nm (100 km) north of the Lease Area (see Appendix II-A1), in the vicinity of Long Island and trending westerly through northern New Jersey. Gravel and coarser sediments were deposited at the southern edge of the Wisconsin glacier, known as the terminal moraine. This terminal moraine stretches from the southern end of Staten Island through Brooklyn and Queens and is composed of glacial till (glacio-fluvial and glacio-marine lacustrine drift and till). New York City and surrounding geological setting is complex given the significant natural and human influence on the physiography of the region.

In the region surrounding the Lease Area, northwest to southeast oriented channels cut across the exposed continental shelf. These now buried paleo-channels in the shallow subsurface have been mapped from geophysical data and appear to emanate from the Great Egg River, the Mullica River, and other smaller drainages to the west (see Figure 2.1-1 and Figure 2.1-2). The large paleo Hudson Shelf Valley, cut by the Hudson River in New York, is well east of the Lease Area but is proximate to portions of the Northern ECC (see Figure 2.1-1 and Figure 2.1-2). Within New York Harbor and Raritan Bay, paleo-channels present are associated with the Hudson River and Raritan River.

As the climate warmed, sediments washed out of the melting glaciers and were transported south in pulses of meltwater, which resulted in lateral and vertical variations of depositional environments and sediment characteristics. As sea level rose, these sediments were winnowed and reworked by waves, tides, and storms, forming distinctive surficial bedforms such as ripples, mega ripples, sand waves, and less mobile features referred to as sand ridges, with ridge and swale topography, across the Mid-Atlantic continental shelf. Some of these subparallel seafloor features can be seen on Figure 2.1-1. Sea level rise over the last 20,000 years has elevated the New Jersey sea level an estimated 350 to 400 feet (ft) (107 to 122 meters [m]) vertically (Stockton Coastal Research Center c2020), resulting in the westerly migration of the shoreline to its present location. Marine processes on this open continental shelf continue to winnow and rework the unconsolidated surficial marine sediments.

#### 2.1.1.2 Local Geology – Marine

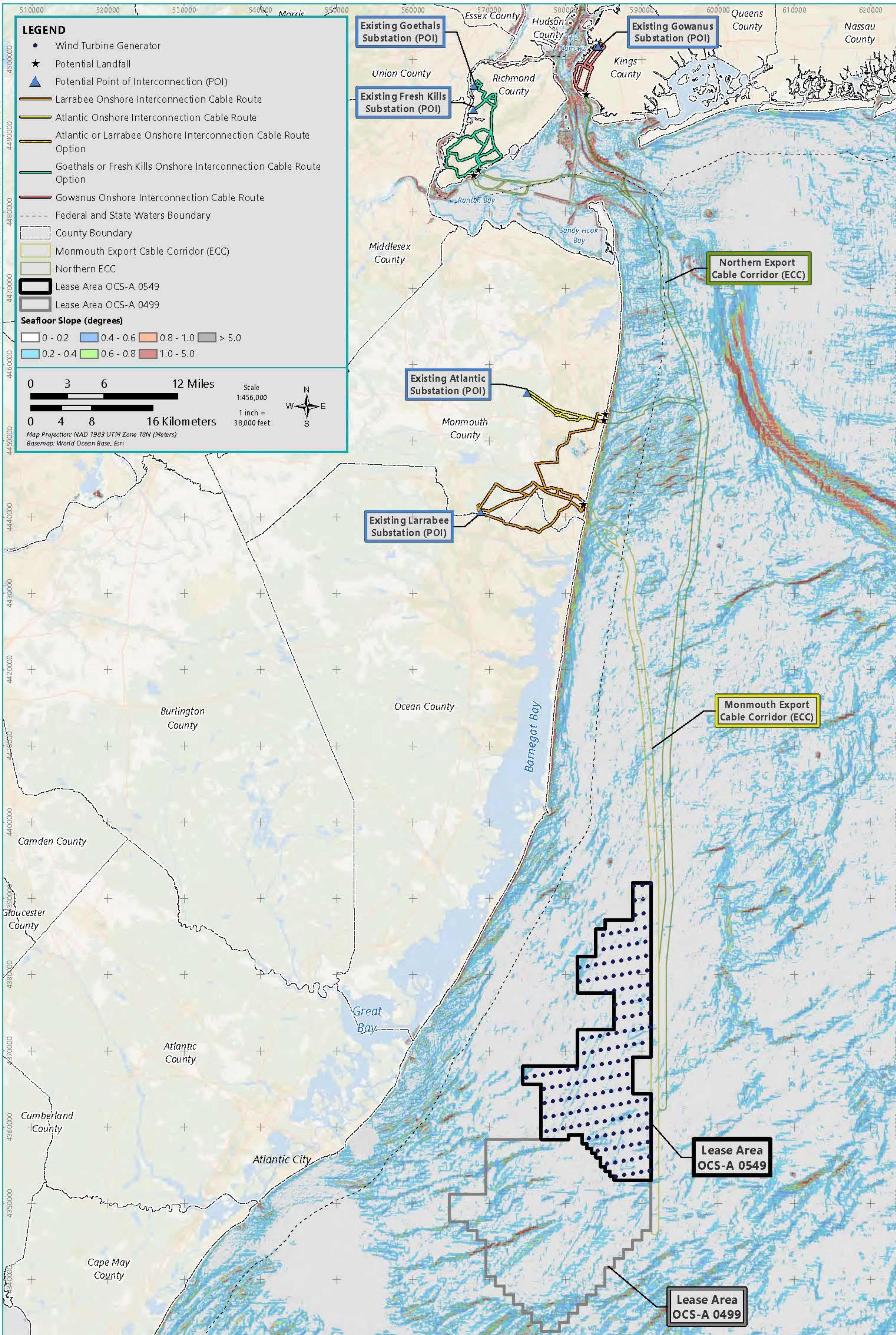
Most of the Project will be located offshore. Marine sediment types, seafloor sediments, and potential shallow hazards in the Lease Area and Export Cable Corridors (ECCs), are described below based upon the studies identified in Section 2.1.1 as well as other desktop research.

##### 2.1.1.2.1 Sediment Types

The sediment types expected within the maximum horizontal and vertical footprints in the Offshore Project Area can be grouped into four key geological units (listed below from youngest to oldest). All Project offshore structures within Lease Area OCS-A 0549, including the offshore cables (export, inter-array, and inter-link cables), will be sited within the three youngest units. The foundations of the wind turbine generators (WTGs), the offshore substations (OSSs), and the meteorological tower are expected to encounter the underlying Coastal Plain sediments. Export cables may encounter Coastal Plain sediments along the northern part of the Monmouth ECC and the central to northern part of the Northern ECC.

- Holocene Marine Deposits: Holocene marine deposits are unconsolidated deposits that vary in thickness and cover the entire Lease Area, thinning toward the northern portion of the Lease Area. The deposits comprise the bedforms which characterize the seafloor in the Lease Area, including sand ripples, mega ripples, sand waves, and sand ridges. The base of the Holocene Marine Deposits is generally a well-defined erosive boundary into the top of the older sediment deposits.

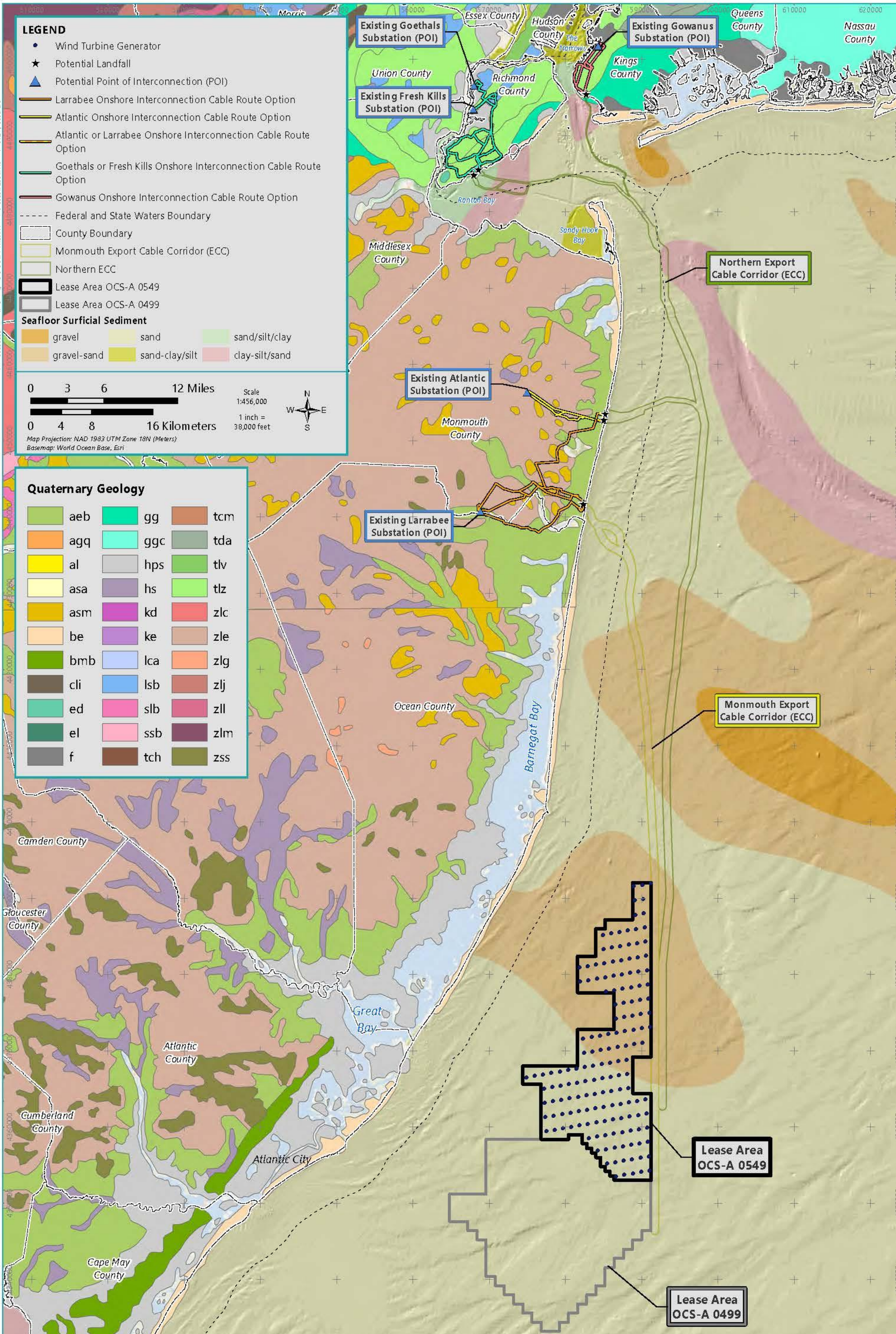
- Late Pleistocene to Holocene Transgressive Channel Group Deposits: These deposits are inferred to be of Late Pleistocene to Holocene age (28 kya to 7.4 kya) based on site specific radiocarbon dating of sediments within Lease Areas OCS-A 0499 and 549 and the Monmouth and Northern ECCs as well as correlation with regional stratigraphy (See Appendix II-A1 MSIRs). Active and advancing fluvial marine processes created varying depositional environments: including the erosion of and incision into subaerially exposed older sediments, such as Pleistocene deposits, filling of paleo-channels with finer sediments, and pulses of meltwater streams which carried glacial sediments from breached moraines to the north (even though these distances would have exceeded the estimated 54 nm [100 km] from the LGM) southerly towards the Lease Area. The subsurface channel sequences from the Great Egg River, the Mullica River, and other smaller drainages to the west (see Figure 2.1-1) are present within this unit. The deposits are bounded at their base by a clear erosional unconformity (gap in the stratigraphic record), which may in places have removed the underlying Pleistocene deposits.




ATLANTIC SHORES offshore wind

**Figure 2.1-1**

*Seafloor Slope (Northeast Atlantic Coastal Relief Model)*




ATLANTIC SHORES offshore wind

**Figure 2.1-2**

*Seafloor Surficial Sediments and Quaternary Geology*

- Pleistocene Deposits: The Pleistocene sequence underlying the Holocene Marine and Late Pleistocene Deposits is likely comprised of sediments derived from at least three intervals of relative sea level high stand and low stands that occurred during the Wisconsin Glacial Stage. The age of these deposits is inferred to be between approximately 128 kya and 28 kya based on site-specific radiocarbon dating and correlation to regional stratigraphy (See Appendix II-A1 for the MSIRs). No basal till is expected in the Lease Area, as the Lease Area was well south of the last glacial maximum; deposits relating to older cycles may be absent. Given the proximity of the Northern ECC to the terminal moraine, the presence of boulders was confirmed at the seabed based on the 2022 field surveys. The top of the sequence is marked by an erosional or ravinement surface incised into the Pleistocene sediments by the Holocene to Late Pleistocene sedimentary processes. The underlying Pleistocene sediment types are commonly comprised of sand with varying amounts of finer-grained sediments and gravels. Thicknesses are expected to be variable, due to sequences of subaerial erosion and deposition, such as channel cut and fill. Correlations of the Pleistocene units may be challenging over large areas due to lateral and vertical variations and changes in thickness.

- Coastal Plain Deposits: An unconformity separates the Pleistocene deposits in the Quaternary Period from the underlying pre-Quaternary age Coastal Plain Deposits. The Coastal Plain deposits in the Lease Area are expected to be of marine origin and primarily comprised of dense to very dense silty to clayey sand, gravel layers, and layers of very stiff to hard clay. Cemented layers have not been encountered in the 2020 to 2022 geotechnical investigations with the Lease Area or ECCs. However, much harder sediment has been encountered near the seafloor within the Coastal Plain Deposits along portions of the Northern ECC. The top of the Coastal Plain Deposits generally deepens to the east and south but becomes very close to or at the seabed north of the Lease Area. The Pliocene-Miocene age Cohansey Formation and underlying Miocene age Kirkwood Formation are expected to be present in the deep stratigraphic section, which appears to be increasingly stratified with depth. East of northern Monmouth County, coastal plain sediments beneath Pleistocene deposits are shallow and may be encountered within a few feet of the seafloor. Upgradient and onshore, these coastal plain formations comprise a large onshore and productive groundwater aquifer beneath eastern New Jersey (see Section 2.1.1.3).

Due to the thickness of the coastal plain sediments in the Lease Area, the Project's foundations (to a maximum depth of approximately 230 ft [70 m]) (see Tables 4.2-1 and 4.4-2 in Volume I) are not expected to encounter crystalline basement. In addition, due to the distance of the Lease Area from primary sediment sources to the west and the maximum southerly advance of the Wisconsin glaciers to the north, the shallow and deep sediments deposited in the Lease Area are expected to be relatively fine-grained, with few boulders, though lateral and vertical variations are expected in sedimentary facies. Boulder deposits transported by glaciofluvial processes to the nearshore region were identified at the seabed within portions of the Northern ECC (NYSERDA, 2019).

The geologic conditions in the Offshore Project Area are expected to be compatible with installation of the WTGs, OSSs, and the offshore cable system. The conditions were confirmed based on completion of the comprehensive 2022 HRG and geotechnical field investigations and provided within the above-referenced Appendices.

#### 2.1.1.2.2 Seafloor Sediments

Interpretation of the seabed using multibeam echosounder bathymetry and side scan sonar data revealed a largely level and consistent seabed across the Lease Area. Predominant seafloor features in the Lease Area include sand bedforms of varying sizes, and swales (see 2.1-1 and Figure 2.1-22; Appendix II-A1 ). Some areas of coarser grained sediments may be eroded exposures of underlying more consolidated late Pleistocene sediments. Linear features indicative of fishing drag scars on the seabed were present throughout the Lease Area.

Regional surficial sediment mapping indicates a fining of predominantly sandy surface sediments to the south across the Lease Area, with increased gravel, and gravelly-sand and gravel deposits present in the surface sediments in the northern parts of the Lease Area (see Appendices II-A1 through II-A6 and the Mid-Atlantic Data Portal (2020)). The site-specific G&G data and benthic habitat surveys acquired by Atlantic Shores to date aligns generally with the regional surficial sediment mapping and further details the surficial sediments within the Offshore Project Area. The G&G data were interpreted and integrated with the benthic habitat survey data that included numerous grab (surficial) sediment samples, sediment profile and plan view imagery (SPI-PV), video imagery from each grab sample location, and towed video and still imagery. Along the Northern ECC, surficial sediments are comprised of gravelly sand and sand, with localized areas of boulders related to both geologic processes and anthropogenic seafloor debris. Clay and silts are localized in proximity to the Hudson Shelf Valley which extends into New York Bay and Raritan Bay. Seafloor sediments within the Raritan River Bay consist of sand with silts and clay. North of The Narrows in New York, the surficial sediments of the Upper Bay are predominately sand with silts and clays, however, several areas are identified as containing an increased gravel content. The surficial sediments along the southern shore of Staten Island, New York near the confluence of the Raritan River Bay is mapped as sand with silts and clays (refer to Figure 2.1-2). Seafloor sediment maps and detailed descriptions of surficial sediments are included in the Marine Site Investigation Reports in Appendix II-A.

As part of the 2019 reconnaissance survey, a total of 16 grab (surficial) sediment samples were collected at seven locations across the Lease Area. An additional 121 grab samples were collected in 2020 associated with the COP for Lease Area OCS-A 0499 which included portions of Lease Area OCS-A 0549 and the Monmouth ECC, as part of the Project's benthic assessment (see Section 4.5 Benthic Resources and Appendices II-G1 and II-G2). Sediment grab samples were also acquired along the Northern ECC in 2022. Grain size analyses of these surficial sediment samples indicated predominately medium grained sands, with grain sizes ranging from very fine to very coarse sands. Medium-grained sands were predominant in the Lease Area, with some gravelly sands along the northern and western portions of the Lease Area, which is generally consistent with literature indicating an overall regional fining of sediments to the south (see Appendix II-A1).

The seabed sediment conditions are included in the comprehensive 2022 HRG and geotechnical field investigations which were completed in 2022 and integrated with previous surveys provided in Appendix II-A1. The results are provided in Appendices II-A1 and A3.

Sand is an important resource in nearshore areas off the New Jersey coast. Sand resources are used for coastal restoration, beach nourishment, and habitat restoration projects, under the jurisdiction of Federal and State agencies. Based on conversations with the Bureau of Ocean Energy Management (BOEM), the New Jersey Department of Environmental Protection (NJDEP), the New York State Department of Environmental Conservation (NYSDEC), and the U.S. Army Corps of Engineers (USACE), the Project's ECCs were routed to avoid, to the maximum extent practicable, most Federal- and State-designated sand resource and sand borrow sites in the vicinity of the Offshore Project Area (see Figure 2.1-3). However, small segments of both ECCs cross designated sand resource areas. Atlantic Shores is actively coordinating with BOEM, the NJDEP, NYSDEC, and the USACE Philadelphia District regarding the placement of ECCs and mapped sand resource areas, including leased sand borrow sites. As depicted on Figure 2.1-3, designated sand borrow sites and potential sand resource areas are present throughout the Offshore Project Area; therefore, Atlantic Shores intends to collaboratively devise a cable layout strategy with these agencies that meets Federal and State requirements and industry best management practices (BMPs). Additional information is presented in Section 7.7 Other Marine Uses and Military Activities.

#### 2.1.1.2.3 Potential Natural Hazards in Offshore Project Area

Natural surficial and shallow subsurface hazards are geologic features and conditions which can pose a risk to Project activities. Natural hazards include but are not limited to mobile sediments, potentially unstable slopes, faults, and scour. The presence, absence, or status of natural hazards listed in 30 CFR §585.626 and 30 CFR §585.627, based upon the cited data and the existing studies listed in Section 2.1.1, are presented in Table 2.1-1. The presence or absence of these features in the Project footprint are fully evaluated in the assessment of the data set. This information is provided as a series of additional G&G reports in Appendix II-A.

### Table 2.1-1. Potential Natural Hazards in the Offshore Project Area

| Hazard | Definition | Description |
|---|---|---|
| Shallow faults; fault zones; fault attenuation<br><br>30 CFR §585.626(a)(1)(i) and (2)(ii) and (iv) | A fault is a planar or gently curved fracture in the earth's crust across which there has been relative displacement. Groups of related faults are termed fault zones. Fault attenuation refers to fault variation over distance. | The Offshore Project Area is located on the shallow OCS of the tectonically passive Western Mid-Atlantic continental margin (see Section 2.1.1.2). No evidence of faulting in the Offshore Project Area has been reported in the Lease Area and the Monmouth and Northern ECCs in the studies listed in Section 2.1. |
| Gas seeps or shallow gas; gas hydrates<br><br>§585.626(a)(1)(ii) and (iv) | Gas seeps or shallow gas refer to methane released into the water column from microbial decomposition of organic material in marine sediments. Gas seeps have been found along and near the Western Mid-Atlantic continental slope, well east and seaward of the Offshore Project Area (USGS 2021c).<br><br>Gas hydrates are a crystalline solid formed of water and methane. Gas hydrates have also been found in the uppermost layers of deep-water continental slope sediments. Because gas hydrates act much like ice, they can affect the stability of shallow marine sediments (USGS 2021d). | Localized areas of possible shallow methane gas have been identified within the late Pleistocene to Holocene channel deposits in the north part of the Lease Area OCS-A 0499 and locally within the north part of the Monmouth ECC, and localized sections of the Northern ECC. No evidence of gas seeps, shallow gas, or gas hydrates has been reported in the Lease Area in the studies listed in Section 2.1. |

| Hazard | Definition | Description |
|---|---|---|
| Slump blocks or slump sediments; instability of slopes at the facility location<br><br>§585.626(a)(1)(iii); §585.626(a)(6)(iv) | Slump blocks or slump sediments refer to a block of unlithified sediments that collapse as a block or as a flow. Fine-grained slump sediments are often found on continental slopes, well east and seaward of the Offshore Project Area. | The seafloor is largely level in the Offshore Project Area (see Section 2.1.1.2.2). No evidence of slump blocks or slump sediments has been reported in the Lease Area or the Monmouth and Northern ECCs in the studies listed in Section 2.1. |
| Ice scour of seabed sediments; effects of subsea permafrost<br><br>§585.626(a)(1)(iii); §585.626(6)(vi) | Ice scour refers effects of ice movement across the land or seafloor, causing striations, gouges, or erosion. Permafrost is a subsurface layer of sediment that remains frozen throughout the year, chiefly in polar regions. | The seabed sediments in the Offshore Project Area are too far south to be affected by current seasonal ice scour, nor is permafrost present at this latitude. During the LGM, the Lease Area was well south of the furthest extent of glacial ice (see Section 2.1.1.1). |
| Scour of seabed sediments<br><br>§585.626(a)(2)(iii) | Seabed sediments can be scoured and eroded by tidal, wave, storm, or oceanic currents along the seafloor. | Bottom currents are expected to be low in the Offshore Project Area (see Section 2.2), given the unconstrained open ocean setting, the water depths, and the minimal topographic relief on the seabed in the Lease Area and along the Monmouth and Northern ECCs. Currents may vary within the New York nearshore zones. Localized currents can occur around introduced structures that can then scour and erode surrounding seabed sediments. Measures to reduce potential scour are described in Section 2.1.2. |

| Hazard | Definition | Description |
|---|---|---|
| Seabed subsidence<br><br>§585.626(a)(2)(iii) | Seabed subsidence is the sinking of the seafloor and underlying sediments. It can be caused by several factors. | The potential for seabed subsidence due to compaction by Project structures is fully analysed and assessed in the complete geotechnical dataset in Appendix II-A2a-A2d; methodology and results are presented in Appendix II-A3. The Project is designed and constructed to minimize potential seabed subsidence. |
| Occurrence of sand waves; sediment transport<br><br>§585.626(a)(6)(iii); §585.627(a)(1) | Sand waves are mobile bedforms classified by the BOEM as having wavelengths of >204 ft (60 m) and heights >5.1 ft (1.5 m). Sediment transport is the movement of sediment particles either due to gravity or within a fluid. | Bedforms have been detected in the Offshore Project Area and will be characterized. Seafloor sediment will be disturbed primarily during Project construction and some volume will be suspended into the water column and subject to transport. A Sediment Modelling study assessing the extent and effects of sediment suspension, transport and re-deposition was completed in 2022, and results are provided in Appendix II-A3. |
| Occurrence of boulders; geologic processes and anthropogenic debris<br><br>§585.626(a)(1)(iii); §585.626(a)(6)(iv) | Boulders are stationary bedforms formed by geologic processes and anthropogenic seafloor debris. | Boulder bedforms have been detected along localized areas of the Northern ECC. Seafloor bedforms will be disturbed primarily during Project construction due to cable installation. These boulders may be moved to accommodate the presence of cables and replaced. Additional cable burial may be installed to accommodate the presence of boulders. Appendix II-A includes a detailed assessment of bedforms along the Northern ECC conducted in 2022. No boulders were identified within the Monmouth ECC and the Lease Area. |

#### 2.1.1.2.4 Potential Anthropogenic Hazards in Offshore Project Area

Anthropogenic hazards listed in 30 CFR §585.627(a)(1) that may affect Project design, siting, and construction include, but are not limited to, MEC, sediment contamination, shipwrecks with associated debris, and modern debris on the seafloor.

##### Munitions and Explosives of Concern (MEC)

MEC is a broad term that includes unexploded ordinance (UXO) and discarded military munitions or constituents that could pose an explosive hazard.

Atlantic Shores commissioned two site-specific studies to gain a more detailed understanding of potential MEC in the Offshore Project Area and potential mitigation measures:

- Atlantic Shores Offshore Wind Munitions and Explosives of Concern (MEC) Hazard Assessment (2023) (Appendix II-A5):

Atlantic Shores Offshore Wind Munitions and Explosives of Concern (MEC) Risk Assessment (2023) (Appendix II-A6): The MEC Hazard Assessment report determined that MEC hazards are likely to be present within portions of the Offshore Project Area, including the ECCs and Lease Area. Chart 2 of the MEC Hazard Assessment report in Appendix II-A5 shows types and locations of identified MEC hazards within the Lease Area and Monmouth and Northern ECCs. Specifically, results of the Project's magnetic surveys indicate concentrations of magnetic anomalies are present in nearshore areas along the Monmouth ECC, and likely will be present in nearshore areas along the Northern ECC. These magnetic anomalies are possible indicators of MEC. Ordinance potential is also increased near the midway point of the Monmouth ECC, where some older wartime ordinance may be present.

Atlantic Shores will implement mitigation measures as noted in the RARMS report to reduce the risk to the industry standard of As Low as Reasonably Practicable (ALARP). Specifically, Appendix II-A6 states that "Except in areas which are classified as a significant hazard (Hazard Zone 1), Ordtek does not recommend that high-resolution magnetometry survey is necessary to detect buried items. The likelihood of encountering buried items that constitute a notable safety risk within the low hazard zones (Zones 2 and 3) is deemed to be below the ALARP threshold. Atlantic Shores expects to avoid significant magnetic features or other potential MEC targets. Atlantic Shores may also further investigate potential MEC targets by diver or remotely operated vehicle (ROV) to confirm whether the target is MEC. While avoidance will be the primary mitigation measure, if avoidance of potential MEC targets is not possible, other alternatives will be considered prior to construction to reduce risk to ALARP, including moving or removing targets within specific areas of planned bottom-disturbing activities (see Appendix II-A6). Atlantic Shores has assessed the potential presence of MEC and developed appropriate mitigation strategies. This information is presented in the Project's Fabrication and Installation Report (FIR) in Appendix II-A5.

## Potential Sediment Contamination

Data on sediment contaminant levels in the Offshore Project Area are limited. Four mapped ocean disposal sites are located proximal to the Offshore Project Area. These are listed in Table 2.1-2; locations are shown on Figure 2.1-3 (MARCO, C2020). Ocean disposal sites are designated, permitted, and managed by the U.S. Environmental Protection Agency (EPA) in coordination with the USACE for the dumping of permitted materials, including dredged material.

Two ocean disposal sites are located proximal the Monmouth ECC. The Axel Carlson Reef site is located west of the Monmouth ECC, and is an artificial reef complex where many boats, military tanks, construction materials, and rock have been disposed. The Manasquan Inlet Artificial Reef site is located south of the Manasquan Inlet in New Jersey and consists of concrete debris and sunken vessels. Atlantic Shores will avoid disposal sites designated as reefs.

The Shark River Spoil Area is located within the Asbury Branch of the Northern ECC and is used for the disposal of dredged material. The Historical Area Remediation Site (HARS) is located proximal to the Northern ECC east of Sandy Hook, New Jersey and was previously used for dredged material disposal but has since been closed.

### Table 2.1-2. Mapped Ocean Disposal Sites Proximal to the Offshore Project Area

| Site Name | Size (Square Nautical Miles [$nm^2$]) | Depth (m) | Primary Use | Location in Relation to Atlantic Shores Project Area |
|---|---|---|---|---|
| Axel Carlson Reef | 5.67 | Unknown | Dumping ground: discontinued | Proximal to Monmouth ECC |
| Manasquan Inlet Artificial Reef | 0.11 | 18 | Dumping ground: available | Proximal to Monmouth ECC |
| Shark River Disposal Site | 0.6 | 12 avg. | Dredged material disposal; available | Proximal to Asbury Branch of the Northern ECC |
| Historic Area Remediation Site (HARS) | 15.7 | Min 12<br>Max 42 | Dredged material disposal, discontinued | Proximal to Northern ECC |

The disposal sites proximal to the offshore project area may contain contaminated sediments given the types of materials that may have been disposed. Atlantic Shores intends to avoid these mapped disposal sites. While there are other ocean disposal sites located outside the Offshore Project Area, given the nature of the activities conducted at these disposal sites, any contaminated sediments at those sites would be unlikely to migrate to the Offshore Project Area at concentrations that would affect marine sediment quality. Additional Information is presented in Figure 7.7-2 in Section 7.7 Other Marine Uses and Military Activities.

### Shipwrecks and Debris Fields

Shipwrecks and associated debris fields can pose a hazard to Project construction, particularly cable installation activities. Research has been conducted by Atlantic Shores to locate wrecks that have been reported in or near the Offshore Project Area. Qualified Marine Archaeologists (QMAs) have evaluated Project survey data to identify known and potential shipwrecks and associated debris fields, and to determine their cultural significance (Section 6.3 Marine Archaeological Resources). Efforts will be made to avoid potential impacts to all potential submerged cultural resources, and to avoid, minimize, and/or mitigate potential impacts to identified ancient, submerged landforms (ASLFs), as described in Section 6.3 Marine Archaeological Resources.

Shipwrecks are evaluated in the Marine Archeological Resource Assessment included as Appendix II-A.

### Modern Debris

Modern debris on the seafloor, such as fishing debris or materials discarded by ships, can pose a potential risk to offshore cable installation equipment, anchored or jack-up vessels, or other construction activities. These features are detected and mapped during the HRG surveys.

### Cable Crossings

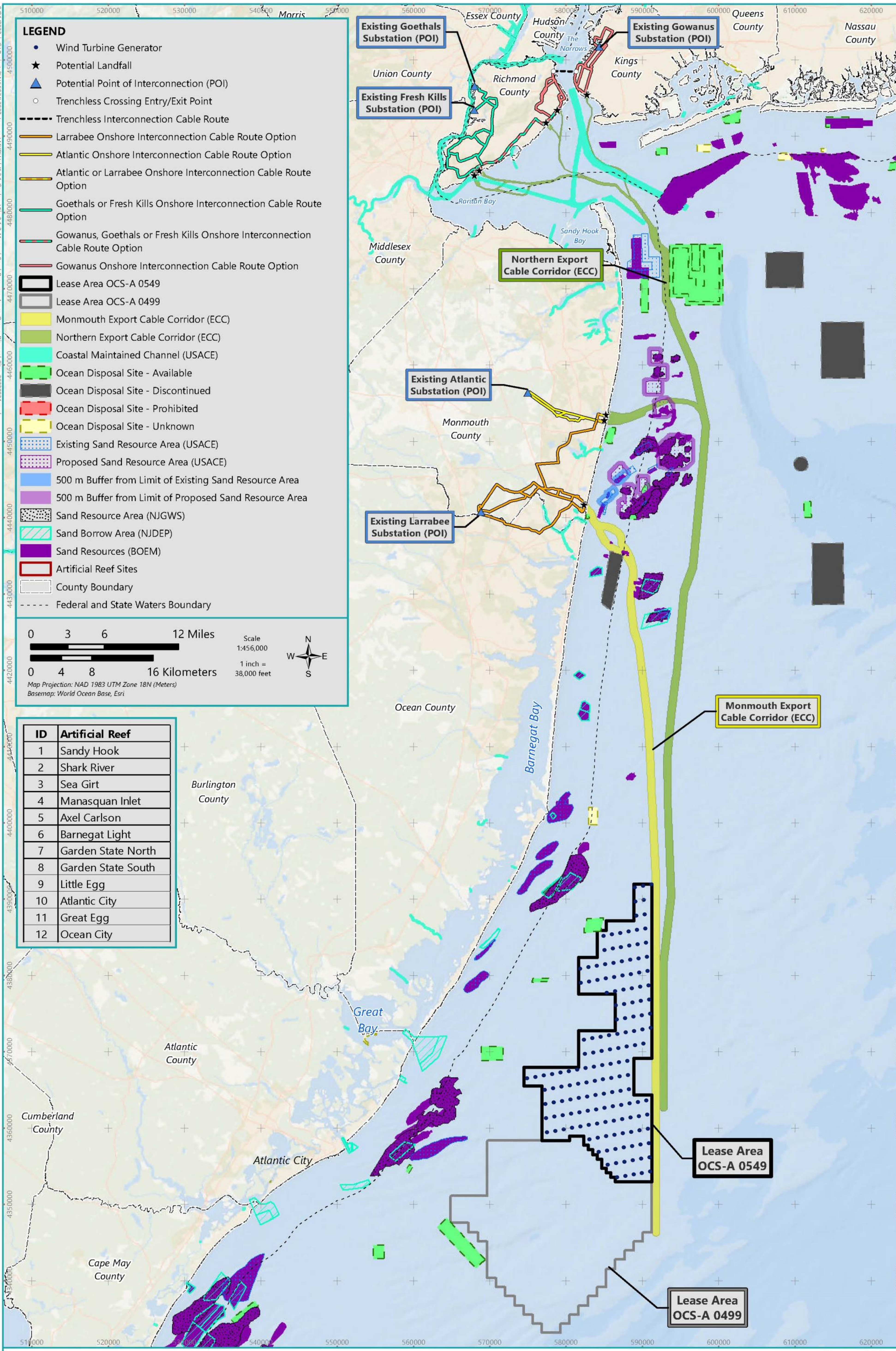
As described in Section 4.5.8 of Volume I, the ECCs will cross existing marine infrastructure, including submarine cables (see Figure 2.1-4). The Monmouth ECC could have up to 28 cable or pipeline crossings from the Lease Area to the Monmouth Landfall Sites. The Northern ECC from the Lease Area to the Landfall Sites in New York (inclusive of the Asbury Branch in New Jersey) could have up to 93 cable or pipeline crossings.[1] Atlantic Shores anticipates that there will also be inter-array and inter-link cable crossings required for the Project.

Any cable crossing will be surveyed in accordance with applicable industry standards and practices and, if the cable is still active, Atlantic Shores will seek to enter into a crossing agreement with its owner.

1 The maximum number of cable crossings for each ECC accounts for the possibility that other offshore cables may be installed prior to the start of Project construction.

The crossing agreement will address crossing methods, setback requirements, and other parameters. Atlantic Shores has identified all cable owners and has initiated discussions regarding crossing methods and/or setbacks.

At each crossing, before installing the Atlantic Shores cable, the area around the crossing will be cleared of any marine debris. Depending on the status of the existing cable and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable and the Atlantic Shores overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. The presence of an existing cable likely would prevent the Atlantic Shores cable from being buried to its target burial depth of 5 to 6.6 ft (1.5 to 2 m). In this case, cable protection may be required at the crossing location to cover the new cable. Following installation of the new cables, the cable crossing will be surveyed again.

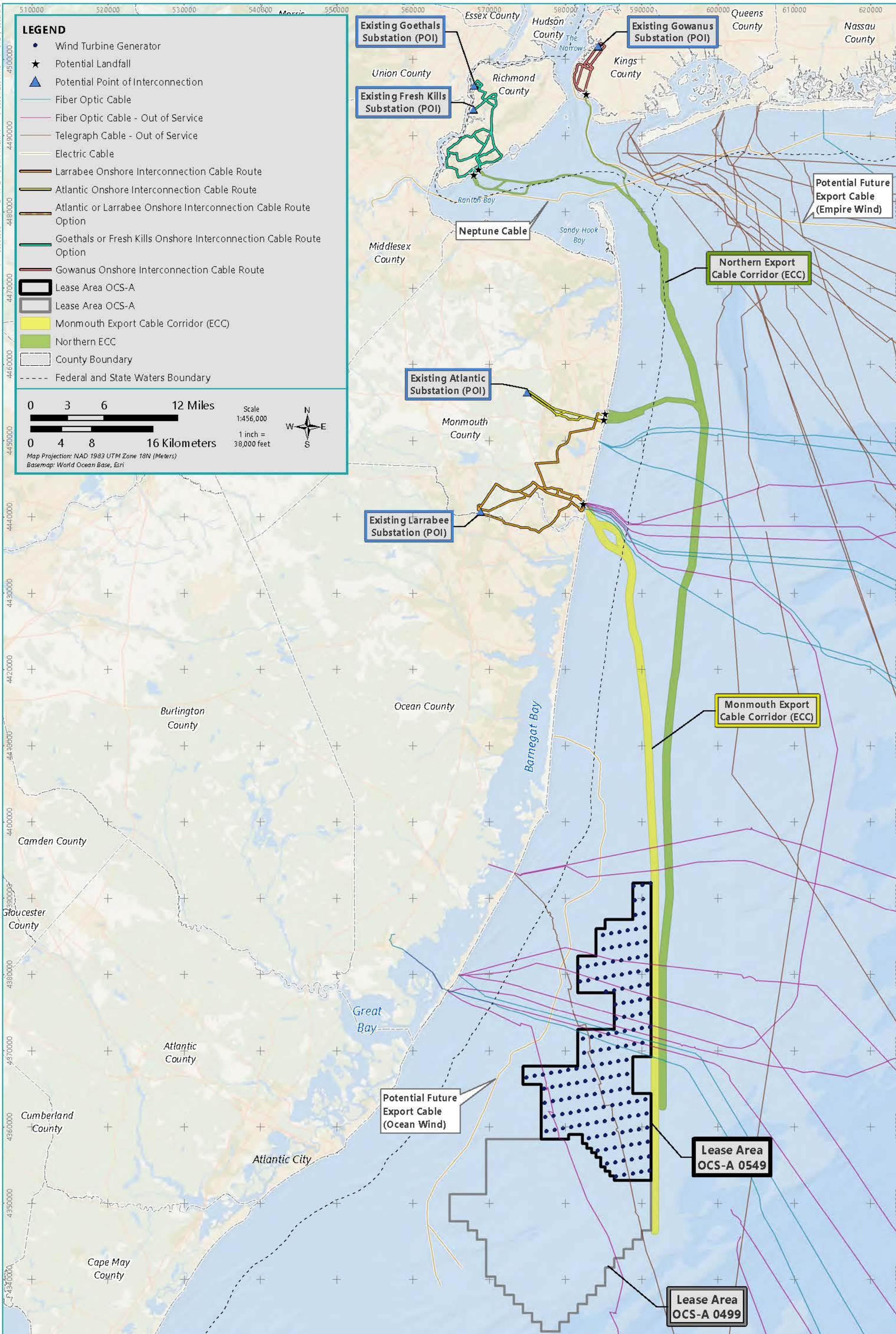



| ID | Artificial Reef |
|---|---|
| 1 | Sandy Hook |
| 2 | Shark River |
| 3 | Sea Girt |
| 4 | Manasquan Inlet |
| 5 | Axel Carlson |
| 6 | Barnegat Light |
| 7 | Garden State North |
| 8 | Garden State South |
| 9 | Little Egg |
| 10 | Atlantic City |
| 11 | Great Egg |
| 12 | Ocean City |

ATLANTIC SHORES offshore wind

**Figure 2.1-3**

*Mapped Sand Resource Areas and Ocean Disposal Sites in Vicinity of Offshore Project Area*




ATLANTIC SHORES offshore wind

**Figure 2.1-4**
*Cable Crossings*

#### 2.1.1.3 Local Geology – Terrestrial

This section describes the terrestrial geology and soils within the Onshore Project Area (i.e., at the landfall sites, along the proposed onshore cable interconnection routes, and at the proposed onshore substation sites) from review of published information and Project-specific soils reports. The New Jersey Onshore Project Area is located within the Coastal Plain physiographic province of New Jersey. The New York Onshore Project Area is located at the southern edge of the Wisconsin terminal moraine composed of glacial till and outwash sediments (gravel, sand, silt). New York City and the surrounding geological setting is complex given the significant natural and human influence on the physiography of the region.

Onshore Project components in New Jersey and/or New York may include landfall sites, onshore cable interconnection routes and substation/converter stations. For onshore Project facilities located in Monmouth County, shallow bedrock is not expected during underground installation of the onshore interconnection cables due to the thickness of coastal plain sediments below coastal New Jersey. For onshore Project facilities located in New York in both Richmond and Kings Counties, shallow bedrock is not expected during underground installation of the onshore interconnection cables. Subsurface conditions within the Project's vertical and lateral footprints are confirmed in geotechnical surveys within the New York and New Jersey Onshore Project Areas. This section describes the local geology and soils present in each county.

##### 2.1.1.3.1 Monmouth County, New Jersey

The offshore export cables within the Monmouth ECC will transition onshore at potential landfall sites in southern Monmouth County, New Jersey. The Asbury Branch of the Northern ECC will transition onshore in the vicinity of Asbury Park in northern Monmouth County, New Jersey.

The offshore to onshore cable transition will be accomplished using horizontal directional drilling (HDD) to avoid nearshore and beach effects (see Section 4.8 of Volume I). The HDD will penetrate subsurface nearshore unconsolidated sands, silts, and clays. The HDD will be installed at depths designed to prevent exposure of the cable at the landfall site from beach and nearshore erosion.

The onshore interconnection cable route will largely be constructed within previously developed and disturbed areas. Undisturbed soil units mapped by the NRCS within approximately 100 ft (30.5 m) of the centerline of the onshore route(s) and associated substation locations are provided Appendix II-A7a for New Jersey and Appendix II-A7b for New York. Additional physical characteristics of the soils will include hydric status, acidity, drainage characteristics, inclusions and other conditions relevant to suitable onshore design of the Project.

A Phase 1 Environmental Site Assessment will be conducted prior to ground disturbing activities in the Onshore Project Area to confirm the site conditions present within the Project construction footprint. If potentially impacted soils are encountered during construction, Atlantic Shores will address this issue in accordance with applicable Federal, State, and local laws and regulations.

#### 2.1.1.3.2 Richmond and Kings County, New York

The offshore export cables within the Northern ECC may transition onshore in Richmond County, New York at the potential Lemon Creek and Wolfe's Pond Landfall Sites on Staten Island, New York and The Fort Hamilton Landfall Site in Brooklyn, New York.

The offshore to onshore cable transition will be accomplished using HDD, to avoid nearshore and beach effects (see Section 4.8 of Volume I). The HDD will penetrate subsurface nearshore unconsolidated gravels, sands, silts, and clays. The HDD will be installed at depths designed to prevent exposure of the cable at the landfall site from beach and nearshore erosion.

The onshore interconnection cable route will largely be constructed within previously developed and disturbed areas. Undisturbed soil units mapped by the NRCS within approximately 100 ft (30.5 m) of the centerline of the onshore routes and associated substations are assessed and are provided in Appendix II-A7a for New Jersey and Appendix II-A7b for New York. Additional physical characteristics of the soils will include hydric status, acidity, drainage characteristics, inclusions and other conditions relevant to suitable onshore design of the Project.

A Phase 1 Environmental Site Assessment will be conducted prior to ground disturbing activities in the Onshore Project Area to confirm the site conditions present within the Project construction footprint. If potentially impacted soils are encountered during construction, Atlantic Shores will address this issue in accordance with applicable Federal, State, and local laws and regulations.

### 2.1.2 Potential Impacts and Proposed Environmental Protection Measures

Geological conditions influence Project siting and design. Geological conditions may also be disturbed by Project construction, O&M, or decommissioning. Project facilities and activities which may be affected by geological conditions, or which may disturb geologic conditions, are presented in Table 2.1-3.

**Table 2.1-3. Impact Producing Factors for Geology**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Influence of Site Geology on Project Design | ● | ● | ● |
| Natural and Anthropogenic Hazards | ● | ● | ● |
| Installation and Maintenance of New Structures and Cables | ● | ● | ● |
| Presence of Structures and Cables | | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for the purpose of this section is the maximum onshore and offshore build-out of the Project (as defined in Section 4.11 of Volume I).

#### 2.1.2.1 Influence of Site Geology on Project Design

##### Offshore

Atlantic Shores has conducted HRG and geotechnical surveys of the Lease Area and/or ECCs in 2019, 2020, 2021, and 2022. All survey data are being carefully evaluated to guide the siting, design, and engineering of offshore Project components, including WTG and OSS foundations and offshore cables (export, inter-array, and inter-link cables).

As described in Section 3.4 of Volume I, Atlantic Shores performed an extensive evaluation of all viable WTG and OSS foundation types that may be suitable for the geological conditions in the Lease Area. Following this detailed analysis, which included an assessment of preliminary sediment profiles, Atlantic Shores determined that piled, suction bucket, and gravity foundations are all suitable to include in the PDE (see Sections 3.4, 4.2, and 4.4 of Volume I). As additional geophysical and geotechnical data are evaluated, Atlantic Shores will continue to refine the design of the foundation types specific to geological conditions. Atlantic Shores is also continuing to evaluate geophysical and geotechnical data to inform the siting and design of the inter-array cables within the Lease Area.

Atlantic Shores also evaluated geological conditions within the ECCs using data from the marine field investigations, as well as additional field investigations conducted in 2022. As described in Section 3.3 of Volume I, Atlantic Shores considered geological conditions when siting the ECCs. Mapped surficial and shallow geological characteristics were used to confirm technical feasibility for cable installation tools. The presence of mobile sediments was also assessed (see Section 2.1.2.2). Mobile sediments may pose a risk of over-burial or exposure of the cable (see Section 3.3 of Volume I). Bathymetry maps were also used during siting of the ECCs to identify any areas of steep slopes, which are not preferred due to expected installation constraints (see Section 3.3 of Volume I).

During siting of the ECCs, sandy sediments were preferred over rocky, stiff, or very fine sediments to ensure cable burial to a sufficient depth (see Section 3.3 of Volume I). The Project's ECCs were routed to avoid most Federal- and State-designated sand resource areas and sand borrow sites in the vicinity of the Offshore Project Area (see Section 2.1.1.2.2). As depicted on Figure 2.1-3, for the small segments of both ECCs which cross designated sand resource areas and sand borrow sites, Atlantic Shores is actively coordinating with the relevant regulatory agencies (BOEM, NJDEP, NYSDEC, and USACE Philadelphia District) to collaboratively devise a cable layout strategy that meets Federal and State requirements and industry BMPs (see Section 7.7 Other Marine Uses and Military Activities).

##### Onshore

Atlantic Shores considered site geology when developing the onshore interconnection cable routes. The selected onshore interconnection cable routes each provide shorter, more direct routes than other alternatives considered to minimize the area disturbed (see Section 3.2.4 of Volume I). Additionally, the onshore interconnection cable routes will largely be constructed within previously developed and disturbed areas such as existing roadways, utility ROWs, and/or bike paths to minimize effects to undisturbed land areas.

Atlantic Shores will also use trenchless techniques (e.g., HDD, pipe jacking, and jack-and-bore) to minimize soil disturbance in select locations such as wetlands, waterbodies, or busy roadways.

Atlantic Shores will conduct geotechnical borings as necessary to confirm geological subsurface conditions prior to onshore interconnection cable installation. Atlantic Shores is also evaluating sediment profiles at the landfall sites and in the nearshore area to engineer the HDD bore paths. Use of HDD will avoid effects to the beaches at the landfall locations.

Onshore substation sites will be selected to avoid disturbance to undeveloped land areas and resources such as wetlands and floodplains (see Section 4.9.1 of Volume I).

### 2.1.2.2 Natural and Anthropogenic Hazards

The Project will avoid natural and anthropogenic hazards to the extent practicable.

#### Offshore

The Offshore Project Area has been sited and designed to avoid natural hazards to the extent practicable. The Project will be sited on a largely level submerged continental shelf in interbedded coastal plain and marine sediments. Project structures are not expected to encounter bedrock. The passive margin setting is comparatively inactive and stable tectonically. Faults have not been identified in the Lease Area or the Monmouth and Northern ECCs, based upon the ongoing studies in Section 2.1.1. The presence or absence of these features in the Project footprint, including the Northern ECC and the Asbury Branch have been fully evaluated  and are provided as Appendix II-A1.

Based on the seafloor sediment compositions provided in Section 2.1.1.2., Project components have been predominantly sited within sandy sediments, which are preferred over rocky, stiff, or very fine sediments to ensure cable burial to a sufficient depth. The expected presence of mobile sand bedforms (i.e., ripples, mega ripples, and sand waves) within the Lease Area may necessitate the removal of the tops of some sand bedforms prior to offshore cable installation to ensure the cables can be installed within stable seabed. Sand bedform removal will be limited only to the extent required to achieve adequate cable burial depth. Additionally, foundations, particularly gravity foundations, may require some seabed preparation. Seabed preparation involves removing the uppermost sediment layer to establish a level surface, remove any surficial sediments that are too weak to support the planned structure, and enable full contact between the foundation's base and the seafloor.

Atlantic Shores considered natural and anthropogenic hazards to develop the target burial depth for the offshore cables. All offshore cables will have a target minimum burial depth of 5 to 6.6 ft (1.5 to 2 m). The cable burial depth is based upon a cable burial risk assessment that considers activities such as anchor use and commercial fishing practices to develop a safe target burial depth for the cables. The Initial cable burial risk assessments (CBRA) for the Monmouth ECC has been provided with this COP in Appendix II-A4. Cable burial risk assessments for Northern ECC are currently underway and will be provided to BOEM upon completion. Cable surveys will be performed at regular intervals to identify any issues associated with potential scour and depth of burial (see Section 5.4.4 of Volume I). Atlantic

Shores is continuing to investigate the potential presence of anthropogenic hazards. The Project has been designed to the extent practicable to avoid mapped ocean disposal sites located proximal to the Offshore Project Area. Atlantic Shores also plans to avoid shipwrecks and MEC. If any anthropogenic hazards cannot be avoided, appropriate mitigation measures will be developed in consultation with BOEM and other appropriate resource agencies. Mitigation strategies for MEC are presented in Section 2.1.1.2.4 and Appendix II-A5.

Existing cables cross both ECCs. Atlantic Shores is in the process of identifying cable owners and will initiate discussions with them regarding crossing methods and/or setbacks.

The Project will also implement a comprehensive Oil Spill Response Plan (OSRP) during construction and operation to minimize risk of sediment contamination.

### Onshore

Atlantic Shores is proposing to accomplish the offshore-to-onshore transition at each landfall site using HDD. The HDD will be installed at depths designed to prevent exposure of the cable at the landfall sites due to beach and nearshore erosion.

The onshore interconnection cable route will largely be constructed within previously developed and disturbed areas. A Phase 1 Environmental Site Assessment will be conducted prior to ground disturbing activities in the Onshore Project Area. Any potentially impacted soils will be addressed in accordance with applicable Federal, State, and local laws and regulations. Atlantic Shores will also develop and maintain a Spill Prevention, Control, and Countermeasure (SPCC) Plan for the life of the Project.

During installation of the onshore interconnection cable, existing underground utilities along the onshore interconnection route could constitute an anthropogenic hazard. Atlantic Shores will confirm utility locations using available as-built plans, survey pits, and/or Ground Penetrating Radar (GPR) of the existing infrastructure and is consulting with the New Jersey Department of Transportation (NJDOT), the New York State Department of Transportation (NYSDOT) involved municipalities, and utility representatives to ensure appropriate siting and placement of Project infrastructure.

### 2.1.2.3 Installation and Maintenance of New Structures and Cables

The installation of new structures and cables may result in:

- temporary disturbance to marine sediments and terrestrial soils during construction and decommissioning; and/or
- temporary effects to water quality from suspension and transport of disturbed marine sediments or erosion and sedimentation of terrestrial soils.

#### Offshore

The installation of new WTG and OSS foundation structures and offshore cables will temporarily disturb marine sediments. As described in Section 4.0 of Volume I, seafloor-disturbing activities include seabed preparation, placement of scour protection, installation of WTG and OSS foundations, limited dredging of the tops of mobile bedforms, cable installation activities, HDD operations at the landfall sites, anchoring of support vessels, and use jack-up vessels. A summary of the seafloor disturbance under the maximum design scenario is presented in Section 4.11 of Volume I.

Seafloor disturbance will mobilize and temporarily suspend some shallow sediments into the water column, where they may be transported and re-deposited onto the seafloor. Sediment disturbance resulting from installation of new structures and cables is expected to result in a short-term increase in suspended sediment concentrations at the seafloor, limited to areas immediately adjacent the specific construction activity. Effects to water quality will be temporary and localized, and no long-term effects to water quality conditions are anticipated (see Section 3.2 Water Quality). Atlantic Shores will use the shortest feasible offshore cable route to minimize seafloor disturbance and will select cable installation techniques (e.g., jet plow embedment) that minimize sediment suspension to the extent practicable. Atlantic Shores will also use anchor midline buoys and dynamically positioned vessels as practicable to minimize seafloor disturbance. Sediments disturbed during offshore construction activities are not expected to contain contaminants given that sediments are predominantly sandy and known sources of anthropogenic contaminants (i.e., the mapped ocean disposal sites described in Table 2.1-2) will be avoided. Within nearshore areas, some sediments have the potential to contain contaminants given the finer sediment composition (silts/clays); however, use of HDD cable installation should avoid disturbance of these sediments.

During O&M, the degree of suspended sediment will be significantly lower than during construction because any needed maintenance activities will be limited to discrete portions of offshore cables or structures. Any effects during O&M are expected to be short-term and temporary due to the sandy seafloor in the Offshore Project Area. Decommissioning of structures and cables is expected to have similar short-term and localized effects as those described for construction.

#### Onshore

Atlantic Shores has minimized potential disturbance of terrestrial soils by siting the onshore interconnection cables primarily along existing roadways, utility ROWs, and/or along bike paths.

Atlantic Shores is also proposing to use HDD to accomplish the offshore-to-onshore transition, which will minimize the amount of soil disturbance at the landfall sites. Atlantic Shores will also use trenchless techniques to minimize soil disturbance in select locations such as wetlands, waterbodies, or busy roadways.

BMPs will be employed to properly contain excavated soils and sediments and stabilize disturbed soil areas, to avoid erosion and sediment runoff into waterbodies. These will include, but are not limited to:

- pre-construction installation of appropriate erosion and siltation control measures, such as siltation fencing, near water bodies, around catch basins, and around temporary stockpiles
- regular monitoring of disturbed areas and existing drainage areas, and monitoring of these areas immediately after precipitation events and adjustment of measures as needed
- development of a dust control plan to control dust during construction, in compliance with applicable dust control standards in NJDOT's Soil Erosion and Sedimentation Control Standards and the NYSDOT's Soil Erosion and Sedimentation Control Standards
- stabilization, through seeding or re-paving of disturbed areas as appropriate, as soon as possible following installation activities
- development and implementation of a Stormwater Management Plan, including erosion and sedimentation control measures.

#### 2.1.2.4 Presence of Structures and Cables

Offshore Project structures such as WTG and OSS foundations will occupy areas of the seabed over the operational life of the Project. The presence of these structures may result in localized changes to the seafloor.

During O&M, localized bottom currents can develop around Project structures at the seabed that can then scour and erode sediments surrounding foundations. To minimize these effects and maintain the structural integrity of the foundation, scour protection may be installed on the seafloor at the base of each foundation. Types of scour protection that may be utilized around WTG and OSS foundations include rock placement, rock bags, grout- or sand-filled bags, concrete mattresses, ballast-filled mattresses, or frond mattresses described in Sections 4.2.5 and 4.4.3 of Volume I, respectively. Alternately, for monopile foundations, scour protection may not be used; if scour protection is not used, the depth of penetration will be increased to account for the expected scour (see Table 4.2-1 in Volume I).

Offshore cable surveys will be performed at regular intervals to identify any issues associated with potential scour and depth of burial (see Section 5.4.4 of Volume I). If needed, cable protection, as described in Section 4.5.7 of Volume I, will be installed.

### 2.1.2.5 Summary of Proposed Environmental Protection Measures

The Project will be designed to be compatible with geologic conditions in the Project Area.

#### Offshore

- HRG and geotechnical surveys of the Lease and/or ECCs in 2019, 2020 and 2021 were conducted, with additional surveys completed in 2022 to fulfill BOEM's regulatory requirements and provide detailed site data for Project design;
- The shortest feasible offshore cable route will be used to minimize seafloor disturbance. Additionally, dynamic positioning vessels and jet plow embedment will be used to the maximum extent practicable to minimize sediment disturbance and alteration during the offshore cable installation process. Atlantic Shores will also use anchor midline buoys on anchored construction vessels, where feasible, to minimize disturbance to the seafloor and sediments;
- The Project will be designed to avoid known natural and anthropogenic hazards to the maximum extent practicable. This includes avoidance of three proximal mapped ocean disposal areas, shipwrecks, and MEC;
- As depicted on Figure 2.1-3, the Project's ECCs were routed to avoid, to the maximum extent practicable, most Federal- and State-designated sand resource areas and sand borrow sites. For the small segments of both ECCs which cross these areas, Atlantic Shores is actively coordinating with the relevant regulatory agencies (BOEM, NJDEP, NYSDEC, and USACE) to collaboratively devise a cable layout strategy that meets Federal and State requirements and industry BMPs;
- Existing cables cross both ECCs. Any cable crossing will be surveyed in accordance with applicable industry standards and practices both before and after each cable crossing. Atlantic Shores has identified all cable owners and has initiated discussions regarding crossing methods and/or setbacks;
- All offshore cables will be buried to a target depth of 5 to 6.6 ft (1.5 to 2 m) to avoid interference with existing marine uses (e.g., anchoring and commercial fishing) and protect the cable;
- The Project will implement a comprehensive Oil Spill Response Plan (OSRP) during construction and operation to minimize risk of sediment contamination; and

- Cable surveys will be performed at regular intervals to identify any issues associated with potential scour and depth of burial.

**Onshore**

- A Phase 1 Environmental Site Assessment will be conducted prior to ground-disturbing activities to assess the presence or absence of pre-existing contamination in the construction footprint.
- Onshore geotechnical borings will be conducted as needed.
- Onshore interconnection cable routes have been sited to travel primarily along previously disturbed areas such as existing roadways, utility ROWs, and/or bike paths.
- HDD will be used at the offshore to onshore transition sites. The HDD will be installed at depths designed to prevent exposure of the cable due to beach and nearshore erosion.
- A dust control plan will be prepared to control fugitive dust during construction, in compliance with applicable dust control standards in NJDOT's Soil Erosion and Sedimentation Control Standards and the NYSDOT's Soil Erosion and Sedimentation Control Standards.
- Trenchless techniques will be used to minimize soil disturbance in select locations such as wetlands, waterbodies, or busy roadways.
- A SPCC Plan will be developed and maintained for the life of the Project.
- BMPs will be employed to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into nearby resource areas. These will include, but are not limited to:
- Pre-construction installation of appropriate erosion and siltation control measures, such as siltation fencing, near water bodies, around catch basins, and around temporary stockpiles.
- Regular monitoring of disturbed areas and existing drainage areas and monitoring of these areas immediately after precipitation events and adjustment of measures as needed.
- Stabilization, through seeding or re-paving of disturbed areas as appropriate, as soon as possible following installation activities
- Development of a Stormwater Management Plan, including erosion and sedimentation control measures.

This section provides a detailed description of the general environmental setting including geologic, meteorologic, and physical oceanic conditions within the Project Area.

## 2.2 Physical Oceanography and Meteorology

This section describes the oceanographic and meteorological (metocean) conditions affecting the Onshore and Offshore Project Areas, including a discussion of physical characteristics of currents, regional circulation, and winds, and how the proposed facilities, construction, operation, and maintenance (O&M), and decommissioning may affect or be affected by the metocean conditions within the Project Area.

### 2.2.1 Affected Environment

The information in this section used to characterize the affected environment is based on published data as cited herein and the following site-specific surveys and reports:

- **Volume I Metocean Analysis** (Appendix II-B1) was conducted in 2020 and evaluated long-term hindcast modelized timeseries, dating back to 1979, at four representative locations (one in the northern portion of the Lease Area OCS-A 0499 [Lease Area], one in the southern portion of the Lease Area, and one at each landfall location) describing the wind, wave, current, and atmospheric conditions. The study addressed both normal and extreme conditions and was used for preliminary design work, namely for foundations and wind turbine selection.

- **Volume II Metocean Design Basis** (Appendix II-B2) was conducted in 2020 and presents the background data and full data sets and methodologies used to develop Volume I Metocean Analysis Report.

Through ongoing campaigns that were initiated in 2019, Atlantic Shores has and continues to collect data on wind, wave, water level, currents, as well as parameters such as air and water temperature, air pressure, and conductivity in and surrounding the Lease Area through the use of buoy deployments. All data collected by the buoys can be publicly accessed through the MARACOOS ERDDAP server. Atlantic Shores also initiated a multi-year site-specific metocean campaign in the Lease Area, which began with approval of the Site Assessment Plan (SAP) in April 2021.[2] This campaign will further refine the understanding of conditions (including the extremes of those conditions) and validate modeling data within the Offshore Project Area. These collective metocean studies are key inputs into the Project design basis. The results of these multi-year studies will be provided with the FDR and Fabrication and Installation Report (FIR) prior to Project construction.

The Lease Area is located in the Mid-Atlantic Bight region which extends from Cape Hatteras, North Carolina, to Cape Cod, Massachusetts. The larger Atlantic Shores Project Region can be divided into two parts: the Atlantic Shores Offshore Project Region, which extends from North Carolina to

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[2] The SAP was originally approved for lease 0499, which has now been segregated into two lease areas, OCS-A 0499 and OCS-A 0549, each of which have a metocean data collection buoy.

Massachusetts encompassing the Mid-Atlantic Bight, and the Atlantic Shores Onshore Project Area, which ranges from Atlantic City, New Jersey, to Brooklyn, New York. The Offshore Project Region is affected by the circulation features of the Mid-Atlantic Bight coastal area, as well as the Gulf Stream current and eddies, while the Onshore Project Area experiences the humid subtropical climate of the Mid-Atlantic region. Based on a scientific literature review and metocean studies conducted for Atlantic Shores (see Appendix II-B1 and Appendix II-B2), the major oceanographic and meteorological processes that are expected to influence the Offshore Project Area are wind, waves, currents, tides, tidal currents, and hurricanes and strong storms. The following subsections discuss the primary metocean conditions affecting the Offshore Project Area.

#### 2.2.1.1 Currents

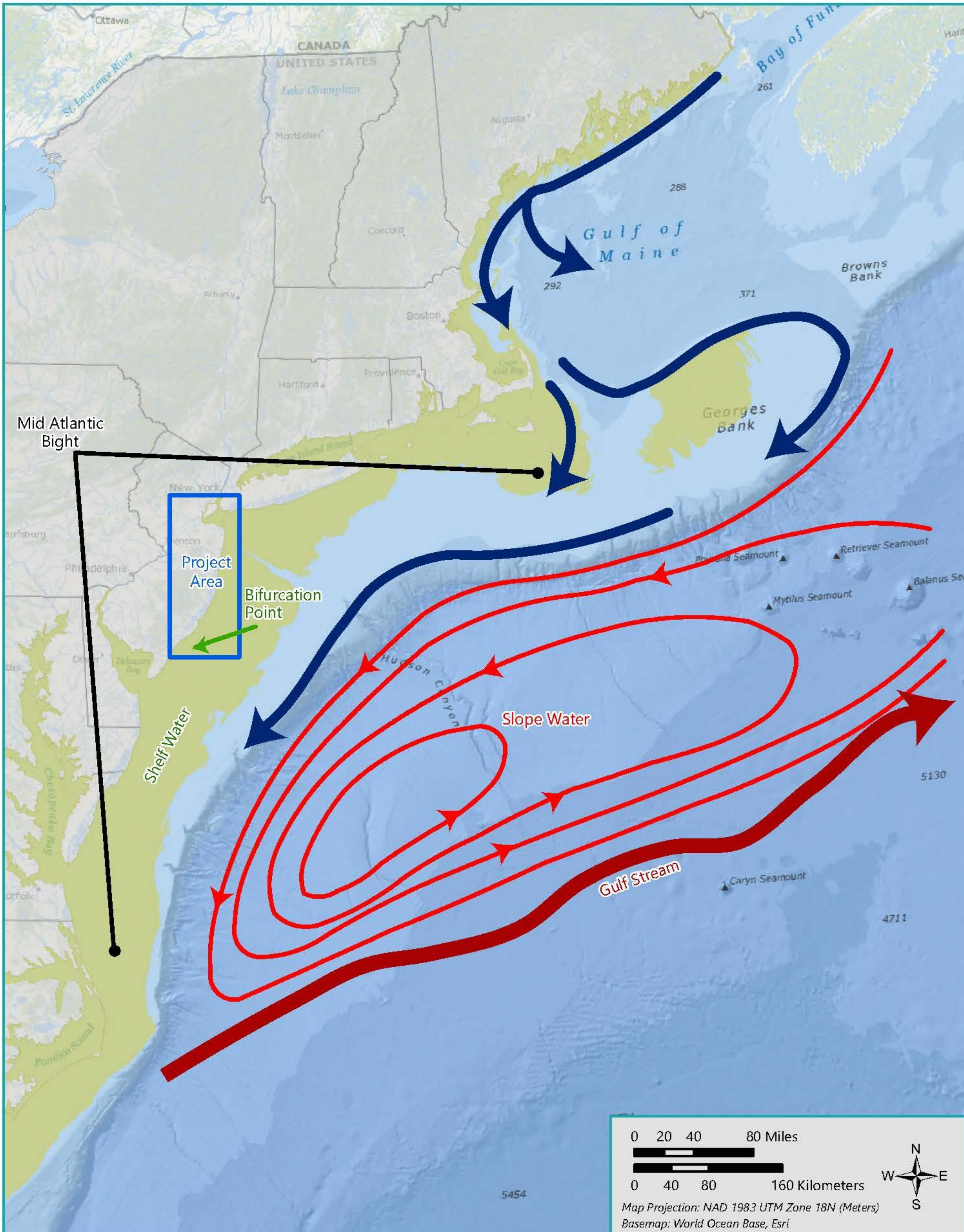
The offshore waters near the Mid-Atlantic Bight are influenced by two main current systems: the southward flowing cool water (temperatures less than 46 degrees Fahrenheit/8 degrees Celsius [46 °F/8°C]) coming from New England and the warm water of the Gulf Stream, which flows northward along the coast from Florida to North Carolina and then migrates northeastward into deeper water after reaching Cape Hatteras at 35°N (see Figure 2.2-1). The Gulf Stream can have significant effects on the ecosystems of the Mid-Atlantic Bight.

The currents near the Offshore Project Area in the coastal Mid-Atlantic Bight are separated and flow in opposite directions at a point which varies over a distance of 54 nautical miles (nm) (100 kilometers [km]) along the New Jersey coastline (Ashley et al. 1986). This bifurcation phenomenon is likely caused by the combination of several mechanisms including wave refraction, residual drift of ocean currents over the continental shelf, and swell processes. The currents near the bifurcation point show spatial variation, especially regarding the short-term regional current pattern (Buteux 1982). However, variability is less pronounced over the long term (Bumpus 1965).

In combination with this regional scale pattern, small scale circulation patterns are also present near the coast. These currents are caused by wave refraction around ebb tidal deltas and rip current circulation. However, the smaller scale current reversals do not show significant spatial variation and can cause erosion in the Offshore Project Area.

Beardsley and Winant (1978) discussed two possible mechanisms that can drive the alongshelf flow in the Mid-Atlantic Bight region: river runoff and the physical mechanism which creates alongshelf pressure gradient. The study found that river runoff cannot solely drive the alongshelf flow. Rather, in addition to the runoff, large scale wind stress and heat flux distribution are necessary.

Based on High Frequency (HF) Radar data collected in the New Jersey Shelf, Kohut et al. (2004) found that the annual mean current measured between May 1999 and May 2000 showed a weak southwestward flow along the shore as presented in Figure 2.2-2. This study discussed the seasonal variation of the New Jersey Shelf current, where stratification caused by freshwater runoff and warmer temperatures can be seen during the summer season. However, during the winter season, current is more variable and shows relatively less correlation with the wind and is strongly correlated with the topography.




ATLANTIC SHORES offshore wind

**Figure 2.2-1**

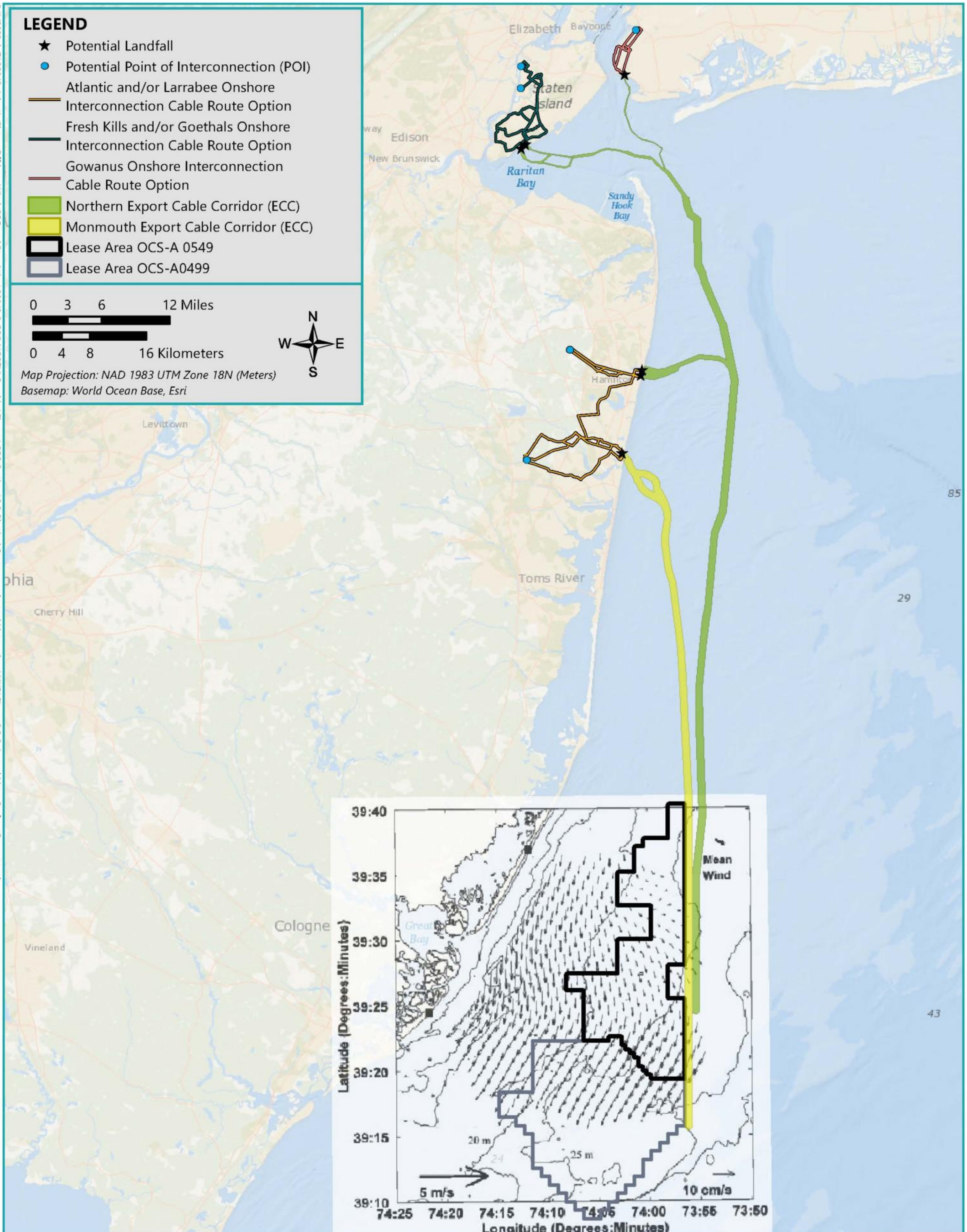
*Currents in the Mid-Atlantic Bight, as Modified from Mid-Atlantic Regional Ocean Assessment (MAROA 2020), Offshore New Jersey*

Gong et al. (2010) also characterized the spatial structure of the mean current and seasonal surface circulation in the New Jersey Shelf, using long-range HF radar data from 2002 to 2007. The mean surface flow over New Jersey Shelf is between 1 and 5 inches per second (in/s) (2 and 12 centimeters per second [cm/s]) down shelf and towards the south. The study also suggested that the surface flow in the New Jersey Shelf is a function of topography, seasonal stratification, and wind forcing. The current is in the same direction of the wind during the unstratified/mixed (winter) season, as dominant northwest winds drive cross-shelf offshore flows. However, during the stratified season (summer), the flow direction is to the right of the wind due to Ekman forcing, as dominant southwest wind drives cross-shelf offshore flow. During the transition seasons (spring and autumn), northeast winds drive energetic along-shelf flows.

An extremal analysis of current speed for different return periods and different depth levels from all directions is presented in Table 2.2-1 based on the hindcast period 1924–2018 of GROW-FINE East Coast Model (GFEC) model (see also Appendix II-B2). Based on this analysis, the maximum current speed can reach 1.12 feet per second (ft/s) (0.34 meters per second [m/s]) at the surface layer for a 1-year return period, which is close to the annual maximum of the shelf break jet of the Mid-Atlantic Bight (Chen and He 2010).

### Table 2.2-1. Extreme Current Speeds (as ft/s and m/s) for Different Return Periods from a location in the Lease Area

| Depth Level | Current Speed for Return Period | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 Year | | 10 Year | | 50 Year | | 100 Year | |
| | ft/s | m/s | ft/s | m/s | ft/s | m/s | ft/s | m/s |
| Surface | 1.12 | 0.34 | 2.72 | 0.83 | 3.84 | 1.17 | 4.30 | 1.31 |
| Depth Average | 1.08 | 0.33 | 2.36 | 0.72 | 3.12 | 0.95 | 3.41 | 1.04 |
| Near-Bottom | 0.98 | 0.30 | 1.94 | 0.59 | 2.56 | 0.78 | 2.79 | 0.85 |





ATLANTIC SHORES offshore wind

**Figure 2.2-2**

*Annual Mean Surface Current near the Lease Area Measured by HF Radar Offshore New Jersey*

### 2.2.1.2 Tides

The nature of tides on the Mid-Atlantic Bight shelf is semi-diurnal (i.e., changes direction twice a day) and rotary. In offshore regions, tidal currents are weak (less than 0.2 ft/s [0.05 m/s]); however, nearshore tidal currents could reach velocities of 5 ft/s (1.5 m/s) (USDOI 1982).

Tidal levels relative to lowest astronomical tide are extracted from the closest National Oceanic and Atmospheric Administration tide station (Station ID: 8534720) to the Offshore Project Area and presented in Table 2.2-2. The Highest Astronomical Tide recorded at the station is 7.05 ft (2.15 m) while the Mean Tide Level is 3.38 ft (1.03 m) above Lowest Astronomical Tide.

**Table 2.2-2. Tidal Levels Relative to Lowest Astronomical Tide at Atlantic City, New Jersey**

| Tide Levels | Feet | Meters |
|---|---|---|
| Highest Astronomical Tide | 7.05 | 2.15 |
| Mean Higher High Water | 5.81 | 1.77 |
| Mean High Water | 5.31 | 1.65 |
| North American Vertical Datum (NAVD88) | 3.84 | 1.17 |
| Mean Sea Level | 3.44 | 1.05 |
| Mean Tide Level | 3.38 | 1.03 |
| Mean Low Water | 1.38 | 0.42 |
| Mean Lower Low Water | 1.21 | 0.37 |
| Lowest Astronomical Tide | 0.00 | 0.00 |

The monthly average, maximum, and minimum water levels near the potential landfall sites is presented in Table 2.2-3, based on the observation data from Atlantic City Steel Pier (Buoy 8534720), and tidal elevation record from Sandy Hook, New Jersey (Buoy 8531680) in 2019. The data show the maximum water level of 5.16 ft (1.57 m) in October; however, as discussed in Appendix II-B1, the absolute extreme maximum water level of this station is 6 ft (1.83 m) above mean sea level (AMSL) as recorded on September 14, 1944. The absolute extreme minimum is 7.45 ft (2.27 m) below mean sea level (BMSL) as recorded on January 10, 1978 (Tides and Currents 2020a).

Tidal elevation record at Sandy Hook, New Jersey, shows the maximum water level of 5.16 ft (1.572 m) in January 2019. The absolute extreme maximum and minimum water level of this station is 9.45 ft (2.881 m) AMSL and 6.95 ft (2.118 m) BMSL as recorded on October 26, 2012, and on January 10, 1978, respectively (see Appendix II-B1; Tides and Currents 2020b).

**Table 2.2-3. Tidal Elevation (Relative to Mean Sea Level) Measurement in Atlantic City and Sandy Hook, New Jersey Buoys**

| Month | Unit | Atlantic City Steel Pier | | | Sandy Hook, New Jersey | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Max | Min | Mean | Max | Min |
| January | ft | 0.21 | 0.46 | -4.66 | 0.23 | 5.16 | -5.22 |
| | m | 0.06 | 0.14 | -1.42 | 0.07 | 1.57 | -1.59 |
| February | ft | -0.05 | 0.40 | -3.68 | 0.02 | 4.66 | -4.07 |
| | m | -0.01 | 0.12 | -1.12 | 0.01 | 1.42 | -1.24 |
| March | ft | 0.21 | 4.01 | -3.65 | 0.24 | 4.94 | -4.45 |
| | m | 0.07 | 1.22 | -1.11 | 0.07 | 1.51 | -1.36 |
| April | ft | 0.41 | 3.78 | -3.11 | 0.37 | 4.50 | -3.53 |
| | m | 0.13 | 1.15 | -0.95 | 0.11 | 1.37 | -1.08 |
| May | ft | 0.68 | 4.21 | -2.29 | 0.77 | 4.44 | -2.42 |
| | m | 0.21 | 1.28 | -0.70 | 0.24 | 1.35 | -0.74 |
| June | ft | 0.61 | 3.92 | -2.42 | 0.71 | 4.37 | -2.65 |
| | m | 0.19 | 1.20 | -0.74 | 0.22 | 1.33 | -0.81 |
| July | ft | 0.59 | 4.03 | -2.33 | 0.70 | 4.39 | -2.56 |
| | m | 0.18 | 1.23 | -0.71 | 0.21 | 1.34 | -0.78 |
| August | ft | 0.78 | 4.06 | -2.76 | 0.77 | 4.32 | -3.22 |
| | m | 0.24 | 1.24 | -0.84 | 0.24 | 1.32 | -0.98 |
| September | ft | 0.87 | 4.19 | -2.45 | 0.79 | 4.52 | -2.94 |
| | m | 0.27 | 1.28 | -0.75 | 0.24 | 1.38 | -0.90 |
| October | ft | 1.11 | 5.16 | -2.90 | 1.02 | 5.07 | -3.80 |
| | m | 0.34 | 1.57 | -0.89 | 0.31 | 1.54 | -1.16 |
| November | ft | 0.62 | 4.41 | -3.28 | 0.56 | 4.52 | -3.73 |
| | m | 0.19 | 1.34 | -1.00 | 0.17 | 1.38 | -1.14 |
| December | ft | 0.38 | 4.17 | -3.48 | 0.41 | 4.49 | -4.20 |
| | m | 0.12 | 1.270 | -1.06 | 0.12 | 1.37 | -1.28 |

### 2.2.1.3 Water Temperature, Salinity, and Density

There are three main water masses present in the Mid-Atlantic Bight: the relatively fresh Shelf Water with salinity less than 35 parts per thousand (ppt); the more saline slope water (35 ppt < salinity < 36 ppt); and the warm and salty Gulf Stream (temperature >64 °F [18 °C], salinity >36 ppt) (Miller et al. 2014).

Using satellite-derived velocity and temperature data, Connolly and Lentz (2014) showed that interannual variability in wintertime temperature in the Mid-Atlantic Bight is partially controlled by alongshore advection of warmer water. The study also demonstrated that surface heat flux is controlled by the difference of air-sea temperature.

Based on data collected at the New Jersey Wind Energy Area (NJWEA) for 2003–2016, the median salinity of the water in the Offshore Project Area is 32.2 ppt and ranges from 29.4 to 34.4 ppt. Temperature in the Offshore Project Area shows higher seasonal variability (BOEM 2017), with variation of temperature as high as 68 °F (20 °C) at the surface and 59 °F (15 °C) at the seabed (BOEM 2017). During spring and summer, the water in the Mid-Atlantic Bight experiences a strong stratification caused by increased freshwater runoff and warmer temperatures. During this time, the warm fresh water creates a layer over the cooler and saltier layer; thus, preventing the water from mixing. This creates a bottom-trapped, cold, nutrient-rich pool, referred to as the Mid-Atlantic Cold Pool that extends from Georges Bank, Maine to Cape Hatteras, North Carolina and is located over the mid- and outer-shelf of the Mid-Atlantic Bight (NEIEA n.d.; Chen et al. 2018).

The formation of the Cold Pool is driven by seasonal patterns in solar heating and wind (Ganim 2019) and is not spatially uniform (Lentz 2017). It forms at the start of spring, when wind mixing is reduced and surface heat fluxes increase, causing the water column to become stratified (Ganim 2019; Lentz 2017). Freshwater runoff in the spring can further intensify stratification (Castelao et al. 2010). The Cold Pool, located along the seafloor, is isolated from warming surface waters by the seasonal thermocline and creates habitat conditions that provide thermal refuge to colder water species in the Mid-Atlantic Bight ecosystem (Lentz 2017). Cold Pool waters are nutrient-enriched and, when upwelled toward the surface, can drive phytoplankton growth and high concentrations of particulate organic matter in the water column (Voynova et al. 2013). The timing of the formation and breakdown of the Cold Pool, as well as its spatial extent, varies significantly each year but generally develops annually between spring and fall (Chen and Curchitser 2020). The Cold Pool dissipates in the fall due to enhanced vertical mixing from an increase in the frequency of strong wind events and the cooling of surface temperatures (Ganim 2019). Despite a growing body of scientific literature on the Cold Pool, the mechanisms of its formation, evolution, and long-term fluctuations remain poorly understood (Chen et al. 2018), and multi-year observations show continued warming and a diminishment in size (NOAA 2020).

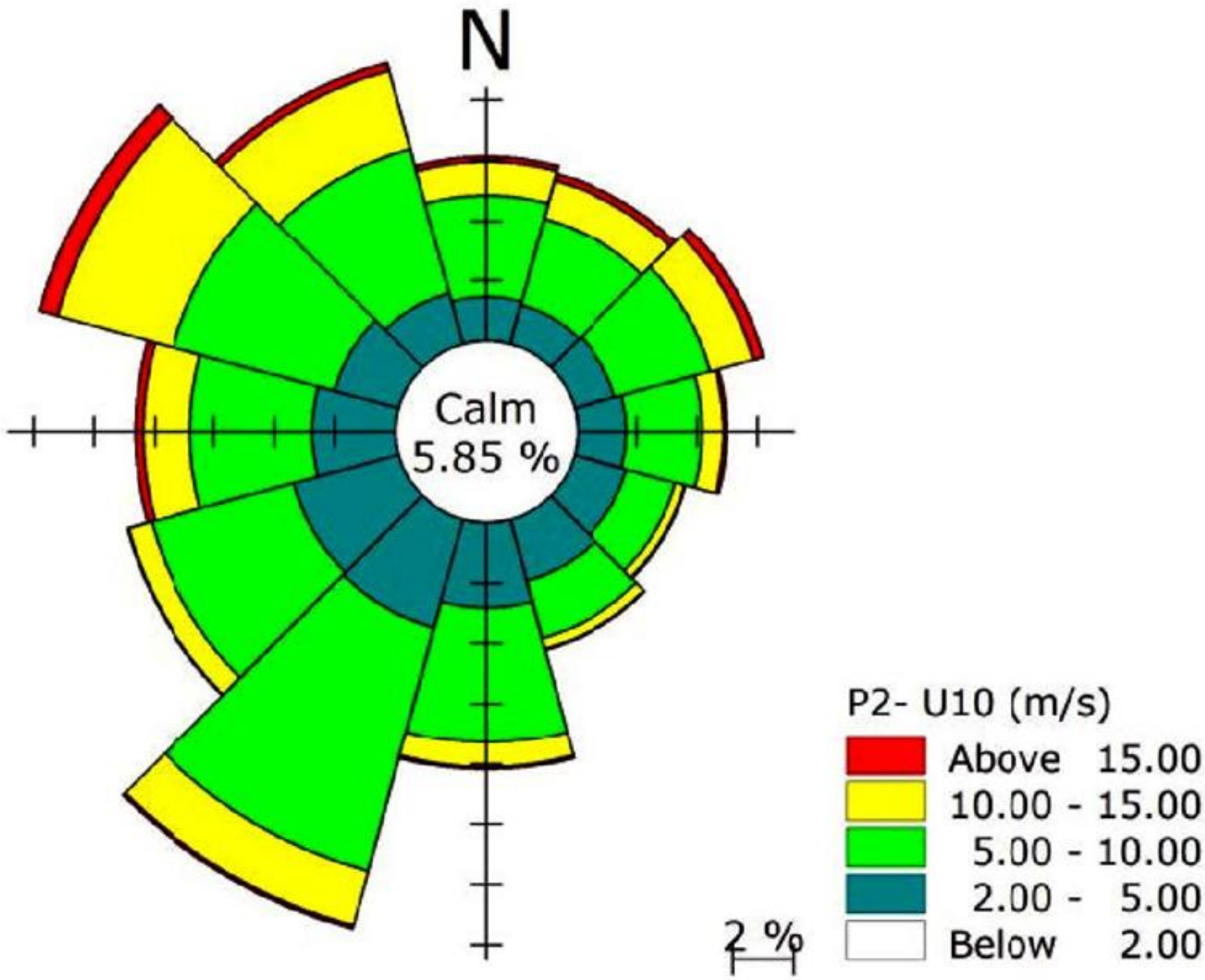
Considering the environmental, economic (with respect to fishing), and scientific significance of the Cold Pool, and the necessity of collecting more information at both the water surface and the ocean floor (Goldsmith et al. 2019) to help understand this environmental phenomenon, Atlantic Shores' metocean buoys have been equipped with additional bottom sensors since 2019 deployments. This buoy has captured and will continue to record weather events, which are crucial to analyzing the Cold Pool development life cycle (Chen et al. 2018).

**Winds, Air Temperature, and Density**

The wind record was obtained from the GFEC continuous timeseries provided by Oceanweather, Inc. (1979–2018).

Based on this dataset, winds at this location predominantly come from the south-southwest, with a significant number of high-speed winds (greater than 33 ft/s [10 m/s]) coming from the northwest as presented in Figure 2.2-3 (see Figure 2-1 in Appendix II-B2).

Extreme event analyses of wind speed at 33 ft (10 m) AMSL for different return periods and for several averaging periods are presented in Table 2.2-4. The analysis was done combining all the time series available from GFEC in all directions. Based on this analysis, the annual maximum wind speed (10-minute average) is 49.2 miles per hour (mph) (22.0 m/s), and the maximum wind speed is 69.3 mph (31.0 m/s) for a 50-year return period and 74.0 mph (33.1 m/s) for a 100-year return period. Further extreme event analysis will be performed during detailed design and will be presented with the FDR and FIR.




ATLANTIC SHORES
offshore wind

**Figure 2.2-3**

*Windrose from within the Lease Area for 1979-2018*

*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*

### Table 2.2-4. Extreme Wind Speeds within the Lease Area (Elevation: 33 ft [10 m AMSL])

| Averaging Time | Unit | Return Period (Years) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 10 | 50 | 100 | 500 | 1,000 |
| 1 hour | ft/s | 68.6 | 85.0 | 96.5 | 103.0 | 126.0 | 134.8 |
| | m/s | 20.9 | 25.9 | 29.4 | 31.4 | 38.4 | 41.1 |
| 10 minutes | ft/s | 72.2 | 89.2 | 101.7 | 108.6 | 132.5 | 142.1 |
| | m/s | 22.0 | 27.2 | 31.0 | 33.1 | 40.4 | 43.3 |
| 1 minute | ft/s | 79.4 | 98.4 | 111.9 | 119.4 | 145.7 | 156.2 |
| | m/s | 24.2 | 30.0 | 34.1 | 36.4 | 44.4 | 47.6 |
| 3 seconds | ft/s | 90.2 | 111.5 | 127.0 | 135.5 | 165.7 | 177.5 |
| | m/s | 27.5 | 34.0 | 38.7 | 41.3 | 50.5 | 54.1 |

Monthly and annual values of air temperature and density at this location were analyzed at 443 ft (135 m) AMSL, using the model output for continuous period (1979–2018). In January, air temperature is minimum, and density is maximum; while in August, air temperature reaches the highest value while density drops to its minimum. The average air temperature at this offshore location is 53.4 °F (11.9 °C) and average air density is 0.05 $lb/ft^3$ (0.87 $kg/m^3$). The highest monthly average temperature at this location is 72.7 °F (22.6 °C) (in August) and lowest monthly average temperature is 35.4 °F (1.9 °C) (in January) as presented in Table 2.2-5.

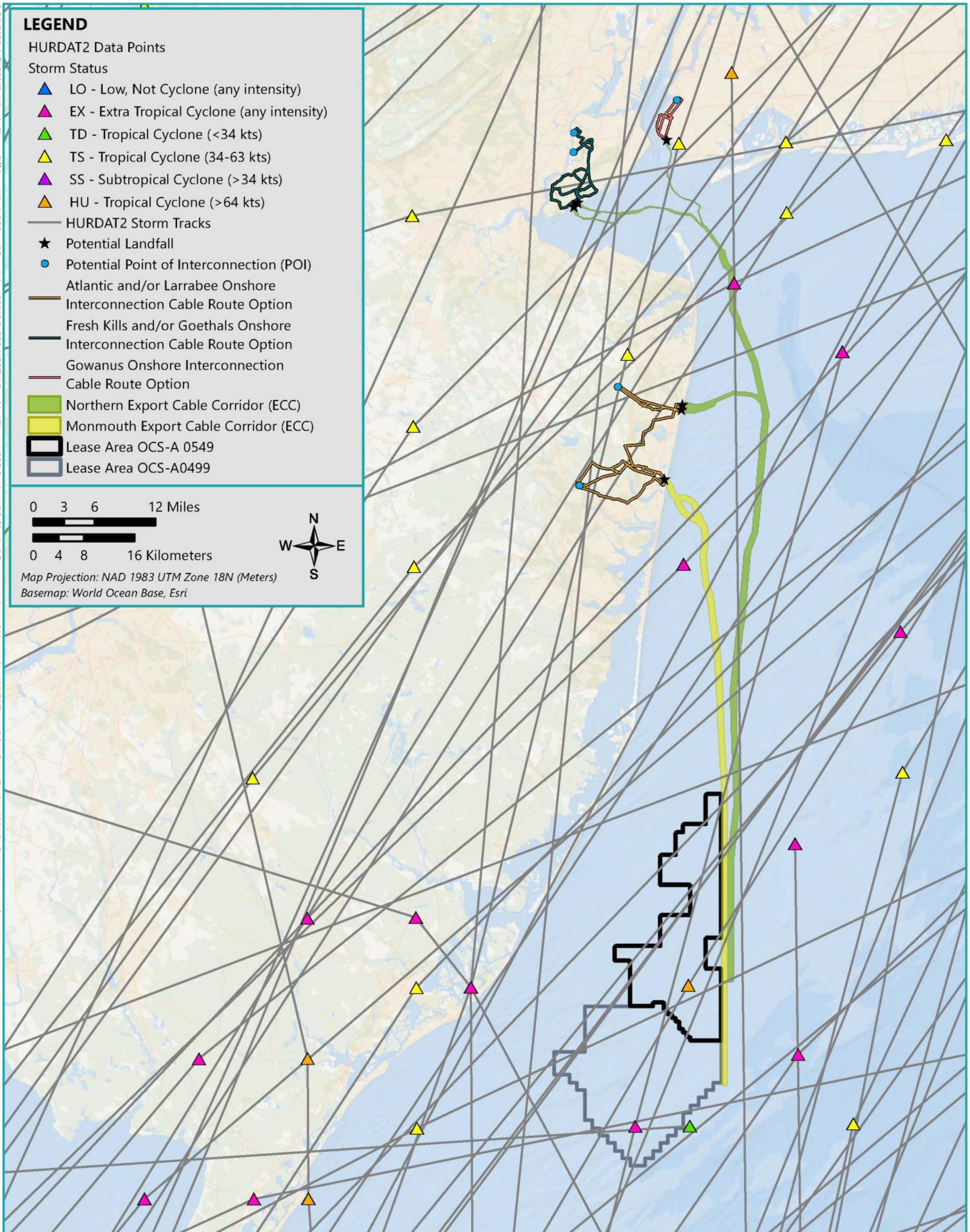
### Table 2.2-5. Monthly Statistics of Air Temperature and Air Density within the Lease Area for 1979-2018

| Month | Unit | Air Temperature | | | Unit | Air Density | | |
|---|---|---|---|---|---|---|---|---|
| | | Mean | Avg | Max | | Min | Avg | Max |
| January | °F | 0.9 | 35.4 | 57.2 | $lb/ft^3$ | 3.9 | 2.8 | 3.04 |
| | °C | -17.3 | 1.9 | 14.0 | $kg/m^3$ | 1.18 | 1.27 | 1.38 |
| February | °F | 5.18 | 35.6 | 55.9 | $lb/ft^3$ | 2.62 | 2.80 | 3.02 |
| | °C | -14.9 | 2.0 | 13.3 | $kg/m^3$ | 1.19 | 1.27 | 1.37 |
| March | °F | 10.8 | 39.7 | 57.9 | $lb/ft^3$ | 2.58 | 2.76 | 2.98 |
| | °C | -11.8 | 4.3 | 14.4 | $kg/m^3$ | 1.17 | 1.25 | 1.35 |
| April | °F | 21.7 | 46.9 | 64.6 | $lb/ft^3$ | 2.60 | 2.71 | 2.84 |
| | °C | -5.7 | 8.3 | 18.1 | $kg/m^3$ | 1.18 | 1.23 | 1.29 |
| May | °F | 42.6 | 55.6 | 74.1 | $lb/ft^3$ | 2.56 | 2.67 | 2.78 |
| | °C | 5.9 | 13.1 | 23.4 | $kg/m^3$ | 1.16 | 1.21 | 1.26 |

| Month | Unit | Air Temperature | | | Unit | Air Density | | |
|---|---|---|---|---|---|---|---|---|
| | | Mean | Avg | Max | | Min | Avg | Max |
| June | °F | 50.2 | 65.3 | 79.5 | $lb/ft^3$ | 2.51 | 2.62 | 2.73 |
| | °C | 10.1 | 18.5 | 26.4 | $kg/m^3$ | 1.14 | 1.19 | 1.24 |
| July | °F | 57.9 | 72.1 | 82.8 | $lb/ft^3$ | 2.51 | 2.58 | 2.67 |
| | °C | 14.4 | 22.3 | 28.2 | $kg/m^3$ | 1.14 | 1.17 | 1.21 |
| August | °F | 55.0 | 72.7 | 82.9 | $lb/ft^3$ | 2.44 | 2.58 | 2.71 |
| | °C | 12.8 | 22.6 | 28.3 | $kg/m^3$ | 1.11 | 1.17 | 1.23 |
| September | °F | 50.0 | 67.8 | 80.6 | $lb/ft^3$ | 2.47 | 2.62 | 2.73 |
| | °C | 10.0 | 19.9 | 27.0 | $kg/m^3$ | 1.12 | 1.19 | 1.24 |
| October | °F | 38.5 | 58.6 | 73.8 | $lb/ft^3$ | 2.47 | 2.68 | 2.80 |
| | °C | 3.6 | 14.8 | 23.2 | $kg/m^3$ | 1.12 | 1.21 | 1.27 |
| November | °F | 24.8 | 49.5 | 66.5 | $lb/ft^3$ | 2.58 | 2.71 | 2.89 |
| | °C | -4.0 | 9.7 | 19.2 | $kg/m^3$ | 1.17 | 1.23 | 1.31 |
| December | °F | 8.8 | 41.0 | 61.0 | $lb/ft^3$ | 2.44 | 2.69 | 3.04 |
| | °C | -12.9 | 5.0 | 16.1 | $kg/m^3$ | 1.11 | 1.22 | 1.38 |

#### 2.2.1.4 Storms

The Atlantic Shores Offshore and Onshore Project Areas are subject to extreme weather, such as storms and hurricanes, which may impose hydrodynamic load and sediment scouring. The Project will be designed to withstand extreme events including hurricanes and winter storms. Figure 2.2-4 shows the major historic storm tracks in the Offshore Project Area from 1851 to 2021 extracted from HURDAT2 dataset (Landsea and Franklin 2013). The different types of storms presented in Figure 2.2-4 are summarized in Table 2.2-6. The extreme event analysis and the return period of wind, wave, and hydrodynamics that will be generated due to different storms are presented in Appendix II-B2 and are being used in the design of the wind farm to assure withstanding and survival of the Project at the time of extreme conditions.




ATLANTIC SHORES
offshore wind

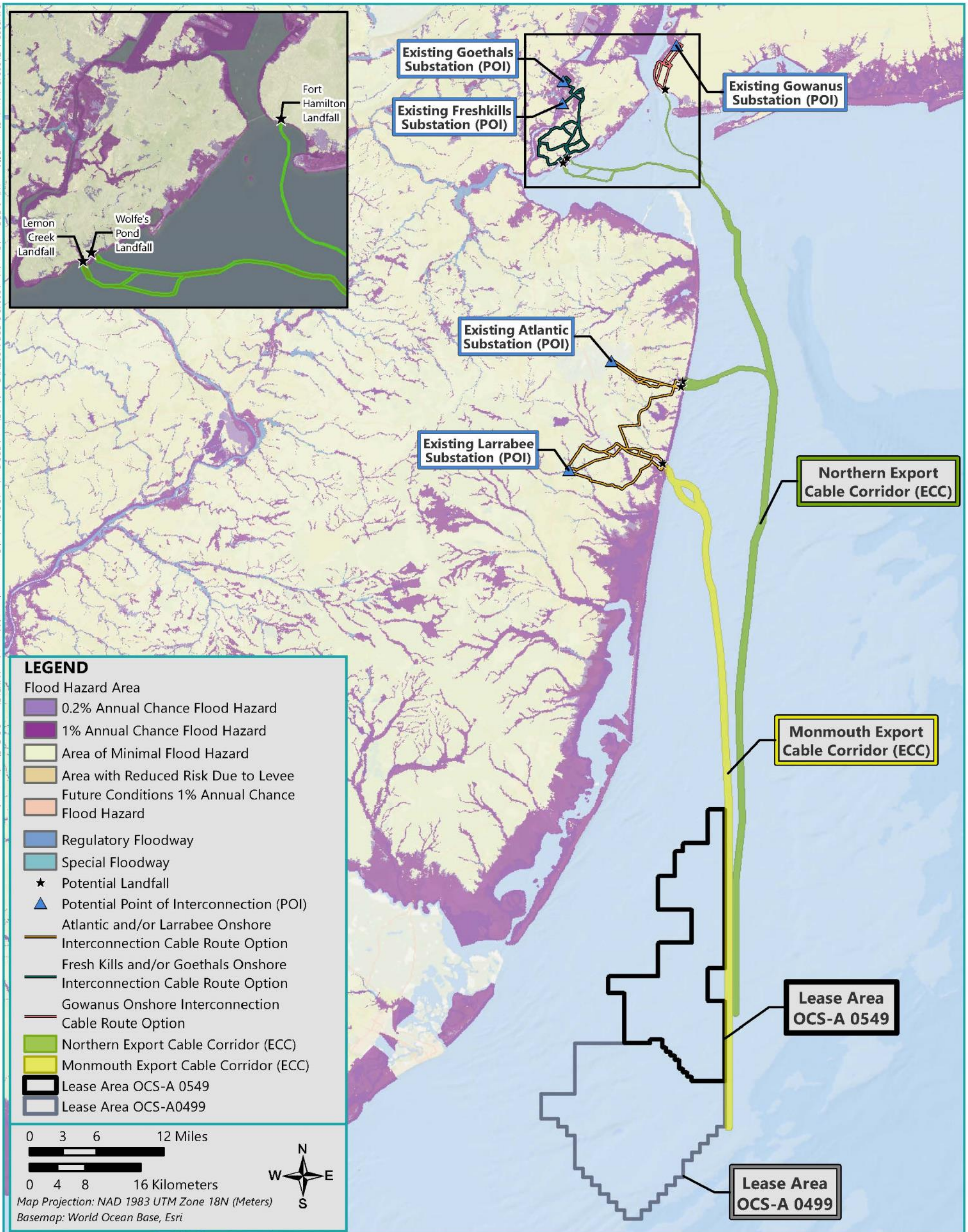
**Figure 2.2-4**
*Storm Tracks in the Project Area*
*Offshore New Jersey and New York*

### Table 2.2-6. Abbreviations Used in Figure 2.2-4

| Abbreviation | Description |
|---|---|
| EX | Extratropical cyclone (of any intensity) |
| HU | Tropical cyclone of hurricane intensity (>64 knots) |
| LO | A low that is neither a tropical cyclone, a subtropical cyclone, nor an extratropical cyclone (of any intensity) |
| SS | Subtropical cyclone of subtropical storm intensity (>34 knots) |
| TD | Tropical cyclone of tropical depression intensity (<34 knots) |
| TS | Tropical cyclone of tropical storm intensity (34-63 knots) |

Any onshore substations and/or converter stations and the proposed Points of Interconnection (POI) will be located inland from the ocean and not located in or proximate to any floodplain. The distance from the shore and elevation above sea level (greater than 45 ft [13.7 m]) is expected to be sufficient to shelter this infrastructure from the risk of coastal flooding due to storm surge. Although the majority of the proposed landfall sites are located in flood zones, as presented in Figure 2.2-5, all cables will be buried to an appropriate design depth to protect them from sediment erosion and to prevent exposure due to flood and severe weather.

The storm wave direction in the Offshore Project Area varies throughout the year. Storm waves typically come from the north throughout the summer, which is the season with the lowest wave record. However, during the winter season, the largest storm waves come from the northeast. Typically, wave heights detected in the Lease Area are less than 4.9 ft (1.5 m) (see Appendix II-B1).




ATLANTIC SHORES offshore wind

**Figure 2.2-5**

*National Flood Hazard Layer (NFHL 2020)*

Table 2.2-7 provides extreme high-water level (EHWL) and extreme low-water level (ELWL) at an offshore location relative to mean sea level (MSL) for different return periods. This dataset is obtained by analyzing all timeseries from the GFEC model (see Appendix II-B2). Based on the analysis, EHWL can be as high as 9.58 ft (2.92 m) AMSL, and ELWL can be as low as 7.94 ft (2.42 m) BMSL for a 1,000-year return period.

### Table 2.2-7. Extreme Total Water Levels Relative to MSL from within the Lease Area

| Variable | Unit | Return Period (Years) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 10 | 50 | 100 | 500 | 1,000 |
| EHWL | ft | 2.92 | 4.95 | 6.14 | 6.59 | 8.43 | 9.58 |
| | m | 0.89 | 1.51 | 1.87 | 2.01 | 2.57 | 2.92 |
| ELWL | ft | -2.62 | -4.27 | -5.38 | -5.91 | -7.28 | -7.94 |
| | m | -0.80 | -1.30 | -1.64 | -1.80 | -2.22 | -2.42 |

Table 2.2-8 presents extreme wave heights (in feet relative to MSL) and associated wave periods for different return periods. Based on the analysis, the maximum wave height can reach 57.4 ft (17.5 m) and the peak wave period can be 17.3 seconds for a 1,000-year return period.

### Table 2.2-8. Extreme Wave Heights (relative to MSL) and Associated Wave Periods from within the Lease Area

| Variable | Unit | Return Period (Years) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 10 | 50 | 100 | 500 | 1000 |
| $H_S$ | ft | 15.7 | 21.7 | 25.9 | 27.9 | 38.4 | 41.3 |
| | m | 4.8 | 6.6 | 7.9 | 8.5 | 11.7 | 12.6 |
| $T_P$ | seconds | 9.8 | 11.5 | 13.0 | 13.7 | 16.8 | 17.3 |
| $H_{MAX}$ | ft | 29.2 | 38.1 | 43.0 | 44.9 | 57.1 | 57.4 |
| | m | 8.9 | 11.6 | 13.1 | 13.7 | 17.4 | 17.5 |
| $T_{HMAX, LOW}$ | seconds | 7.8 | 9.2 | 10.4 | 11.0 | 15.1 | 15.6 |
| $T_{HMAX, UP}$ | seconds | 9.4 | 11.0 | 12.5 | 13.2 | 16.1 | 16.6 |
| $C_{MAX}$ | ft | 21.0 | 31.2 | 39.4 | 43.3 | 66.5 | 73.8 |
| | m | 6.4 | 9.5 | 12.0 | 13.2 | 20.3 | 22.5 |

Comparison of the storms during the tropical and extra-tropical storm periods suggests wave heights and wind speeds are greater during the tropical storm period.

#### 2.2.1.5 Sea Level Rise

Sea level rise is the most predictable component of climate change, while there are also changes in the patterns of extreme events with potential increase in their frequency and severity. Both sea level rise and storm surge can impact coastal facilities more seriously than those farther offshore.

To find the trend of sea level rise in the area, data collected between 1910 and 2021 from NDBC Buoy No. 8534720 (located in the Atlantic City Steel Pier) shows a linear trend increment of the tide level of 0.16 inches per year (in/year) (4.16 millimeters per year [mm/year]) based on monthly sea level data as presented in Figure 2.2-6. A tidal elevation record obtained from a separate buoy (NDBC Buoy No. 8531680) located in Sandy Hook, New Jersey, shows the exact same sea level rise of 0.16 in/year (4.17 mm/year for the period of 1932–2021) as presented in Figure 2.2-7.

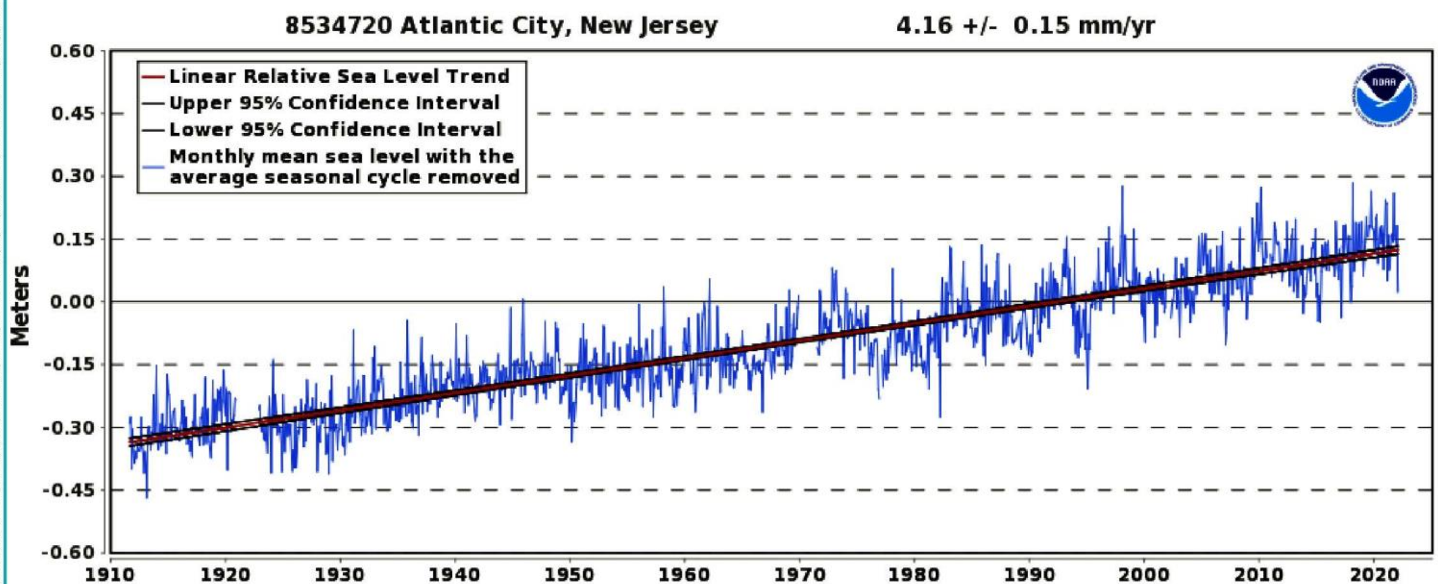
### 2.2.2 Potential Impacts and Proposed Environmental Protection Measures

The construction, O&M, and decommissioning of the Project is expected to have potential localized effects on metocean conditions. These conditions may potentially disrupt Project phases, or damage Project components (e.g., foundations, WTGs, export cables, onshore elements) once installed. This section discusses how the Project may be affected by the metocean conditions in the Offshore Project Area as well as how metocean conditions may be influenced by the presence of Project facilities.

#### 2.2.2.1 Effects of Metocean Conditions on Project Facilities and Activities

As discussed in Sections 4.3 and 4.4 of Volume I, the WTGs and offshore substations (OSSs) will be designed according to site-specific conditions, including winter storms, hurricanes, and tropical storms, based on industry standards such as American Clean Power Association, International Electrotechnical Commission, American Petroleum Institute, and International Organization for Standardization standards.

Atlantic Shores will also design the Project construction schedule to take into consideration both extreme weather and environmental conditions. In addition to the meteorological (met) tower, up to two temporary metocean buoys may be installed and kept in place during construction to monitor weather and sea state conditions to ensure safe working conditions for all personnel. During O&M, safe weather limits will be established for all installation and maintenance activities, including shutdown during extreme weather.

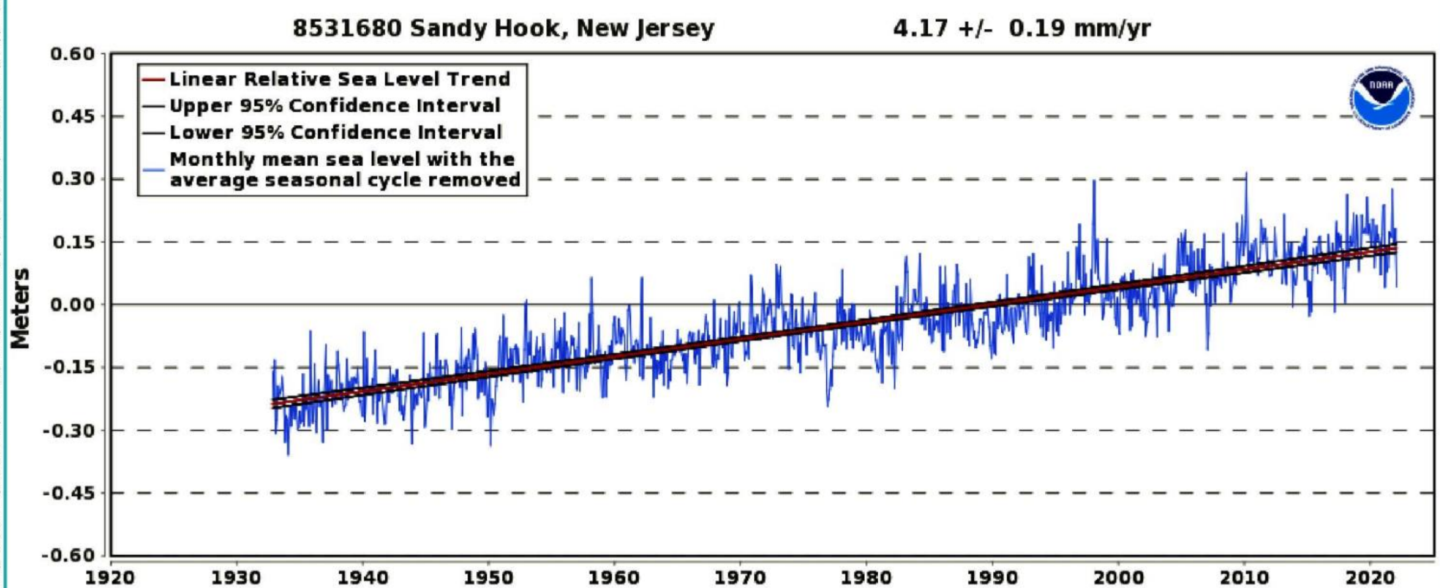



ATLANTIC SHORES offshore wind

**Figure 2.2-6**

*Sea Level Rise Trend for 1910-2020, Atlantic City, New Jersey*

*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*




ATLANTIC SHORES offshore wind

**Figure 2.2-7**

*Figure 2.2-8_Sea Level Rise Trend for 1932-2020, Sandy Hook, New Jersey*

*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*

Hurricanes, strong storms, and associated waves and currents, tides, and tidal currents have the potential to cause seabed impacts through movements of sediments. This can expose buried cables and scour the sea floor around WTG, OSS, and met tower foundations. Inter-array, inter-link, and export cables will be buried to a target burial depth of 5 to 6.6 ft (1.5 to 2 m), which will help reduce these effects. The selection of equipment best suited for installation is an iterative process that involves reviewing seabed conditions, cable properties, laying and burying combinations, burial tool systems, and anticipated performance. Cable protection (e.g., rock placement, concrete mattresses, rock bags, or grout-filled bags) may be necessary if sufficient burial depth cannot be achieved (e.g., due to sediment properties or a cable joint). Cable protection may also be required to support the crossing of existing marine infrastructure such as submarine cables or pipelines (see Section 4.5.7 of Volume I). While Atlantic Shores will work to minimize the amount of cable protection required, based on sediment conditions in the Offshore Project Area, it is conservatively assumed that up to 10% of the export cables, inter-array cables, and inter-link cables may require cable protection. A cable burial risk assessment was completed to supports the design and selection of embedment techniques. In addition, as discussed in Section 5.4 of Volume I, post-event inspections will be conducted after a storm during which measured environmental conditions exceed specified conditions (e.g., a hurricane or significant storm event) to assess the potential effects on Project components.

Scour protection may be installed at the base of foundations to protect them from sediment transport/erosion caused by water currents. The presence of foundations can create locally higher currents around the structures, which scour protection can withstand.

From the potential landfall sites, onshore interconnection cables will travel underground primarily along existing roadways and/or utility ROWs to proposed onshore substations. From the proposed onshore substations, the onshore interconnection cables will continue underground to the proposed POIs for interconnection to the electrical grid. HDD at the landfall sites will help ensure sufficient burial of the cables along the beachfront which is subject to erosion and coastal flooding. Also, cables will be buried underground and encased in a concrete duct bank to protect these components from the effects of storm surge and coastal flooding. Aboveground facilities (i.e., onshore substations and POIs) are outside of Federal Emergency Management Agency-designated flood zones.

#### 2.2.2.2 Impact-Producing Factors on Metocean Conditions

The presence of Project structures in the ocean could result in localized changes to current and associated mixing of the water column near foundations and/or scour protection. However, the potential effect of offshore wind structures on oceanographic processes is highly dependent on the specifics of the wind farm and the underlying atmospheric and oceanographic conditions.

Monitoring the physical dynamics in the Mid-Atlantic Bight and Cold Pool are important to understanding how placement of WTGs may affect ocean mixing. Modeling studies, considering varying sizes of wind projects and technology, have indicated that WTGs may cause atmospheric disturbances to near-surface winds that influence ocean mixing (Afsharian and Taylor 2019). The extent of changes to ocean mixing at local and regional, or mesoscale, scales is not well known and can vary widely in magnitude as local mixing depends on atmospheric forcing, daily heating and cooling, wind, changes in temperature and humidity associated with mesoscale weather, and other processes (Paskyabi et al. 2015). Measuring and predicting any possible effects to ocean mixing is highly dependent on the characteristics of the Project (e.g., spacing between WTGs, size of WTGs), and the local and regional atmospheric and oceanographic conditions (Moum and Smyth 2019).

Drawing early conclusions from European or modeling studies have inherent differences, as the Mid-Atlantic Bight has weaker tidal currents and more intense stratification than the North Sea and is different from other western boundary currents or mesoscale circulation features in European waters. It has been suggested that slower ocean velocities in the southern Mid-Atlantic Bight would result in significantly less mixing than has been found in Europe (Carpenter et al. 2016), and that European studies are more representative of Mid-Atlantic Bight conditions during weaker stratification. It is considered unlikely that artificial structure-induced mixing could overcome the natural intense summer stratification sufficiently to influence the Cold Pool and cause broader ocean mixing (Miles et al. 2020). However, considering the seasonal, annual, and longer scale changes in the Cold Pool and Mid-Atlantic Bight, Atlantic Shores supports contributing to regional collaborative science to study and monitor the Cold Pool and is working with Rutgers University to provide information on the oceanographic conditions in the Offshore Project Area that are being used to monitor the region and its features.

### 2.2.3 Summary of Proposed Environmental Protection Measures

Atlantic Shores has already taken steps and has made commitments to avoid, mitigate, and monitor the effects on the Project and metocean conditions through deployment of their offshore metocean buoys. Additional avoidance and mitigation measures will be evaluated further as the Project progresses through development and as site-specific metocean data becomes available. The following is a summary of environmental protection measures proposed to minimize effects to the Project and to metocean conditions:

- Offshore data collection is being conducted using metocean buoys and shared with the public.
- The Project has been designed to consider site-specific metocean conditions.
- The WTG technology and construction schedules take into consideration both extreme weather and environmental conditions.
- Safe weather limits for all installation and maintenance activities, including shut down during extreme weather will be established.
- Inter-array, inter-link, and export cables will be buried to a target depth of 5 to 6.6 ft (1.5 to 2 m) which will help reduce exposure and/or scour.
- HDD will be employed at the landfall sites to ensure sufficient burial of the cables along the beachfront which is subject to erosion and coastal flooding.
- Buried onshore cables will be encased in a concrete duct bank which protects them from the effects of storm surge and coastal flooding.
- Onshore interconnection cables will be installed underground primarily along existing roadways and/or utility ROWs.

# 3.0 Physical Resources

This section provides a detailed description of the physical resources including air quality and water quality within the Project Area.

## 3.1 Air Quality

This section describes air quality in the affected environment, associated impact producing factors (IPF), and measures to avoid, minimize, or mitigate potential effects from regulated sources during construction, operations and maintenance (O&M), and decommissioning. This section also describes the benefits from avoided air pollutant emissions associated with the Project.

Atlantic Shores recognizes the importance of air quality from a local, regional, and global perspective. Air quality protection is important because air quality affects human health, the health of ecosystems, and climate change, directly and indirectly.

Unlike traditional fossil-fuel based energy generation, the Project's wind turbine generators (WTGs) will not generate any air pollutant emissions. Instead, the electricity generated by the WTGs has the potential to significantly reduce emissions from the regional electric power grid over the life of the Project by displacing electricity generated from pollution-emitting fossil fuel-fired power plants that otherwise would be required to serve the projected increase in electric demand within regional electric markets. Atlantic Shores estimates that power generated by the Project can reduce greenhouse gas (GHG) emissions, reported as carbon dioxide equivalents ($CO_2e$), by approximately 2,605 tons per year (tpy) for every megawatt of capacity. Given that the Project will consist of up to 157 WTGs, a reasonable estimate of the output for the Project would reduce GHG by an estimated 6.13 million tons of $CO_2e$ annually, which is the equivalent of removing 1.21 million cars from the road. Additional detail is provided in Section 3.1.2.5.

While the WTGs will not generate air emissions, air emissions will occur in connection with Project construction, O&M, and decommissioning activities. Air emissions from these Project activities are directly associated with internal combustion engines generating power for vessels, vehicles, and tools needed to support the various phases of the Project. These emitting activities in the Offshore Project Areas will be subject to air quality requirements under 40 CFR Part 55 and implementing New Jersey Department of Environmental Protection (NJDEP) regulations. Within the Onshore Project Area individual onshore stationary emissions sources are subject to relevant New Jersey and New York air permitting jurisdiction, and stationary and mobile air emission sources throughout the Project areas are subject to relevant U.S. Environmental Protection Agency (EPA) jurisdiction.

### 3.1.1 Affected Environment

The affected environment is the airshed in the broader geographic area that may be affected by Project-related air emissions. For the purposes of the assessment of air emissions from the Project, the Atlantic Shores Project Region is the airshed within 25 nautical miles (nm) (46.3 kilometers [km]) of the centroid of the Offshore Project Area, and the airshed within 15.5 miles (mi) (25 km) from the Export Cable Corridors (ECCs), the New Jersey and New York Onshore Project Areas, and ports where Project-related activities could occur (see Figure 3.1-1). The Project Region encompasses the area subject to Outer Continental Shelf (OCS) air permitting (see Section 3.1.1.4) and provides a reasonable buffer for assessing effects from emissions of primary criteria and hazardous air pollutants (HAPs).[3]

The description of the affected environment includes descriptions of criteria air pollutants, HAPs, and GHGs. It also includes a description of the regulatory requirements in place to protect the affected environment.

#### 3.1.1.1 Criteria Air Pollutants

The Clean Air Act (CAA) (42 U.S.C. §§ 7401 et seq., amended 1990) and implementing Federal and State regulations, requires the EPA to established NAAQS for pollutants that are considered harmful to public health and welfare and the environment. These pollutants come from a diverse set of sources, including cars and trucks, electric power plants, factories, office buildings, and homes. EPA has established NAAQS for six air contaminants, known as criteria pollutants. These criteria pollutants are sulfur dioxide ($SO_2$), particulate matter (with a diameter smaller than 10 microns as $PM_{10}$ and a diameter smaller than 2.5 microns as ($PM_{2.5}$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), ozone ($O_3$), and lead (Pb). For these pollutants, two types of NAAQs (40 CFR Part 50) may be established: primary standards that are adopted to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly, and secondary standards that set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has classified all areas of the country as being in attainment, nonattainment, or unclassified with respect to the NAAQS for each of the criteria pollutants. An area that complies with the NAAQS for all the criteria pollutants is classified as an attainment area. An area that is out of compliance with the NAAQS for one or more criteria pollutants is classified as a nonattainment area. An area that cannot be classified as meeting or not meeting the NAAQS based on available information is an unclassified area. Areas that were in nonattainment of an NAAQS standard within the previous 20 years but are currently unclassified or in attainment with the standards, are referred to as maintenance areas.

Emissions standards, permitting requirements and other air quality protection provisions may vary depending upon whether the air quality effects associated with a proposed emissions source occur within or may affect a nonattainment, attainment, unclassified or maintenance area.

[3] The impact of air emissions on secondary pollutant formation (including the formation of ground-level ozone and fine particulate) is regional, and the impact of GHG emissions on climate is global.

Appendix II-C includes a breakdown of maximum emissions in each of five main geographical regions with a breakdown of which ports are in each geographical region. These max emissions represent the worst case for that region assuming any vessel that can operate from one of the ports in the given region operates exclusively from that region. This breakdown is found in the tables on pages II-C-36 through II-C-38.

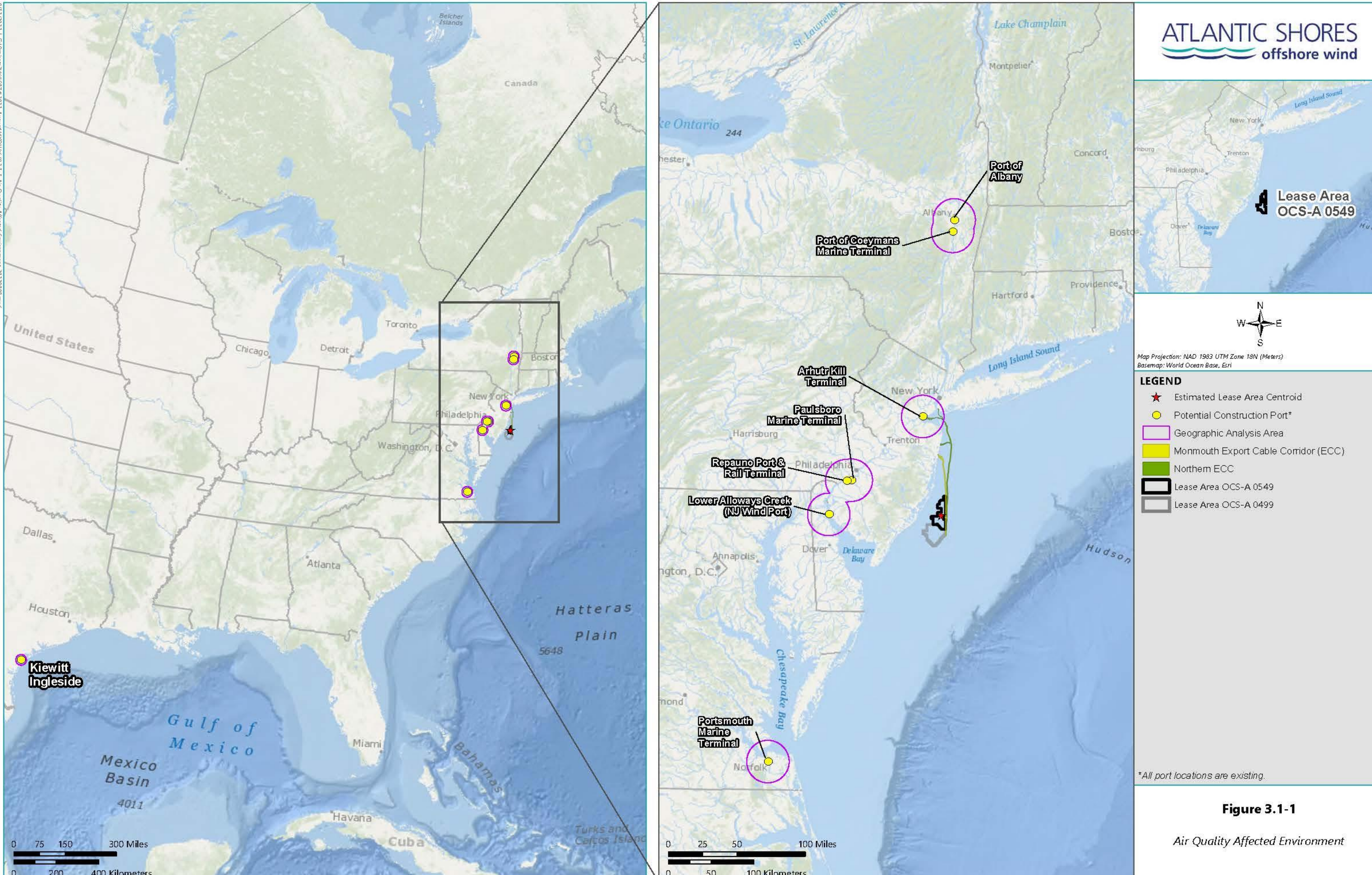



**Figure 3.1-1**

*Air Quality Affected Environment*

When the EPA designates a new NAAQS, older standards are not automatically revoked. Because of this, there are two different 8-hour ozone standards (designated as the 2008 and 2015 8-hour ozone standards), and the attainment classifications are different for the different standards. Also, the CAA required the EPA to classify areas that are designated as nonattainment for ozone standards by the severity of their pollution. These classifications, in order of severity, are marginal, moderate, serious, severe, and extreme.

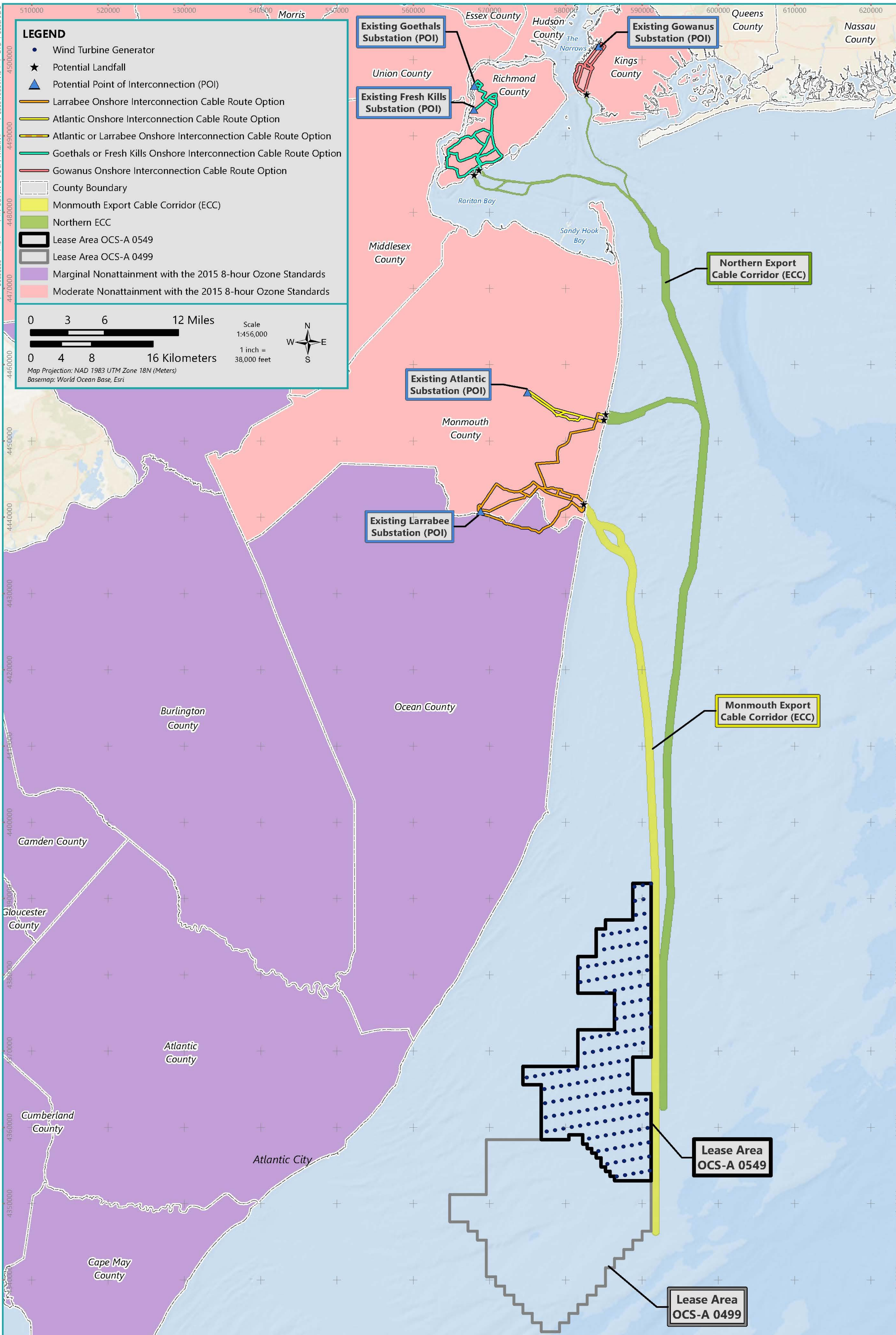
The EPA does not designate the attainment status of offshore areas. Offshore areas within 25 mi (40.2 km) of shore are subject to the regulations of the corresponding onshore area, including NAAQS-related regulations. Therefore, offshore areas are treated as having the same attainment status as the corresponding onshore areas. As shown in Figure 3.1-2, the Offshore Project Area is closest to Ocean County, New Jersey, which is designated as being in marginal nonattainment with the 2008 and 2015 8-hour ozone standards.

Appendix II-C includes a table listing the nonattainment and maintenance status for each county where Project activities could occur.

Figure 3.1-3 shows measured ambient concentrations of key criteria pollutants in and near the Project Region, over the last 10 years. The CAA gives special air quality and visibility protection to national parks larger than 6,000 acres (24.3 square kilometers [$km^2$]) and national wilderness areas larger than 5,000 acres (20.2 $km^2$) that were in existence as of the 1977 CAA amendments (NPS 2020). These areas are referred to as “Class I” areas. One Class I area, the Brigantine Wilderness Area, is part of the Edwin B. Forsythe National Wildlife Refuge located approximately 11 mi (14.5 km) west of the Lease Area. Figure 3.1-3 shows the Lease Area in relation to the Brigantine Wilderness Area.

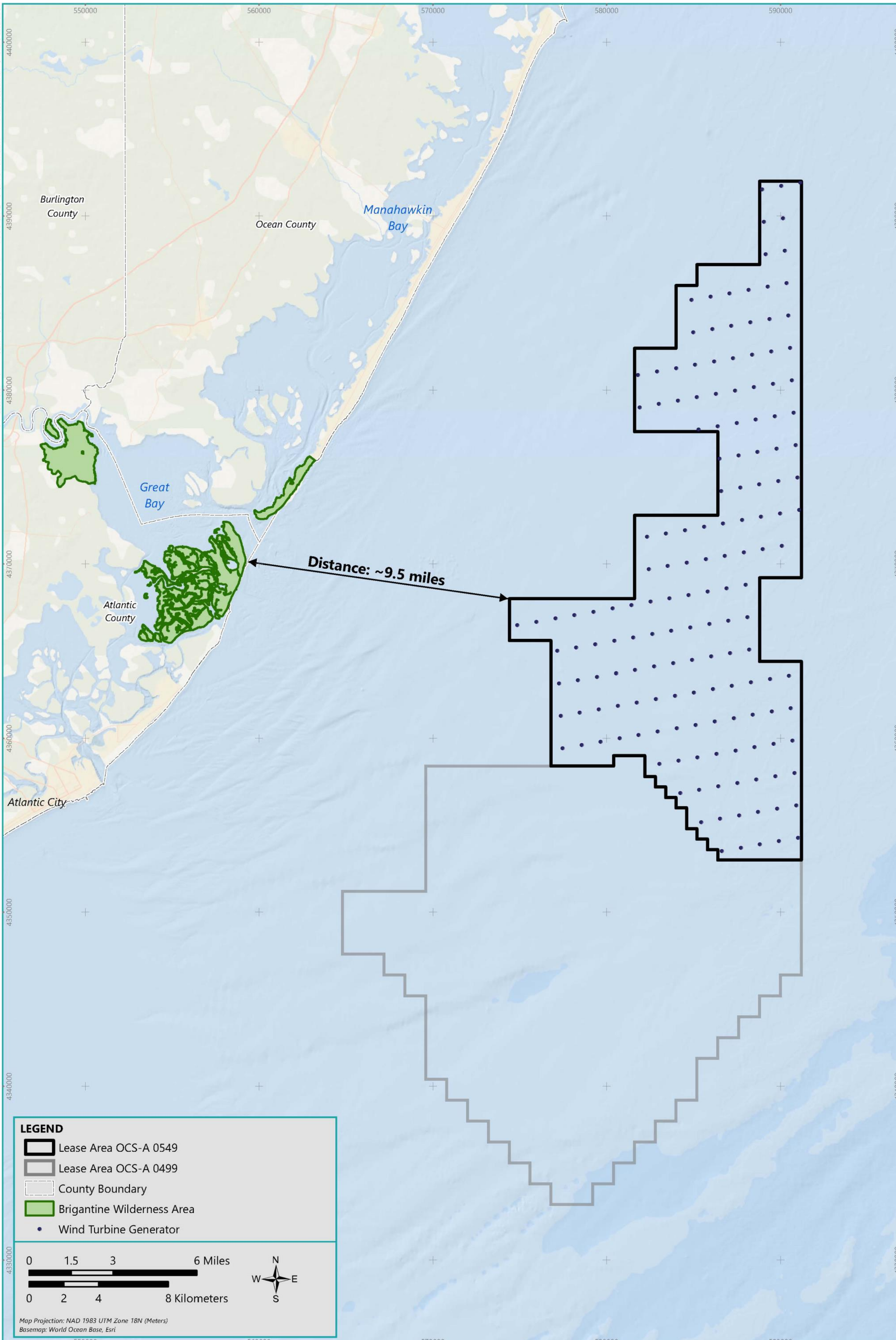
Despite the current NAAQS attainment status for the Project Region, overall air quality in the northeastern U.S. has been improving over the last 10 years. Examples of this overall improvement are shown in Figure 3.1-4. The figure shows ambient air concentration trends as measured at the continuously operated monitoring stations that are nearest to the Offshore Project Area and the onshore transmission routes and substations. Over the last 10 years both short-term and long-term average concentrations of these criteria pollutants have decreased or remained constant.

Air pollutant emissions derive from both naturally occurring (biogenic) and human-made (anthropogenic) sources. The NJDEP Bureau of Evaluation and Planning tracks state-wide anthropogenic emissions for the following source categories: point sources (large stationary sources such as coal- or natural gas-fired power plants), area sources (small stationary sources such as home furnaces and fireplaces), on road mobile sources (automobiles), and nonroad mobile sources (equipment engines). As shown in Figure 3.1-5, onshore anthropogenic air emissions have decreased for key criteria pollutants in New Jersey over the last 10 years.




ATLANTIC SHORES offshore wind

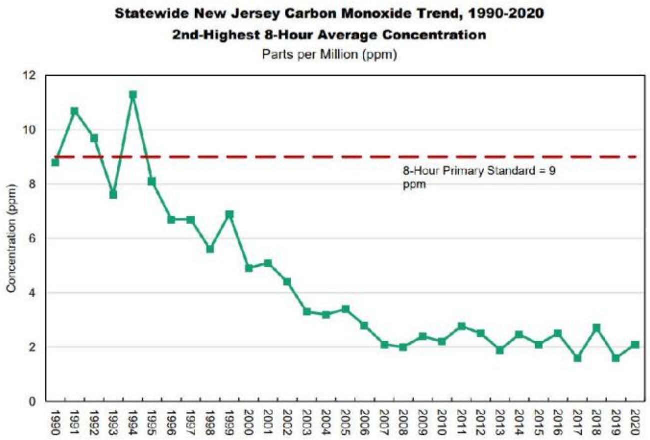
**Figure 3.1-2**
*NAAQS Attainment Status*

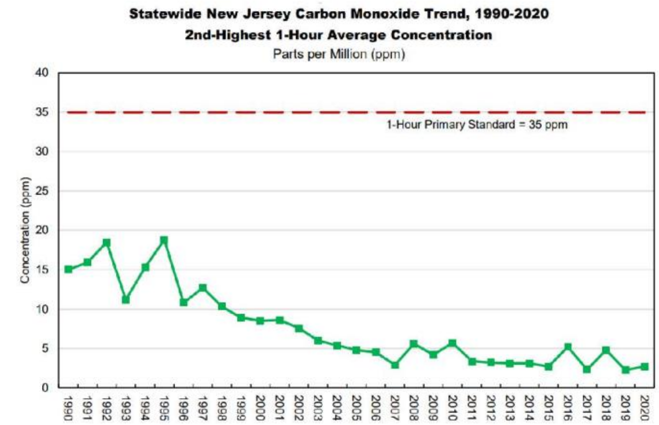


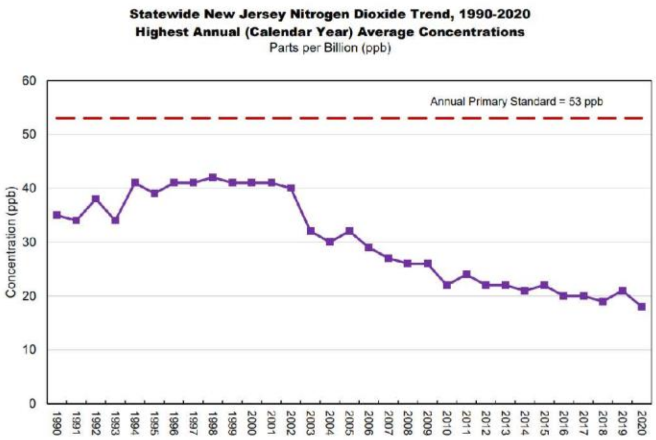

ATLANTIC SHORES offshore wind

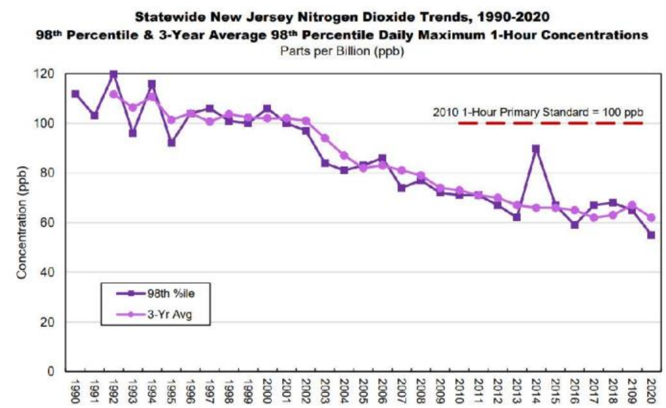
**Figure 3.1-3**

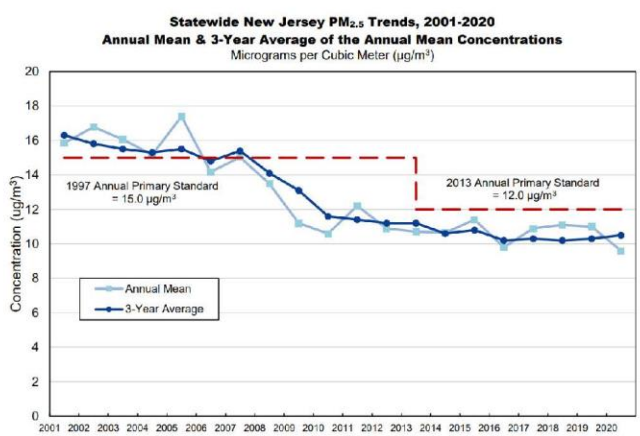
*Lease Area in Relation to Brigantine Wilderness Area*

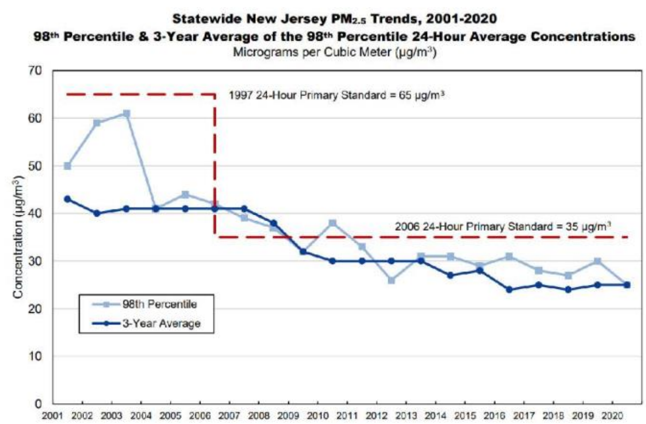


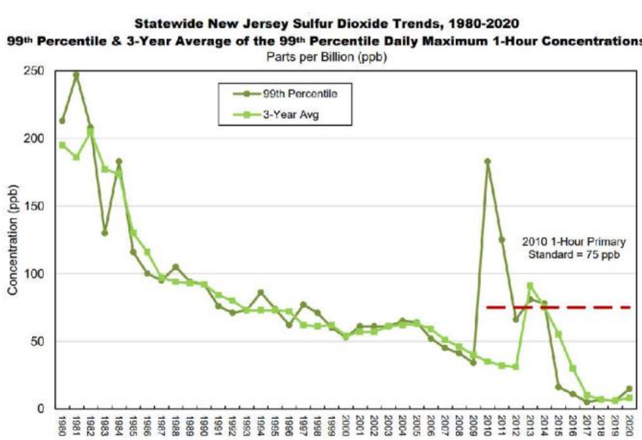



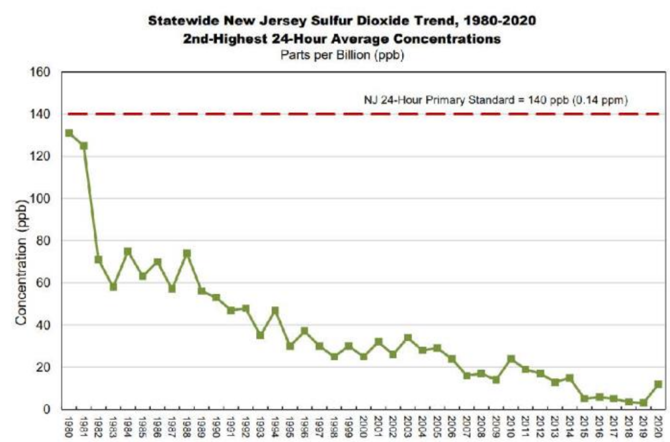



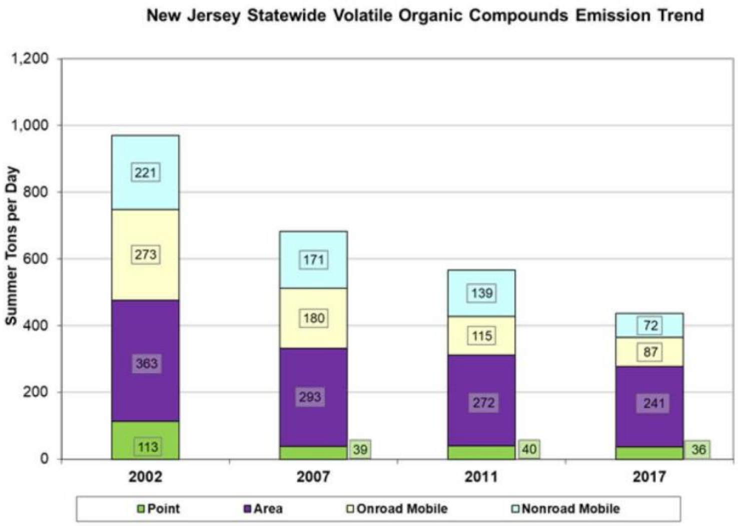



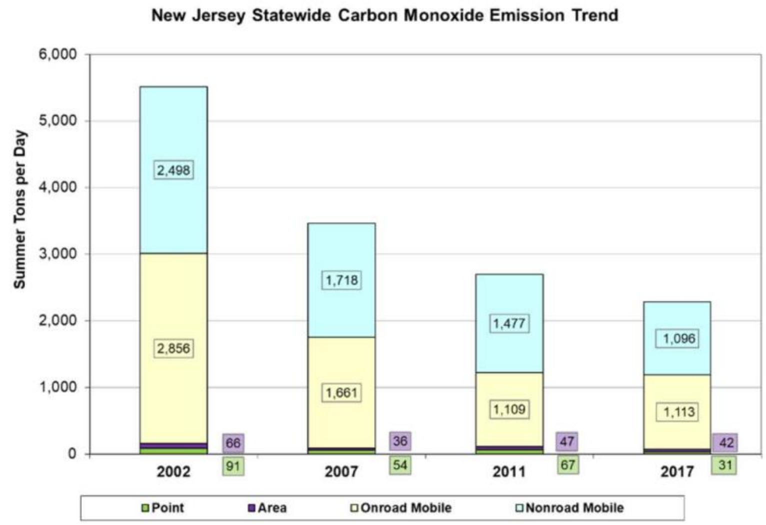

*Source: 2020 New Jersey Air Quality Report. Retrieved from: https://www.nj.gov/dep/airmon/pdf/2020-nj-aq-report.pdf*

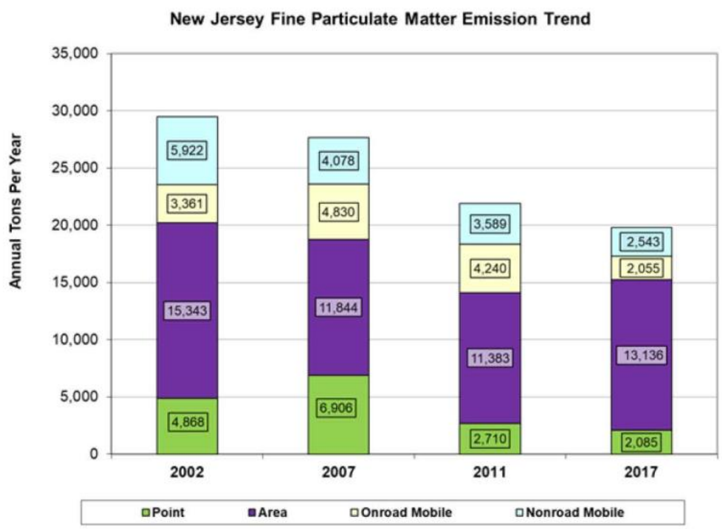
ATLANTIC SHORES offshore wind

**Figure 3.1-4**

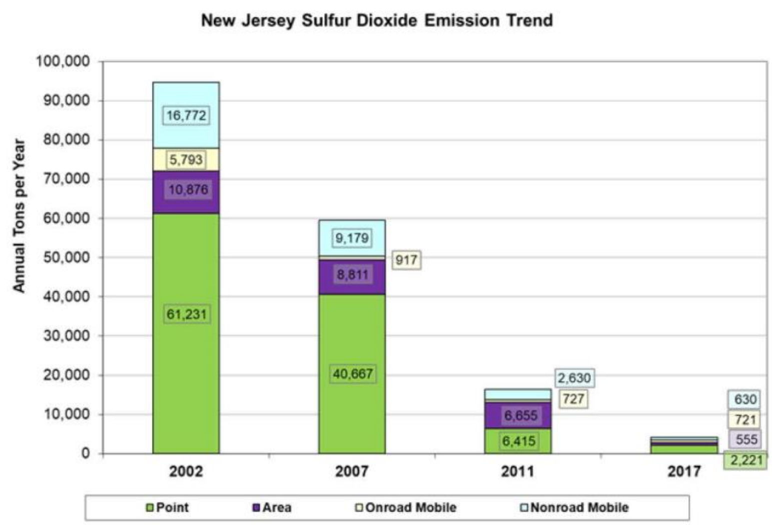
*Regional Ambient Air Concentrations*

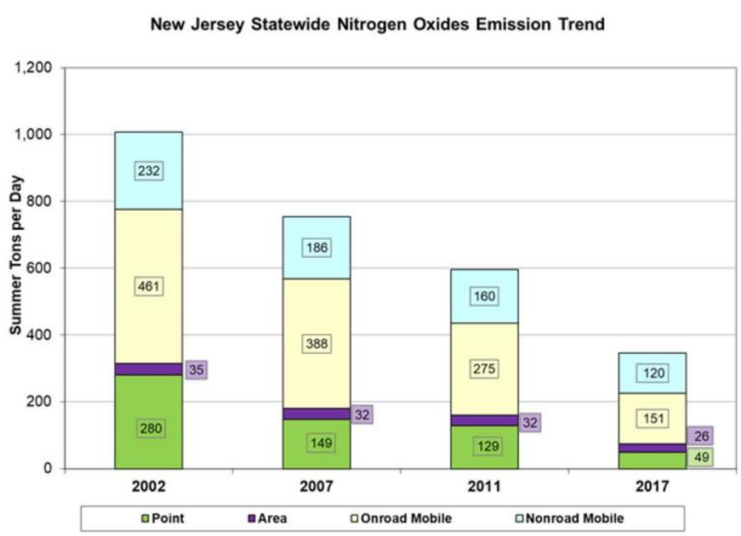



**Note:** Area Source fugitive dust emissions are post-adjustment.




*Source: New Jersey Air Emission Inventories. Retrieved from: https://www.nj.gov/dep/baqp/inventory.html*

ATLANTIC SHORES offshore wind

**Figure 3.1-5**
*Anthropogenic Air Emissions in New Jersey*

Marine vessels are the largest source of anthropogenic air pollutant emissions in the marine environment. For example, waterborne commerce generated 48,322 vessel trips to ports along the Delaware River in 2016 (over 24,000 roundtrips) (USACE 2017). Several of the ports under consideration for Project construction and O&M activities are in developed metropolitan and industrial areas with significant rail, road, vessel, and air traffic that generate associated air emissions.

#### 3.1.1.2 Hazardous Air Pollutants

In addition to criteria pollutants, air pollutants may be classified as HAPs. HAPs are compounds that at varying exposure levels are known or suspected to cause serious health effects (e.g., certain forms of cancer or birth defects) or can result in serious adverse environmental effects. Some examples of HAPs are acrolein, formaldehyde, and cadmium.

HAPs may be emitted from fossil fuel combustion (due to the presence of impurities or products of incomplete combustion) and from industrial processes that involve the use of toxic chemicals. A portion of total PM and total volatile organic compound (VOC) emissions consists of HAPs, and air emission trends will generally follow the particulate matter and VOC trends described in Section 3.1.1.1.

#### 3.1.1.3 Greenhouse Gases

A GHG is an atmospheric gas that slows the rate at which heat radiates from earth into space, thus having a warming effect on the atmosphere. Carbon dioxide ($CO_2$) is the most common GHG. Because $CO_2$ is relatively stable and uniformly mixed in the atmosphere, the effect of GHG emissions generally does not depend upon where within the earth's atmosphere the GHG emissions occur. Anthropogenic GHG emissions make the earth warmer than it would be due to naturally occurring air emissions and other effects alone, and global warming causes several other climate changes, including increases in the frequency and intensity of storms and other severe weather events, and sea-level rise. Based on National Oceanic and Atmospheric Administration (NOAA) data and analysis (NOAA 2022), $CO_2$ ambient air concentrations have an increasing trend, with the global monthly mean $CO_2$ concentration increasing from 340 parts per million (ppm) in 1980 to 417 ppm as of December 2021.

In addition to $CO_2$, GHGs include methane, nitrous oxide, and sulfur hexafluoride ($SF_6$). Each of these compounds has an associated Global Warming Potential (GWP) that correlates the global warming effects of the compound to that of $CO_2$, which has a base value of one (for example, methane has a GWP of 25, which means each ton of methane has the equivalent greenhouse effect of 25 tons of $CO_2$). GHGs are typically multiplied by their GWP values to express the total as $CO_2e$.

Per the International Energy Agency (IEA 2020), global energy-related $CO_2$ emissions increased by 62% from 1990 to 2018. Over the same period, New Jersey's estimated GHG emissions for major sector activities[4] decreased by 20% (NJDEP 2020a).

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[4] New Jersey reported categories are Transportation; Electricity Generation; Residential; Highly Warming Gases; Commercial; Industrial; Waste Management; and Land Use & Sequestration.

As described in Section 4.6.3 of the September 1, 2022, OCS air permit application, Atlantic Shores will request suppliers for option pricing to allow the use of SF6 alternatives where such equipment would meet the safety and performance requirements of the supplied equipment.

#### 3.1.1.4 Regulatory Requirements

As a result of the air quality and emissions standards set by the EPA, the State of New Jersey, and the State of New York, the Project activities which generate emissions will be subject to various Federal and State regulations. These regulations provide the basis for how Atlantic Shores has assessed and will manage emissions sources.

##### OCS Air Permitting

Under 40 CFR Part 55, EPA regulates the air emissions associated with "OCS sources." OCS sources are defined in part as air emissions sources on vessels "permanently or temporarily attached to the seabed and erected thereon and used for the purpose of exploring, developing or producing resources therefrom" (40 CFR §55.2). The Project will require an OCS Air Permit under 40 CFR Part 55 for any regulated OCS sources associated with the Project.

Authority to issue the OCS air permit currently lies with EPA Region 2, but the State of New Jersey is in the process of obtaining delegated authority to issue and enforce OCS air permits. Per 40 CFR §52.11(b), that delegation can occur when New Jersey has demonstrated that the State has adopted the appropriate portions of the regulation into State law, and has adequate authority, resources, and administrative procedures to implement the regulation. New Jersey incorporated 40 CFR Part 55 into the NJDEP regulations (at NJAC 7:27-30) effective May 4, 2020. There are two other key differences in air permitting requirements for operations in the OCS versus onshore operations:

- Under EPA regulations, air quality requirements for OCS sources located within 25 mi of State seaward boundaries are the same as those applicable to sources located in the corresponding onshore area. Atlantic Shores expects that the State of New Jersey will be designated as the corresponding onshore area, and the Lease Area is within 25 mi (40 km) of New Jersey's seaward boundary (which in turn is 3 nm [5.6 km] from the coastline). Therefore, the OCS air permit will address compliance with NJDEP regulations at New Jersey Administrative Code (N.J.A.C.) 7:27.

- A facility's Potential to Emit (PTE) is used in onshore and offshore permitting to determine whether certain major source permitting requirements are triggered. For onshore air permits, the PTE is calculated based on the emissions from stationary sources at the facility, and generally excludes temporary sources associated with construction. For OCS facilities, 40 CFR Part 55 mandates that emissions from vessels that are servicing or associated with the operation of OCS sources must be counted as direct emissions from the OCS source, while those vessels are at the source or transiting within 25 mi (40 km) of the source. EPA has previously determined for offshore wind projects that the PTE includes temporary operations associated with construction. Under this definition of PTE, the construction and operation of

OCS sources in the Lease Area will trigger major source permitting requirements under the Prevention of Significant Deterioration (PSD) rules at 40 CFR §52.21, and the nonattainment New Source Review (NSR) rules at N.J.A.C. 7:27-18.

Through the OCS air permitting process, Atlantic Shores will document compliance with all applicable Federal and New Jersey air quality requirements. As described in Section 3.1.2.6, this will include documentation of compliance with ambient air standards, documentation of State of the Art (SOTA) emission controls and obtaining emissions offsets.

### Other Regulatory Requirements

Project activities onshore and offshore can be subject to other Federal and State air quality requirements. Those can include:

- Federal New Source Performance Standards (NSPS): Per Section 111 of the CAA, the EPA has developed technology-based standards which apply to specific categories of stationary sources. Potentially applicable NSPS include standards for Stationary Compression Ignition Internal Combustion Engines (40 CFR 60, Subpart IIII).

- Federal National Emissions Standards for Hazardous Air Pollutants (NESHAPs): EPA has developed NESHAPs for stationary sources of HAPs. Potentially applicable NESHAPs include standards for Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ).

- Federal standards for nonroad and marine diesel engines: Nonroad diesel engines and marine diesel engines installed on U.S. vessels are subject to regulations at 40 CFR Part 89, 40 CFR Part 94, and 40 CFR Part 1042.

- New Jersey stationary source preconstruction permit requirements: Individual stationary sources onshore could be subject to preconstruction permit requirements. This could include the requirement to obtain a general permit for emergency generators firing distillate fuels (GP-005A).

- General Federal Conformity Determination: The General Federal Conformity Rule (40 C.F.R. Part 93, Subpart B and 40 C.F.R. Part 51, Subpart W) ensures that Federal actions do not interfere with State plans to attain and maintain the NAAQS in areas that are or have been classified as nonattainment for those standards. Bureau of Ocean Energy Management (BOEM) is responsible for determining whether review under the General Conformity Rule is applicable to the Project. If applicable, the analysis would address direct and indirect air emissions from the Project that are not otherwise addressed by the OCS air permit and are within a maintenance or nonattainment area. If emissions are below certain de minimis thresholds, a General Federal Conformity determination is not required.

While not a regulatory requirement applicable to Project activities, the New Jersey Global Warming Response Act (GWRA) (P.L. 2007 c.112; P.L. 2018 c.197) requires the NJDEP and other State agencies to develop plans for reducing emissions of $CO_2e$ to 80% below 2006 levels by 2050. NJDEP's plans include "the rapid adoption of three key strategies: (1) replacing internal combustion vehicles with electric vehicles, (2) converting space and water heating in the residential and commercial buildings to electric heat, and (3) replacing fossil fuels in the electric generation sector with renewable energy sources" (NJDEP 2020b). The plans include offshore wind as a key component, and the Project would serve to support implementation of NJDEP's plans.

Similarly, the Climate Leadership and Community Protection Act (CLCPA) requires New York to reduce economy-wide greenhouse gas emissions 40 percent by 2030 and no less than 85 percent by 2050 from 1990 levels. The Draft Scoping Plan lists New York's nation-leading climate directives as including 9,000 MW of offshore wind by 2035, and the Project would serve to support implementation of that directive.

### 3.1.2 Potential Impacts and Proposed Environmental Protection Measures

While the WTGs will not generate air emissions, air emissions will result from Project-related activities. The potential IPFs which may affect air quality during construction, O&M, or decommissioning of the Project are presented in Table 3.1-1.

**Table 3.1-1. Impact Producing Factors for Air Quality**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel Air Emissions | ● | ● | ● |
| Onshore Air Emissions | ● | ● | ● |
| Structures and Generators Air Emissions | ● | ● | ● |
| Aircraft Air Emissions | ● | ● | ● |
| Avoided Air Emissions | | ● | |

Each IPF section addresses the potential effect of air emissions on air quality because contaminants in the airshed can affect human health, visibility, and soils and vegetation, and because on a global scale GHGs can affect climate.

Almost all of the Project-related air emissions will be from internal combustion; that is, the use of fuel for vehicle/vessel propulsion, for mechanical work, or for generating electricity (e.g., when shore power is not available or practical).

The maximum Project Design Envelope (PDE) analyzed to assess potential affects to air quality is the maximum offshore and onshore build-out of the Project. Section 4.11 of Volume I describes the PDE, which includes several options for construction and O&M. Air emissions calculations use an amalgam of the different options identified for each step of the construction process, and the different options for O&M. The calculations use layers of conservatism in estimating the intensity and duration of each activity, and in calculating air emissions. While emissions from individual activities could be lower or higher than calculated, the totals are conservatively high estimates of overall Project air emissions.

For example, prior analysis presented in the Atlantic Shores Lease Area OCS-A 0499 COP documented that gravity-based structure (GBS) installation is the highest emitting foundation technology. As such, the construction strategy currently presented is based on the use of GBS installation with heavy vessels using the New Jersey Wind Port (NJWP) and Port of Paulsboro. Additional details regarding the analysis and calculation methodology are provided in Appendix II-C.

As described in Section 1.1 of Volume 1, the Project will include a combined maximum of up to 157 WTGs. For the purposes of this affects assessment, calculated air emissions are presented as the maximum for the Project Area consisting of 157 total WTGs.

The Project will be subject to air permit requirements for activities in the OCS, and stationary and mobile source emissions will be subject to regulation (see Section 3.1.1.4). This section first describes the IPFs, then describes regulatory compliance and proposed environmental protection measures. The Project itself is an environmental protection measure because the electricity generated by the WTGs displaces electricity generated by pollution generating fossil fuel-fired power plants. The benefits associated with this emissions reduction profile are documented in Section 3.1.2.5.

### 3.1.2.1 Vessel Air Emissions

Table 3.1-2 summarizes the maximum calculated air emissions associated with PDE from both engine emissions and associated vessel activities during construction. As described in Table 4.1-1 of Volume I, offshore construction emissions will take place in stages over a 2- to 3-year period.

**Table 3.1-2. Construction Vessel Air Emissions**

| Activity Group | $NO_X$, Tons | VOC, Tons | CO, Tons | $PM_{2.5}$, Tons | $SO_2$, Tons | $CO_2E$, Tons |
|---|---|---|---|---|---|---|
| Foundation Installation | 3479.6 | 65.2 | 837.6 | 116.5 | 11.7 | 238,305.1 |
| Offshore Substation Installation | 560.1 | 18.1 | 90.4 | 17.3 | 8.6 | 29,740.6 |
| Scour Protection | 135.1 | 3.1 | 32.1 | 4.6 | 0.9 | 9,112.8 |
| Inter-Array Cable Installation | 435.9 | 9.5 | 103.9 | 14.6 | 2.5 | 29,418.0 |
| WTG Installation | 1,674.3 | 26.0 | 387.6 | 51.5 | 2.4 | 109,440.7 |
| Export Cable Installation | 491.1 | 10.1 | 118.2 | 16.3 | 2.4 | 33,062.3 |
| Fuel Bunkering | 370.4 | 6.8 | 88.9 | 12.3 | 1.2 | 25,174.3 |
| **Project Total** | **7,146.5** | **138.8** | **1,658.6** | **233.1** | **30.8** | **474,253.8** |

During the O&M phase, Atlantic Shores is considering support from two main types of vessels: crew transfer vessels (CTVs) which generally return to port nightly, or a larger service operation vessel (SOV), which remains in the Lease Area for weeks at a time (see Section 5.6 of Volume I for vessel details).

Based on preliminary evaluations, the SOV concept is estimated to generate slightly more air emissions than the CTVs; therefore, the SOV concept was used as the maximum PDE for assessing air emissions from O&M vessel activity. Table 3.1-3 summarizes the maximum calculated air emissions associated with the PDE from both engine emissions and associated vessel activities during O&M. The results presented in Table 3.1-3 represent a weighted average estimate, incorporating activities that are reasonably foreseeable, but expected to be required only once every several years (e.g., an OSS major repair or a WTG retrofit campaign).

### Table 3.1-3. O&M Vessel Air Emissions

| | $NO_X$, Tons/Year | VOC, Tons/Year | CO, Tons/Year | $PM_{2.5}$, Tons/Year | $SO_2$, Tons/Year | $CO_2E$, Tons/Year |
|---|---|---|---|---|---|---|
| O&M Vessels | 521.0 | 8.6 | 121.4 | 16.2 | 1.4 | 34,136.0 |

As described in Section 6.0 of Volume I, the decommissioning phase will likely be sequenced in the reverse order of construction, and vessels used to complete offshore decommissioning activities may resemble those used during installation. To the extent that these vessels combust fossil fuels, they will have effects associated with air emissions. Atlantic Shores is optimistic that current trends in vessel engine design will continue or accelerate; that is, vessel engines will become significantly cleaner and more efficient between now and when decommissioning will occur. Therefore, Atlantic Shores anticipates the quantities of vessel air emissions during decommissioning to be significantly lower than the quantities estimated for construction.

#### 3.1.2.2 Onshore Air Emissions

Onshore air emissions are primarily associated with construction vehicles, equipment and vehicles supporting port activities, and commuter vehicle trips. Minor sources of additional emissions could include fugitive dust, use of paint solvents, and possibly external combustion for heating.

Onshore construction methods and ports are described in Sections 4.7 through 4.10 of Volume I. For purposes of this assessment, horizontal directional drilling (HDD) installation at the cable landfall site is included in the emissions calculations for onshore construction activities. The PDE assumes active marshalling of material to support offshore construction, using one or more of the identified ports, and conservatively assumes use of GBS foundations, which will have more associated port activity[5] than other foundation types identified in the PDE.

[5] Consistent with other materials, the construction of the GBS foundations is not addressed in this Construction and Operations Plan (COP); the assessment of environmental effects starts with the marshalling of constructed materials at the port(s) for transport to the Lease Area. Construction of the foundations will be the responsibility of the foundation provider, and all fabrication activity is expected to occur at a facility zoned and permitted for that activity.

Calculated construction onshore air emissions associated with the maximum PDE are summarized in Table 3.1-4. The use of onshore generators is described in Section 3.1.2.3.

### Table 3.1-4. Construction Onshore Air Emissions

| | $NO_X$, Tons | VOC, Tons | CO, Tons | $PM_{2.5}$, Tons | $SO_2$, Tons | $CO_2E$, Tons |
|---|---|---|---|---|---|---|
| Vehicles | 117.1 | 15.0 | 87.0 | 4.7 | 0.2 | 17,280.1 |
| Stationary Engines | 1.5 | 0.2 | 1.3 | 0.1 | 0.0 | 286.1 |
| **Project Total** | **118.6** | **15.2** | **88.3** | **4.8** | **0.2** | **17,625.6** |

Atlantic Shores does not anticipate significant onshore air emissions during O&M. Air emissions include some minor port activity and commuter vehicle trips. To the extent that commuter vehicle emissions or port-related material handling emissions are associated with the Project, those emissions will not significantly contribute to existing on road vehicle emissions or emissions from port activities.

As described in Section 6.0 of Volume I, decommissioning sequencing will occur in the reverse order of construction, with similar activities. Atlantic Shores is optimistic that onshore vehicle engines will become significantly cleaner and more efficient between now and when decommissioning will occur, resulting in decreased quantities of decommissioning air emissions relative to the estimated quantities of construction air emissions.

#### 3.1.2.3 Structure and Generator Air Emissions

During construction, diesel generators will be used to supply power in circumstances where connection to the electric power grid is not possible or practical, typically for limited periods to support specific activities such as initial equipment testing. The PDE includes estimates of generator use for activities where such generators may be more appropriate than using vessel power or the electric power grid. Also, some equipment (such as hydraulic hammers, air compressors, and motion compensators) are powered by stationary diesel engines. The planned use of such engines (both onshore and offshore) will generate combustion air emissions, as shown in Table 3.1-5. Additionally, offshore construction activities could also include emissions from smaller sources such as paint solvents and fuel evaporation.

### Table 3.1-5. Construction Structure and Generator Air Emissions

| | $NO_X$, Tons | VOC, Tons | CO, Tons | $PM_{2.5}$, Tons | $SO_2$, Tons | $CO_2E$, Tons |
|---|---|---|---|---|---|---|
| Stationary Generators | 150.3 | 20.3 | 174.9 | 7.2 | 0.3 | 37,089.6 |
| Miscellaneous Sources | - | 1.1 | - | - | - | - |

During O&M, diesel generators may be used to supply power in circumstances where electric grid power supply is interrupted (e.g., blackout or scheduled maintenance). The PDE includes estimates of generator use for maintenance and reliability testing. The planned use of such generators (both onshore and offshore) will generate combustion air emissions as shown in Table 3.1-6, along with an estimate of emissions from miscellaneous sources such as paint solvents and electrical equipment.

### Table 3.1-6. O&M Structure and Generator Air Emissions

| | $NO_X$, Tons/Year | VOC, Tons/Year | CO, Tons/Year | $PM_{2.5}$, Tons/Year | $SO_2$, Tons/Year | $CO_2E$, Tons/Year |
|---|---|---|---|---|---|---|
| Stationary Generators | 0.05 | 0.02 | 0.28 | 0.00 | 0.00 | 58.7 |
| Miscellaneous Sources | - | 0.1 | - | - | - | 754.0 |

While decommissioning might use internal combustion engines as temporary power sources, Atlantic Shores is optimistic that lower-emitting or non-emitting sources of temporary power will be available by the time decommissioning occurs.

### 3.1.2.4 Aircraft Air Emissions

As described in Sections 4.10 and 5.6 of Volume I, construction and O&M may include the transport of personnel by helicopter and the use of helicopters for inspections. Such activity may cause air emissions at the appropriate local airport(s) but is expected to be within the bounds of normal airport operations. The maximum PDE analyzed in this section does not explicitly include air emissions from aircraft, because (owing to the reduction in total engine operation time) emissions from aircraft would be lower than emissions from vessels performing the same task. The maximum PDE analyzed includes crew transfer and inspections using marine vessels, as the conservative case with respect to total air emissions.

### 3.1.2.5 Avoided Air Emissions

As described in Section 2.2 of Volume I, the Project will result in a significant net decrease in harmful air pollutant emissions region-wide by displacing electricity from fossil fuel power plants. Available data on avoided emissions is summarized in Table 3.1-7, based on a reasonable Project capacity with 50% capacity factor and 4% transmission losses displacing the latest-available output emission rate for the Reliability First Corporation (RFC) East subregion as published by the EPA (EPA 2020a).

### Table 3.1-7. Avoided Air Emissions[1]

| | $NO_X$, Tons/Year | $PM_{2.5}$, Tons/Year | $SO_2$, Tons/Year | $CO_2E$, Tons/Year |
|---|---|---|---|---|
| Project Avoided Emissions | 3,505 | 238 | 3,312 | 6,130,000 |

[1]Based on the non-baseload output emission rate for $NO_x$, $SO_2$, and $CO_2e$; based on the total output emission rate for $PM_{2.5}$.

The emissions savings shown in Table 3.1-7 provide only a partial description of the air quality-related benefits of the Project, for the following reasons:

- Traditional power plants do not include emissions associated with plant construction, fuel delivery, maintenance, worker commute, safety systems, vehicles, or machinery when reporting direct emissions. A direct comparison of the avoided air emissions to the projected air emissions in Tables 3.1-3 through 3.1-7 would require the addition of emissions from those activities.
- The Project will also avoid emissions of HAPs including mercury, acrolein, formaldehyde, and cadmium associated with fossil fuel generation.
- The emissions reductions will occur at fossil fuel power plants that tend to be near population centers, or upwind of population centers, including overburdened Environmental Justice communities. Project-related air emissions will predominately occur offshore away from population centers.

The Project will support clean energy policies including the NJ GWRA and the NY CLCPA. Per the EPA:

> *Clean energy policies that reduce or avoid air pollution can enhance air quality and improve peoples' health and quality of life. For example, exposure to air pollution from fossil fuel-based energy can exacerbate respiratory diseases, like bronchitis and asthma, and cause heart attacks and premature death. Beyond the physical health effects, pollution-related illnesses impose other 'costs' on people, such as lost wages or productivity when someone has to miss work or school, the costs of medical treatment and outdoor activity restrictions when air quality is poor (EPA 2020b).*

The Project's avoided emissions will benefit human health and the environment over the entire operational life of the Project.

#### 3.1.2.6 Impacts from Air Emissions

As evidenced by the result of the vessel air emissions assessment summarized in Tables 3.1-2 and 3.1-3 and detailed in Appendix II-C, emissions from Project vessel activities will be highest during the 2- to 3-year construction period. These temporary vessel emissions will be localized to the Offshore Project Area. Emissions associated with vessels activities during the O&M phase will also be predominantly localized to the Lease Area. The distance of the Lease Area from shore, combined with winds away from shore, will serve to limit the effect of vessel emissions on humans or sensitive environmental receptors.

Effects from pollutant emissions associated with onshore activities will likely be localized. Onshore interconnection cable installation and onshore substation erection would have effects in-line with similar-sized projects conducted regularly to support the existing electric grid. Port activities supporting the Project will have similar emissions effects to other port activities. All ports considered for this Project are existing ports and as such, construction of the related ports is not considered in this analysis. The addition of air pollutants associated with the temporary Project construction activities will be a small fraction of existing nonroad emissions in New Jersey.

O&M onshore emissions will have similar effects to other port activities and worker commutes; these emissions are not expected to affect local or regional air quality. Similarly, aircraft emissions will have similar effects to existing aircraft and airport operations, and emissions are not expected to affect local or regional air quality.

#### 3.1.2.6.1 Social Cost of Greenhouse Gas Calculation

The Project will produce clean, renewable offshore wind energy that is expected to displace electricity generated by fossil fuel power plants. To quantify the carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and total GHG (reported as carbon dioxide equivalents or $CO_2e$) emissions associated with conventional power generation that would be avoided as a result of the Project, the following equation was used:

$$AE_i = EF_i * PG * 8{,}760 \text{ hr/year} * CF * (1- TLF) * 0.0005 \text{ ton/lb}$$

Where:

$AE_i$ = annual avoided emissions for pollutant i (tons)

$EF_i$ = eGRID avoided emission factor for pollutant i (lb/megawatt [MW]-hr)

$PG$ = total rated peak power generation (MW)

$CF$ = capacity factor

$TLF$ = transmission loss factor

The avoided emissions analysis uses the RFC East (RFCE) annual non-baseload output emission rates from EPA's (2023) Emissions & Generation Resource Integrated Database (eGRID2021)[6] shown in Table 3.1-1.

### Table 3.1-8. eGRID Avoided Emission Factors (lb/MW-hr)

| Pollutant | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
|---|---|---|---|---|
| eGRID avoided emission factor (lb/MW-hr) | 1,357 | 0.106 | 0.015 | 1,364 |

The analysis is based on the minimum nameplate capacity for the entire Lease Area and assumes an annual capacity factor[7] of 50%. An average transmission loss factor of 4% was estimated based on the size of the Project, the distance to shore, and the data provided in Lazaridis's (2005) Economic

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[6] The displacement analysis is based on RFC East subregion annual non-baseload output emission rates from EPA's Emissions & Generation Resource Integrated Database (eGRID2021) released 1/30/2023 https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

[7] Capacity factor refers to the ratio of an offshore wind project's annual power production to the nameplate production potential.

Comparison of HVAC and HVDC Solutions for Large Offshore Wind Farms under Special Consideration of Reliability. This is more conservative than the BOEM Wind Tool's default factor of 3%.

Table 3.1-9 quantifies the air emissions associated with fossil fuel power plants that could be avoided by using electricity generated from the Project, assuming a minimum nameplate capacity. Additional avoided emission calculation details can be found in Appendix II-C.

### Table 3.1-9. Avoided Air Emissions

| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
|---|---|---|---|---|
| Emissions Avoided Annually (US tons/year) | 6,720,194 | 525 | 74 | 6,755,183 |

The "social cost of greenhouse gases" (SC-GHG) is the monetary value of the net harm to society associated with adding an incremental amount of GHGs to the atmosphere in a given year (IWG 2021). The SC-GHG can be used to indicate the societal value (i.e., savings or avoided social costs) of reducing GHG emissions. In principle, the SC-GHG includes the value of all climate change impacts, including changes in net agricultural productivity, human health effects, property damage from increased flood risk natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services (IWG 2021). However, according to EPA (2022), "In practice, because of data and modeling limitations, which prevent full representation of harmful climate impacts, estimates of the SC-GHG are a partial accounting of climate change impacts and, as such, lead to underestimates of the marginal benefits of abatement." The estimate of social costs differs by the type of GHG (e.g., $CO_2$, $CH_4$, and $N_2O$), the year in which the emissions change occurs, and the discount rate applied (i.e., how future damages are converted into present-day values).

Table 3.1-10 presents estimates of the avoided social costs resulting from the Project (assuming a minimum nameplate capacity) based on interim estimates of SC-GHG released by the US Government's Interagency Working Group (IWG) on Social Cost of Greenhouse Gases in 2021 (IWG 2021). The annual estimates of avoided social costs are presented for the years 2030, 2040, and 2050[8] for discount rates ranging from 2.5 % to 5%. IWG (2021) indicates its interim estimates of SC-GHG should be used by agencies until a comprehensive review and update is developed in line with the requirements of Presidential Executive Order 13990 (Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis).While the IWG has not released its updated SC-GHG estimates, in late 2022, EPA released new estimates of SC-GHG that reflect recent advances in scientific literature on climate change and its economic impacts (EPA 2022).

Table 3.1-11 presents estimates of the avoided social costs resulting from the Project (assuming a minimum nameplate capacity) based on EPA's SC-GHG estimates for the years 2030, 2040, and 2050 with a discount rate ranging from 1.5% to 2.5%.

8 A sampling of years during which the Project could be operational.

There is considerable variability in the avoided social costs resulting from Atlantic Shores' Project depending on the source of the SC-GHG estimates, the year of the emission reduction, and the assumed discount rate.

Based on IWG's estimates, the total avoided social costs (for $CO_2$, $CH_4$, and $N_2O$ combined) from the Project, assuming a minimum nameplate capacity, range from $116 million to $712 million annually between 2030 and 2050. Based on EPA's estimates, the total avoided social costs (assuming the minimum nameplate capacity of the Project) ranges from $857 million to $2.9 billion annually between 2030 and 2050.

### Table 3.1-10. Avoided Social Costs Resulting from Atlantic Shores (IWG 2021)

| Year[3] | Annual Avoided Social Costs (2020 dollars) Based on IWG 2021 Estimates[1,2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $CO_2$ | | $CH_4$ | | $N_2O$ | | Total | |
| | 5% Rate | 2.5% Rate | 5% Rate | 2.5% Rate | 5% Rate | 2.5% Rate | 5% Rate | 2.5% Rate |
| 2030 | $115,833,000 | $542,585,000 | $448,000 | $ 1,190,000 | $526,000 | $2,223,000 | $116,807,000 | $545,998,000 |
| 2040 | $152,411,000 | $627,935,000 | $619,000 | $1,476,000 | $674,000 | $2,628,000 | $153,704,000 | $632,039,000 |
| 2050 | $195,087,000 | $707,189,000 | $ 809,000 | $1,809,000 | $ 876,000 | $3,032,000 | $196,772,000 | $712,030,000 |

Notes:
1. The avoided social costs are calculated from the avoided emission estimates presented in Table 2. The avoided emission estimates are based on 2021 air emissions data for the RFCE electric grid, not future projections of emissions from the electric grid.
2. Avoided social costs using the 95th percentile of estimates based on a 3% discount rate are even greater.
3. A sampling of years during which Atlantic Shores could be operational.

### Table 3.1-11. Avoided Social Costs Resulting from Atlantic Shores (EPA 2022)

| Year[2] | Annual Avoided Social Costs (2020 dollars) Based on EPA 2022 Estimates[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $CO_2$ | | $CH_4$ | | $N_2O$ | | Total | |
| | 2.5% Rate | 1.5% Rate | 2.5% Rate | 1.5% Rate | 2.5% Rate | 1.5% Rate | 2.5% Rate | 1.5% Rate |
| 2030 | $853,504,000 | $2,316,654,000 | $905,000 | $1,524,000 | $3,032,000 | $6,737,000 | $857,441,000 | $2,324,915,000 |
| 2040 | $1,036,398,000 | $2,621,477,000 | $1,285,000 | $2,000,000 | $3,706,000 | $8,085,000 | $1,041,389,000 | $2,631,562,000 |
| 2050 | $1,219,292,000 | $2,926,300,000 | $1,666,000 | $2,523,000 | $4,447,000 | $9,432,000 | $1,225,405,000 | $2,938,255,000 |

Notes:
1. The avoided social costs are calculated from the avoided emission estimates presented in Table 2. The avoided emission estimates are based on 2021 air emissions data for the New England electric grid, not future projections of emissions from the electric grid.
2. A sampling of years during which Atlantic Shores could be operational.

### 3.1.2.7 Summary of Proposed Environmental Protection Measures

While the Project will result in a significant net decrease in harmful air pollutant emissions region-wide (as described in Section 3.1.2.5), Atlantic Shores is committed to avoiding, minimizing, and mitigating the effects of air emissions that could occur. This commitment includes the following environmental protection measures:

- Engines manufactured and installed to meet or exceed emission control requirements will be used. Engine manufacturers incorporate pollution control measures into their designs. Techniques used by engine manufacturers include: ensuring complete combustion in the engines by control of the combustion air, controlling fuel flow, ensuring complete mixing, and staging combustion; avoiding hot spots in the combustion process that can form $NO_x$ by staging combustion, injecting water, recirculating flue gas, and otherwise cooling the system; and using post-combustion controls to remove air pollutants after they have formed by adding particulate filters, oxidation catalysts, and selective catalytic reduction systems.

- Vessel engines will use a combination of combustion and post-combustion controls to meet or exceed applicable marine engine standards, including: The International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI (for foreign vessels); 40 C.F.R. Part 89 (for Tier 1 and 2 domestic marine diesel engines smaller than 37 kW); Control of Emissions from Marine Compression-Ignition Engines; 40 C.F.R. Part 94 (for Tier 1 and 2 domestic marine diesel engines larger than 37 kW); and Control of Emissions from New and In-Use Marine Compression-Ignition Engines and Vessels, 40 C.F.R. Part 1042 (for Tier 3 and 4 domestic marine diesel engines). On-road engines, nonroad engines, and aircraft engines will meet or exceed similar standards.

- The best engines available for the task will be used. Atlantic Shores will endeavor to minimize air emissions by using the cleanest vessel engines available for the task (i.e., meeting the safety, efficacy, scheduling, and contracting needs for the task). Construction vessels will be supplied by contractors for temporary use on each Project. For routine O&M, Atlantic Shores will have additional ability to specify the vessel(s) used, through long-term contracting or outright purchase. Atlantic Shores is actively evaluating opportunities to use liquefied natural gas (LNG) or hydrogen as the primary fuel for the main CTVs or SOV to be used for routine O&M. Regardless of whether these technologies are practicable, the primary CTV or SOV to be used for O&M will likely be newly built and will meet top-Tier EPA marine engine standards for new construction. Nonroad engine emissions will be minimized using engines compliant with 40 CFR Part 1039, *Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines*, i.e., "Tier 4" engines, where practicable.

- Clean fuels will be used to the maximum extent practicable. Marine diesel fuel will comply with the fuel sulfur limit of 15 ppm per 40 CFR Part 80, which is the same limit as onshore Ultra Low Sulfur Diesel (ULSD). For heavier residual fuel oils used in Category 2 and Category 3 engines, and for engines on foreign vessels, the Project will comply with the fuel oil sulfur content limit of 1,000 ppm set in MARPOL VI and corresponding EPA regulations. Nonroad engines will use

ULSD. The use of clean fuels will minimize emissions from fuel impurities and allow for cleaner combustion.

- During all Project phases, Atlantic Shores is committed to implementing BMPs and investigating the use of innovative tools and/or technologies to minimize air emissions from vessel operations. Specifically, Atlantic Shores will optimize construction and O&M activities to minimize vessel operating times and loads. This will include weather monitoring, forecasting, and Project tracking to minimize emissions resulting from non-productive time, and incentives for contractor fuel savings. Onshore construction mitigation will also include the development of dust-control plans for onshore construction areas to minimize effects from fugitive dust resulting from construction activities.

- Air permit requirements will be met or exceeded, and Atlantic Shores will comply with all applicable air quality regulatory requirements. A key element will be obtaining the OCS air permit. Atlantic Shores will comply with other air-related regulatory requirements by using engines manufactured and maintained in compliance with the appropriate standards, which include NSPS, NESHAPs, and Federal standards for nonroad and marine diesel engines as described in Section 3.1.1.4. If onshore stationary equipment triggers any requirement to obtain a New Jersey air permit (including obtaining coverage under a general permit), Atlantic Shores will obtain the required permit.

Any required OCS air permit will address the following key requirements:

- Documentation of compliance with ambient air standards. Atlantic Shores will use one or more EPA-approved air dispersion models to show that air emissions in the Lease Area will not cause or significantly contribute to a condition of air quality impacts. Applicable standards for assessing air quality impacts include the NAAQS described above, as well as PSD increments (allowed increases over a baseline set to prevent deterioration of air quality), and the NJDEP risk assessment process for air toxics (NJDEP Technical Manual 1003 as required per N.J.A.C. 7:27-22.3(cc)).

- Documentation of no adverse impact to air quality related values (AQRVs) at Class I Areas. Per National Park Service guidance: "Under the CAA, the Federal Land Manager (FLM) and the Federal official with direct responsibility for management of Federal Class I parks and wilderness areas have an affirmative responsibility to protect the AQRVs (including visibility) of such lands, and to consider whether a proposed major emitting facility will have an adverse impact on such values" (NPS 2010). The FLM for the Brigantine Wildlife Refuge is the United States Fish and Wildlife Service (USFWS). Atlantic Shores expects to work with the USFWS through the OCS air permit review process to identify mitigation strategies that will alleviate potential adverse impact concerns.

- Control technology review. Atlantic Shores will document that emissions from the OCS sources meet the following related requirements: SOTA, per N.J.A.C. 7:27-22.35; Best Available Control Technology (BACT), per 40 CFR 52.21(j); and Lowest Achievable Emission Rate (LAER), per

N.J.A.C. 7:27-18.3(b)1. Atlantic Shores will document compliance with these standards by evaluating alternative processes, designs, and technologies, evaluating, and ranking pollution control technologies, and proposing the lowest feasible emission rates for each OCS source. The SOTA requirements will apply to all air pollutants, the BACT requirements will apply to pollutants subject to PSD, and the LAER requirements will apply to pollutants subject to nonattainment NSR.

- Emission offsets. Per N.J.A.C. 7:27-18.3(c), Atlantic Shores will secure emissions offsets for OCS source air pollutants subject to nonattainment NSR. These will be Certified Emission Reductions (CERs) banked through the NJDEP emissions offset program (generally through shutdown or emissions reduction at existing sources of air pollution), or offsets obtained through an alternative method in coordination with the OCS air permit reviewing agency.

## 3.2 Water Quality

This section describes water quality conditions in the Onshore and Offshore Project Areas; associated impact-producing factors (IPF); and measures to avoid, minimize, or mitigate potential effects during construction, operations and maintenance (O&M) and decommissioning of the Project.

The Project has been sited and designed to avoid or minimize adverse impacts to water quality within and proximate to the Project Area such as sediment suspension and transport and accidental release of hazardous materials (i.e., from Project vessels, vehicles, or equipment) to the ocean or inland waters. Appropriate and targeted best management practices (BMPs) and operational controls will be implemented to minimize and mitigate potential impacts. The water quality discussion includes marine waters (offshore) and water supplies (onshore). Surface waters, including wetlands, streams, and other waterbodies, are discussed in Section 4.1 Wetlands and Waterbodies, which provides additional information on the potential Project-related effects on these inland resources.

### 3.2.1 Affected Environment

The affected environment with respect to potential Project-related water quality impacts includes the marine waters of the Offshore Project Area encompassing the outer continental shelf (OCS) waters of the Lease Area to the nearshore and intertidal waters along the ECCs to the landfall locations. The affected environment also includes any documented water supplies within the Onshore Project Area. The characterization of water quality in the affected environment is based on available scientific literature, published State and Federal agency research, online data portals, and online mapping databases.

#### 3.2.1.1 Marine Water Quality

Water quality within the Offshore Project Area is influenced by the bays and rivers that drain into the ocean, the composition of atmospheric deposition, and the influx of constituents from sediments (BOEM 2012). Oceanic circulation, influenced by tides, currents, bathymetry and upwelling, drives the dispersal, dilution and biological uptake of inorganic and organic matter deposited in the ocean. Water quality offshore in the waters of the Lease Area and along the ECCs is supportive of marine life based on regional monitoring data syntheses for offshore waters (EPA 2015). Nearshore waters, within New Jersey's jurisdictional limits and closer to recreation areas, population centers and industrial uses, are monitored closely by Federal and State authorities (i.e., New Jersey State Health Assessment Data, NJDEP Division of Water Quality, and USEPA). Coastal waters within New York State's jurisdiction in the area of the Northern ECC are monitored by the New York-New Jersey Harbor Estuary Program (NY-NJ HEP 2022), New York City Department of Environmental Protection (NYCDEP) and the New York State Department of Environmental Conservation (NYSDEC). Therefore, the water quality along the ECCs, closer to shore, is monitored more frequently than within the Lease Area.

**Existing Pollution Sources in the Offshore and Onshore Project Areas**

Most contaminants in the coastal and marine environment are derived from point and nonpoint sources from land-based and offshore anthropogenic activities. There are several permitted surface water discharges located along the New Jersey and New York coast along the Monmouth ECC and Northern ECC, including domestic (sewage), industrial or commercial facilities, and petroleum product cleanup site outfalls (NJDEP 2019d; NYSDEC 2022a) (see Figure 3.2-1). None of these permitted discharges are located directly within the Lease Area or Monmouth and Northern ECCs, and proposed Project activities are not expected to interact with these permitted discharges. Water quality concerns related to these sources are regulated by permit effluent standards, and any related water pollution impacts are mitigated by the mixing and dilution occurring in the receiving bays, rivers, and ocean. Stormwater is a nonpoint source that transports sediment and/or pollutants from the land to an aquatic system (e.g., wetlands or waterbodies). Most stormwater is not treated; as rainwater or snowmelt travels over surfaces mobilizing destabilized soils and pollutants from human and animal activity (NJDEP 2020f; Mallin et al. 2008; NYSDEC 2022a). Common pollutants found in stormwater runoff include fertilizers, insecticides, herbicides, oil, gas, sediment, and nutrients and bacteria from animals which drive water quality degradation due to high levels of fecal coliform, turbidity, orthophosphates, biological oxygen demand, total phosphorus, total suspended solids (TSS), surfactant compounds, and organic carbon (NJDEP 2020f; NYSDEC 2022b). Acute and chronic nonpoint source pollution near ocean beaches, coastal bays, and other tidal systems can lead to harmful algal blooms, threats to human health, threats to wildlife, and destruction of habitat in these sensitive areas (NJDEP 2020f; Mallin et al. 2008; NYSDEC 2022b). In contrast, in offshore waters (i.e., Lease Area, ECCs), where depth and circulation drive the transport and dilution of water pollution, impacts from stormwater runoff are limited.

**Relevant Water Quality Assessments**

A number of water quality assessments are ongoing in the region and report water quality data at different intervals for locations within the Project Area. The EPA's National Coastal Condition Assessment (NCCA) report (EPA 2015) provides regional estimates of coastal water quality conditions for the east coast of the United States. At the regional and state level, New Jersey Department of Environmental Protection (NJDEP), NY-NJ Harbor Estuary Program, NYCDEP, and NYSDEC also collect and report water quality data in the New York-New Jersey coastal waters.

Information is provided in reports and via GIS. These sources were used to describe the water quality conditions in the Project Area.

Water quality was evaluated using measurements of dissolved oxygen (DO), dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), light transmissivity, and turbidity to determine the overall water quality index at sampling sites. Water quality parameters based on the NCCA is presented in Table 3.2-1. The EPA published results from 24 sampling sites located along New Jersey and New York's coast extending from Lower New York Bay to Delaware Bay. No NCCA stations directly correspond to the Lease Area and ECCs, but they provide indicative coastal water quality conditions in the nearby waters (Figure 3.2-2).

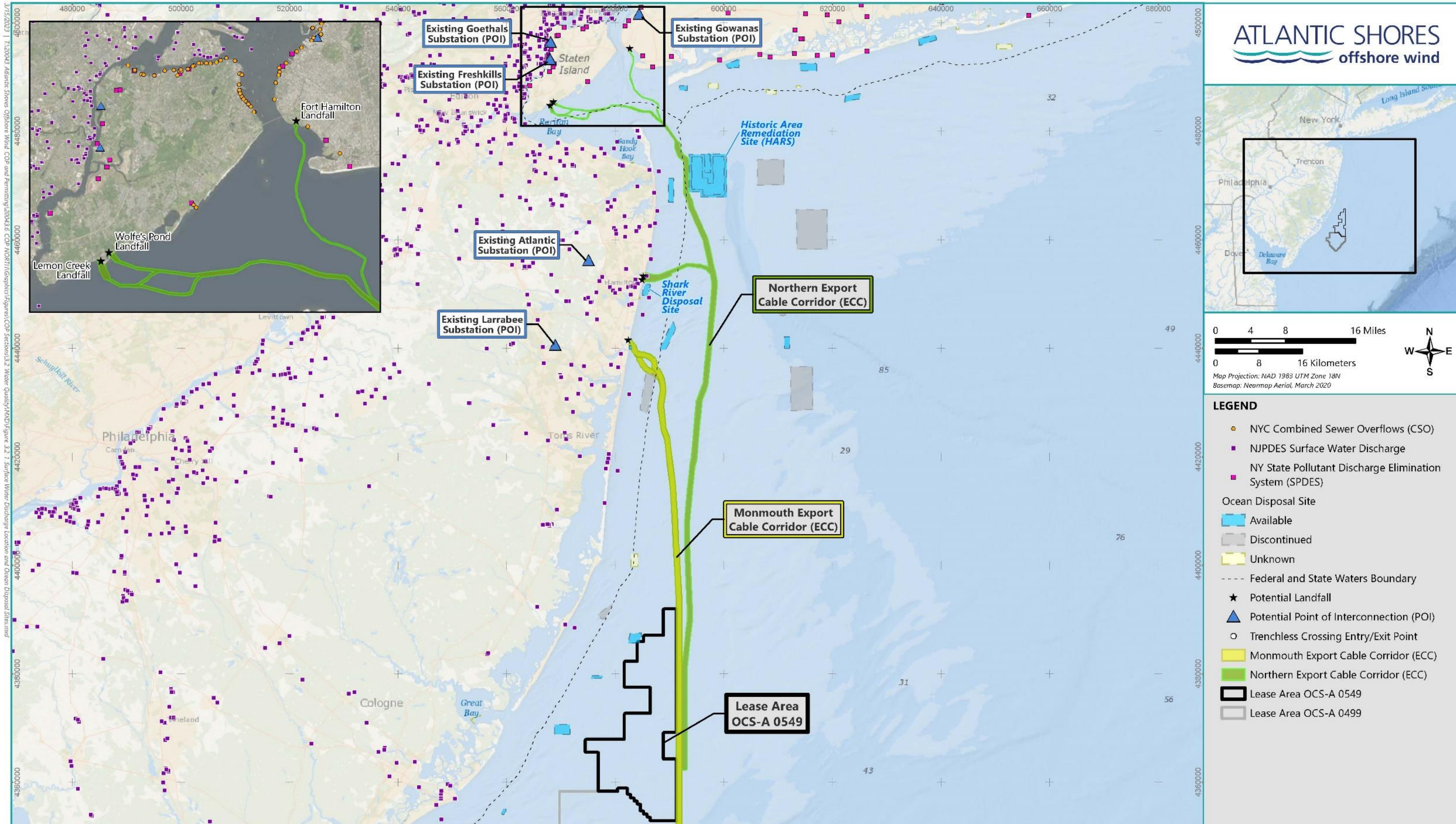


**Figure 3.2-1**

*Surface Water Discharge Locations and Ocean Disposal Sites*

## Table 3.2-1. Summary of Water Quality Parameter Results Indicative of the Atlantic Shores Offshore Project Area, U.S. Environmental Protection Agency's National Coastal Condition Assessment

| Parameter | Definition | Value | EPA NCCA Water Quality Indicator (see Figure 3.2-2) |
|---|---|---|---|
| Dissolved Oxygen (DO)† | DO refers to the amount of oxygen in the water generated from atmospheric oxygen exchange and photosynthetic processes from plants and phytoplankton. | 2.6–9.1 milligrams per liter (mg/L) | 16 sites – 'good' condition and eight sites – 'fair' condition |
| Chlorophyll-a† | Chlorophyll *a* concentration tends to be most present where there are high levels of nutrients, which can stimulate an overproduction of algae, creating algal blooms which deplete oxygen levels used by aquatic organisms and block sunlight for underwater plants. | 5.44–120.37 micrograms per liter (µg/L) | 16 sites – 'fair'" condition and 8 sites – 'poor' |
| Dissolved inorganic nitrogen (DIN)† | DIN is a common form of nitrogen found in coastal environments and is attributed to the formation of algal blooms. | 0.02–9.7 µg/L | 13 sites – 'good' condition, 10 sites – 'fair' and 1 site – 'poor' |
| Dissolved inorganic phosphorus (DIP)† | DIP is another nutrient that is used by photosynthetic organisms like phytoplankton. | 0.007–0.284 µg/L | 2 sites – 'good' condition, 13 sites – 'fair' condition, and 9 sites – 'poor' condition |
| Total suspended solids (TSS)†† | TSS is a measurement of the concentration of sediment particles in the water column obtained by measuring the total dry weight of particles in a water sample. | 17.2–35.7 mg/L | N/A |
| Turbidity†† (water clarity or Secchi disk reading) | Turbidity is an optical characteristic of water and is a measurement of the amount of light scattered by suspended particulate matter. | 3.2 feet (ft) (1 meter [m])-9.8 ft (3 m) | 'Medium' turbidity |

Notes: † - EPA, 2015; †† - NJDEP 2020e.

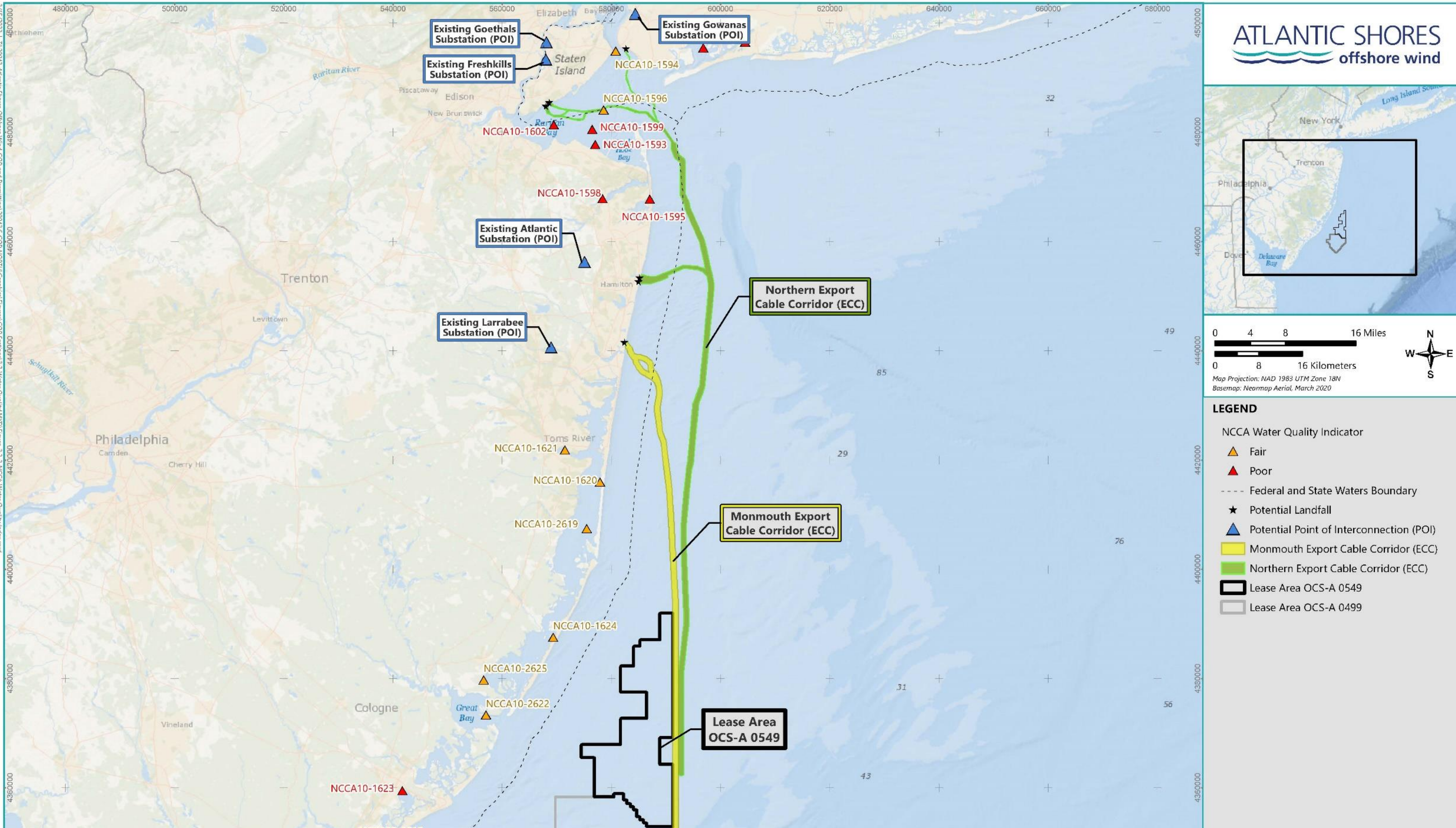


**Figure 3.2-2**

*National Coastal Condition Assessment (NCCA) Water Quality Index*

Two adverse water quality conditions resulting from water pollution that may directly affect the capacity of waterbodies to support human and wildlife uses are algal blooms and exceedances in bacteria levels. Excess nutrients (i.e., phosphorus and nitrogen) are primary contributors to algal blooms. In 2020, the NJDEP established the Harmful Algal Bloom Interactive Mapping and Reporting System for monitoring and reporting algal blooms. No historical algal blooms have been recorded between 2017 and 2020 within estuarine or coastal environments along the New Jersey coastline, inclusive of the Offshore Project Area (NJDEP 2019b; NJDEP 2019c; NJDEP 2020b; NJDEP 2020c). NYSDEC has reported algal blooms in Richmond County within inland waterbodies, including ponds, as recently as May 2023 (NYSDEC HABS GIS 2023). No algal bloom information was documented in New York state coastal waters (NYSDEC HABS GIS 2023).

In addition to algal blooms, bacteria levels in a coastal environment threaten public health, shellfish, and fish. A common indicator bacteria found in coastal environments is fecal coliform bacteria, which is linked to shellfish closures along the east coast of the United States (NJDEP 2020d; MDMR 2016; VDH 2020). In the regional context of the Project, fecal coliform levels are monitored by the NJDEP, NYCDEP, and NYSDEC within the National Shellfish Sanitation Program (NSSP) and New York City Harbor annual water quality monitoring program (NYHWQ 2018). Figure 3.2-3 illustrates the NJDEP Shellfish Classification based on the State's water quality monitoring program and fecal coliform levels in the context of the Project. According to the NJDEP, most of the New Jersey coastline in the vicinity of the ECCs is open for shell fishing. Prohibited areas for shellfish harvesting are located close to shore along the northern shore of New Jersey from Sandy Hook Bay to Point Pleasant Beach, south of Seaside Park, Surf City, Atlantic City, Ocean City, Avalon, Wildwood Crest, and around the U.S. Coast Guard Training Center (NJDEP 2018). The Monmouth and Northern ECCs traverse prohibited areas for shellfish harvesting close to shore. In the Lower New York Bay, reported fecal coliform levels have declined since the 1980s and have been lower than the safe swimming standard (less than 35 cells/100 mL) since 1992 (NYHWQ 2018). Figure 3.2-3 illustrates the NYSDEC and NYCDEP Shellfish Classification based on the State's water quality monitoring programs. Class SA waters are defined as shell fishing areas for market purposes with a primary and secondary use of contact recreation and fishing (NYSDEC 2019). Class SB waters are designated as primary and secondary contact recreation and fishing. There are several areas in New York that are seasonally prohibited or uncertified for shellfish harvesting and are located close within Westchester, Rockland, Bronx, Kings, New York, Richmond, and Queens Counties. Areas within the Rockaway Inlet, Jamaica Bay, and Reynolds Channel all prohibit shellfish harvesting (NYSDEC 2022).

In 2016, the NJDEP published an Integrated Water Quality Assessment Report (IWQAR) on the health of New Jersey waters in accordance with the Federal Clean Water Act, New Jersey Water Quality Planning Act, and New Jersey Pollution Control Act (NJDEP 2019a). A total of 958 assessment units were established throughout New Jersey to assess water quality conditions of fresh, brackish, and marine water habitats (NJDEP 2019a). Water quality was characterized by acceptable water uses given various chemical, physical, and biological parameters of waterways (e.g., public water supply, recreation). For the purposes of this section, the applicable IWQAR results for the ECC nearshore and landfall locations (i.e., approximately 3 miles (mi) or 4.8 kilometers [km]) offshore) were evaluated to determine current water quality conditions near the Project.

In 2018, NYCDEP produced a New York Harbor Water Quality Report on the health of the estuarine and coastal waters of New York for its Harbor Survey Program (NYHWQ 2018). This water quality program's study area consists of several waterbodies grouped into distinct survey areas, including a Lower New York Bay – Raritan Bay (LNYB-RB) survey area, which covers the area of the Northern ECC approach to the New York landfall locations. The LNYB-RB included eight 2018 sampling locations with four, nearshore open water locations reporting on water quality parameters including bacteria (fecal coliform), dissolved oxygen (DO), chlorophyll A, secchi transparency and nitrogen (N). The open water sampling locations (Figure 3.2-2) typically show that waters of the LNYB-RB meet or surpass the New York State bacteria standard (NYHWQ 2018).

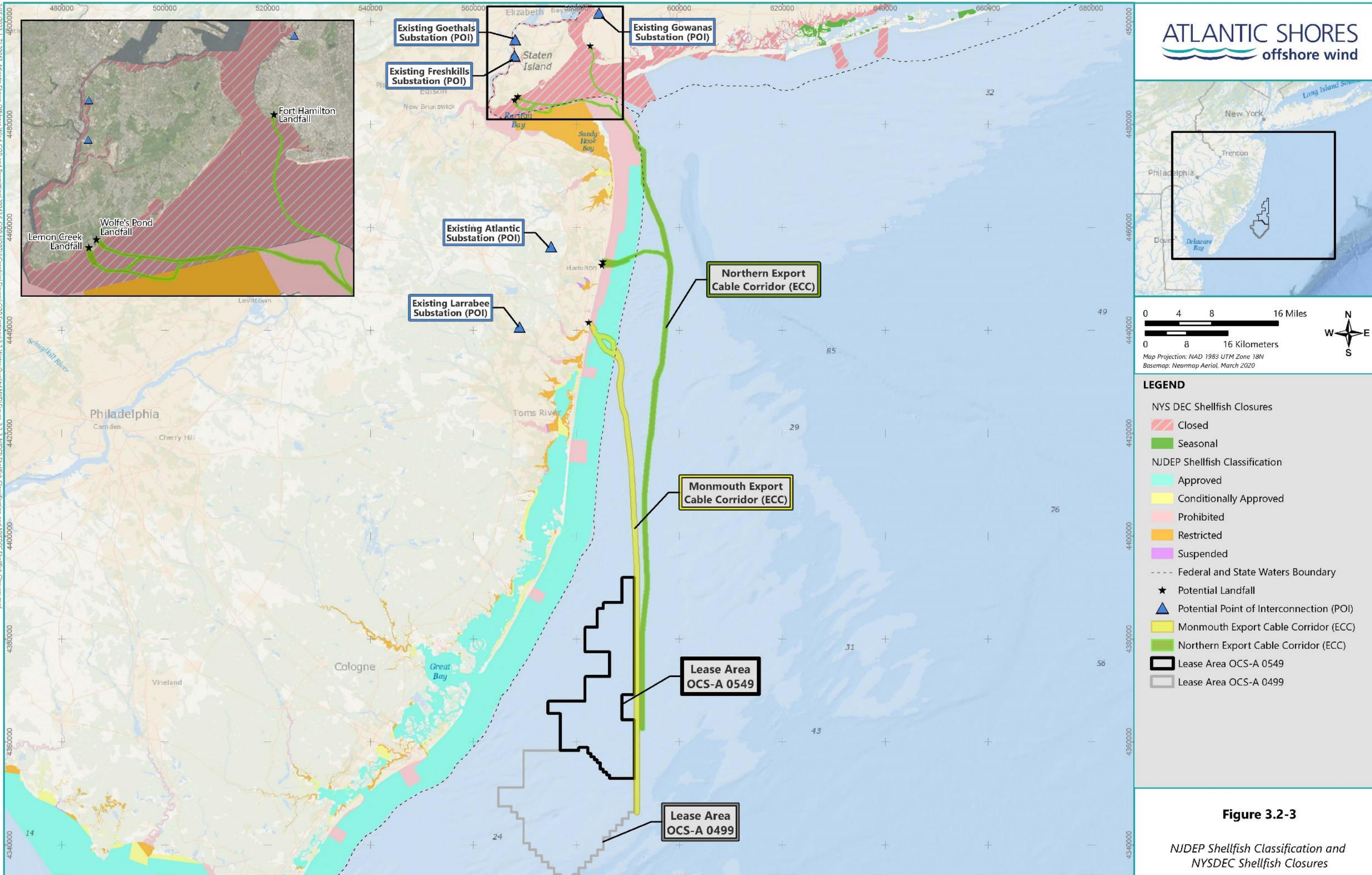


**Figure 3.2-3**

*NJDEP Shellfish Classification and NYSDEC Shellfish Closures*

### 3.2.1.2 Water Supplies – Groundwater and Surface Water Reservoirs

As described in Section 2.1 Geology, groundwater reservoirs underlie portions of the Onshore Project Area and some of these groundwater resources are designated and monitored because they supply water to communities. There are several types of public and private water supplies within the Onshore Project Area, although none are at risk of Project-related effects.

New Jersey has different types of public water supplies, including community public systems (i.e., municipalities and communities with at least 15 year-round service connections) and noncommunity transient or non-transient public systems (e.g., schools, factories, motels). Noncommunity systems typically obtain water from groundwater resources (NJDEP Division of Water Supply and Geoscience 2020). A third type of water supply is a private system, such as an individual well serving a household.

As of 2017, slightly more than half the households within Monmouth County obtained their drinking water from private groundwater wells (New Jersey Department of Health 2020). Private groundwater wells may be located at individual residences and businesses along the onshore interconnection cable route options and are largely unregulated. The municipalities in Monmouth County along the onshore interconnection cable routes include Howell Township, Wall Township, Manasquan Borough, and Sea Girt Borough. Each town and borough obtain its domestic water from groundwater or surface water reservoirs. Wellhead protection areas, indicating public community and noncommunity groundwater wells in these communities near the Onshore Project Area are shown on Figure 3.2-4. The color-coded tiers around the well locations delineate source areas from which groundwater flows over a certain number of years to reach the well itself (NJDEP Division of Water Supply and Geoscience 2020). One noncommunity wellhead protection area is mapped as intersecting a portion of Lakewood Farmingdale Road in Howell Township, which will contain the onshore interconnection cable route (Figure 3.2-4, Sheet 2).

A public community water system managed by the private New Jersey American Water company supplies Howell Township with potable water. The water is sourced by 14 groundwater wells drawing from various regional groundwater aquifers in north-central New Jersey and one surface water supply (New Jersey American Water 2019). These wells and surface water supply are over 1 mi (1.6 km) from the Onshore Project Area and are not shown on Figure 3.2-4. The Manasquan Reservoir in Howell Township supplies drinking water to approximately 60% of the Monmouth County communities of Sea Girt Borough and Wall Township as well as other area communities. The surface water supply is run by the New Jersey Water Supply Authority (NJ WSA 2017). The Manasquan Reservoir is located more than 1,000 ft (305 m) northwest of the Onshore Project Area at its closest point and will not be affected by the Project.

In New York, landfalls are anticipated to come ashore in the areas of Lemon Creek and Wolfe’s Pond, Staten Island, Richmond County, New York. Drinking water for Richmond and Kings Counties (New York) is supplied by the New York City Public Water supply maintained and operated by the New York City Department of Environmental Protection. Freshwater resources are sourced from two watersheds to the north of New York City – the Catskill/Delaware and the Croton watersheds. These watersheds include a variety of lakes, reservoirs and other groundwater sources to supply water downstate.

Watersheds are 50 to 100 mi (80 to 160 km) from the New York metropolitan area and water is delivered via aqueduct to Richmond and Kings Counties, New York. The onshore interconnection routes do not cross or intersect these resources. There are no primary aquifers or freshwater wells in proximity to the New York landfall locations. The NYSDEC regulates public wells, however there are no wells present in either Richmond or Kings counties. Proposed project activities will not impact public water supplies within Richmond or Kings Counties (New York).

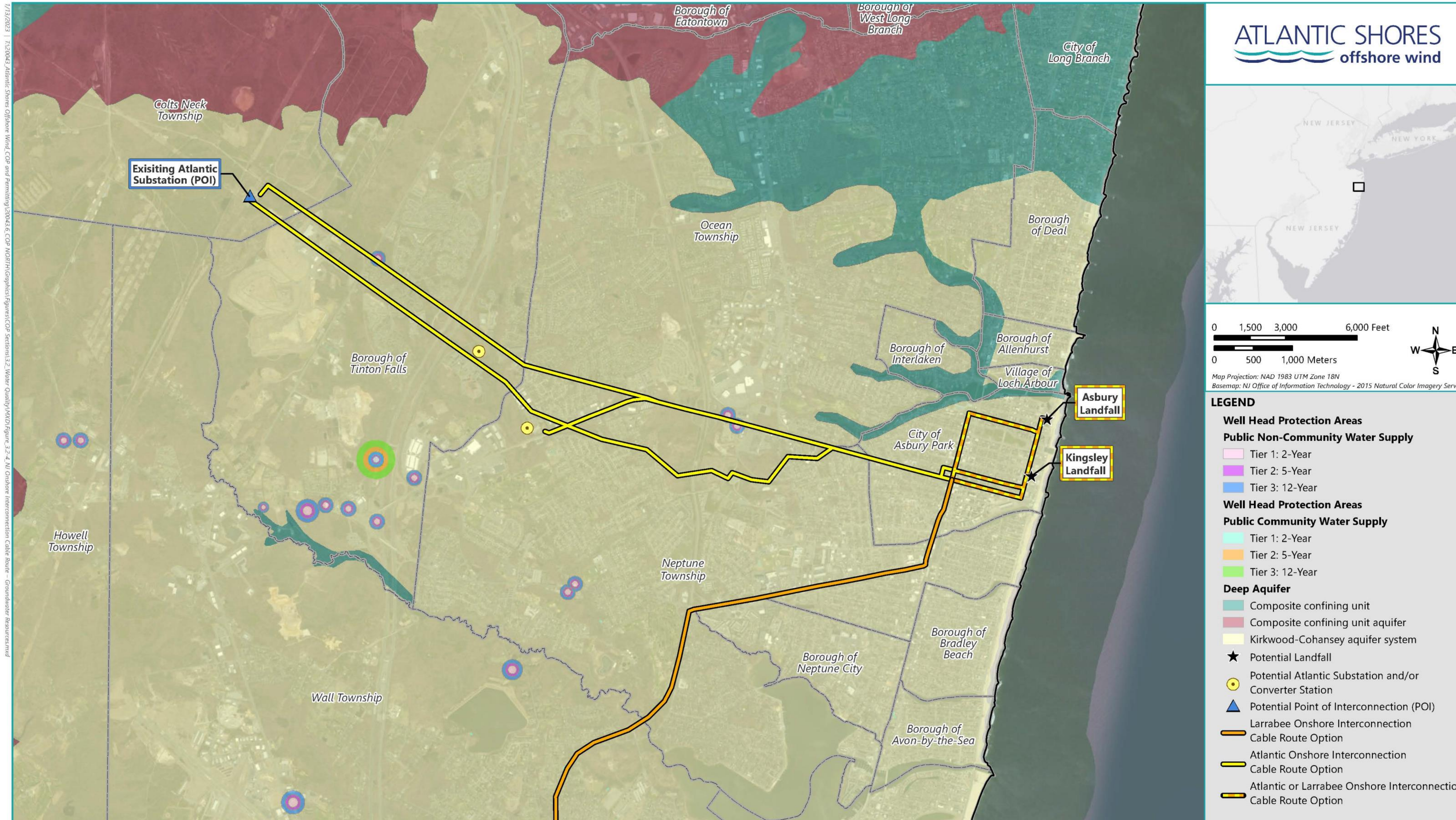


**Figure 3.2-4**

*Sheet 1 of 2*

*Groundwater Resources Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County, New Jersey*

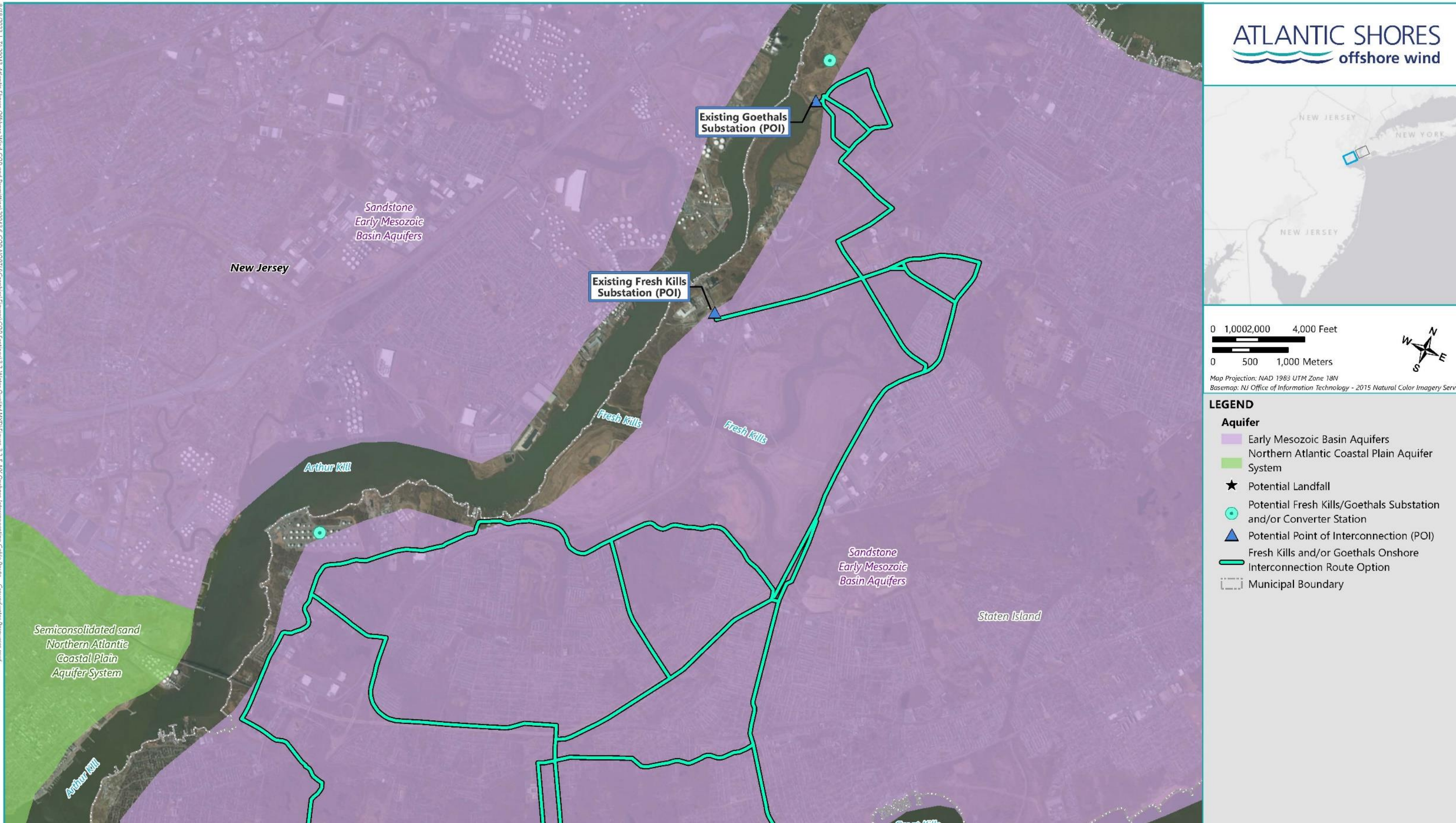


**Figure 3.2-5**

*Sheet 1 of 2*

*Groundwater Resources*
*Landfall and Onshore Interconnection Cable Route Options*
*Richmond and Kings County, New York*

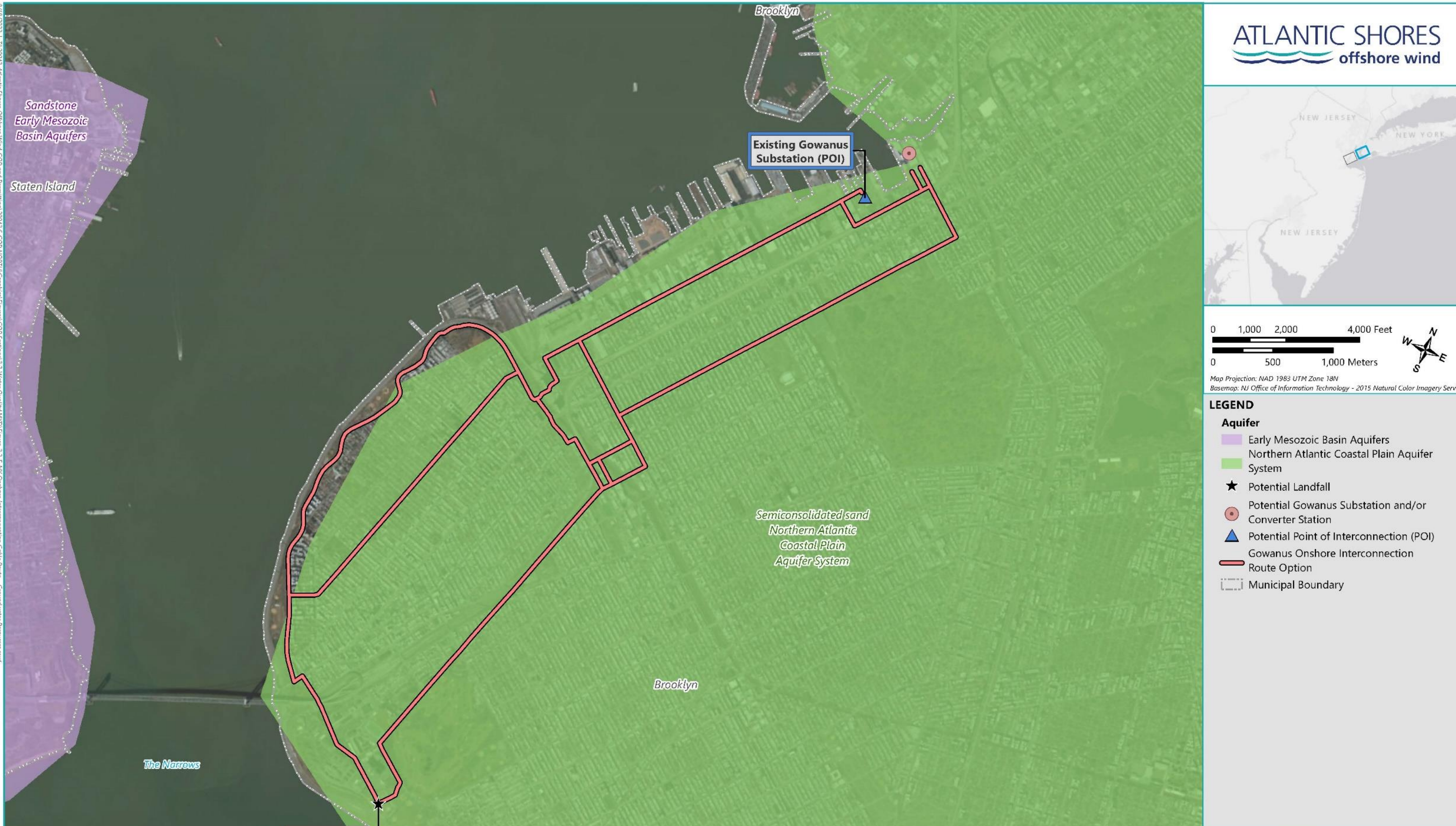


**Figure 3.2-5**

*Sheet 2 of 2*

*Groundwater Resources*
*Landfall and Onshore Interconnection*
*Cable Route Options*
*Richmond and Kings County, New York*

### 3.2.2 Potential Impacts and Proposed Environmental Protection Measures

The Project has been planned and designed to minimize risk to marine water quality and onshore water supplies. Potential water quality risks associated with aspects of Project construction, O&M, and decommissioning, especially seafloor- and land-disturbing activities, will be mitigated by construction BMPs. Any Project-related effects to water quality would be short term and localized within areas of the Onshore and Offshore Project Areas. This section will mainly discuss those Project activities that disturb the seafloor or land because they can pose a threat to water quality by increasing the risks of elevated turbidity in the water column and water pollution, as well as indirect impacts to aquatic and marine habitats.

The potential IPFs that may affect water quality primarily due to sediment suspension offshore and soil erosion onshore during Project construction, O&M, or decommissioning are summarized in Table 3.2-2. The maximum Project Design Envelope (PDE) analyzed for all IPFs is the maximum build-out of the Project.

**Table 3.2-2. Impact Producing Factors for Water Quality**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Installation and maintenance of new structures and cables | • | | • |
| Land disturbance | • | | |
| Anchoring and jack-up vessels | • | • | • |

Water quality may also be affected by accidental releases and discharges, onshore and offshore, from vehicles, equipment, or vessels. Atlantic Shores is accounting for the potential for accidental spills and releases of oils or other hazardous materials in a Project-specific Oil Spill Response Plan (OSRP) (see Appendix I-C) that meets the requirements of the U.S. Coast Guard (USCG), the Bureau of Safety and Environmental Enforcement (BSEE), New Jersey Pollutant Discharge Elimination System (NJPDES), and New York State Pollutant Discharge Elimination System (NYSPDES). Mitigation measures related to accidental releases and associated potential impacts are discussed in Sections 9.2.3 and 9.2.4.

#### 3.2.2.1 Installation and Maintenance of New Structures and Cables

The installation of new Project structures and cables may result in the following:

- temporary disturbance to marine sediments and terrestrial soils during offshore and onshore construction and decommissioning; and
- temporary increases in turbidity and related water quality impacts from the suspension and transport of disturbed marine sediments or erosion and sedimentation of terrestrial soils.

**Offshore**

The installation of new WTG, OSS, meteorological (met) tower foundation structures, and offshore cables will temporarily disturb marine sediments causing localized increases in turbidity near the work activity including seabed preparation, placement of scour protection, limited dredging of the tops of mobile bedforms, cable installation activities, HDD operations (i.e., the inadvertent release of drilling fluids or frac-out) at the landfall sites, anchoring of support vessels, and use of jack-up vessels. A description of the seafloor disturbance anticipated under the maximum design scenario is presented in Section 4.3 of Volume I.

Seafloor disturbance will mobilize and temporarily suspend some shallow sediments into the water column, where they may be transported and re-deposited onto the seafloor causing a temporary increase in turbidity and decrease in water quality. Based on Sediment Transport Modeling completed in support of Atlantic Shores Lease Area OCS-A 0549, suspended sediment concentrations resulting from cable installation and HDD activities are predicted to remain close to the route centerline or HDD pit, be constrained to the bottom of the water column, and occur for short durations. Suspended sediment concentrations from sandwave clearing activities are predicted to extend farther from the route centerline compared with the cable installation and HDD activities due to the introduction of sediments at the water surface and the orientation of the route to the currents.

Representative simulations of several possible inter-array cable or offshore export cable installation methods using either jet trenching installation parameters (for inter-array cable and export cable installation) or mechanical trenching installation parameters (for inter-array cable installation only) predicted above-ambient TSS of ≥10 mg/L[9] stayed relatively close to the route centerline. This is due to sediments being introduced to the water column close to the seabed. For Atlantic Shores' Lease Area OCS-A 0549, TSS concentrations of ≥10 mg/L traveled a range of maximum estimated distances of 1.7 mi (2.7 km), 1.6 mi (2.60 km), and to 1.5 mi (2.4 km) for the inter-array (mechanical trencher scenario), Monmouth ECC, and Northern ECC cable installations, respectively. For the landfall installations using an excavator without a cofferdam, a maximum dispersion distance of approximately 2.1 mi (3.3 km) and 1.2 mi (1.9 km) for the above-ambient TSS concentration ≥10 mg/L was predicted for the Monmouth and Northern representative HDD pits, respectively.

Based on modeling scenarios, TSS concentration dissipated over variable timeframes depending on localized sediment conditions, route orientation with respect to currents, and route length. For the inter-array cable model scenarios, above-ambient TSS concentrations substantially dissipated within 4 to 6 hours and fully dissipated in 8.7 or less hours. By contrast, the Monmouth ECC and Northern ECC model scenarios resulted in above-ambient TSS concentrations substantially dissipating within 2 to 6 hours but required up to approximately 17.7 hours to fully dissipate. Again, these variable modeling results are likely due to the relatively longer route (i.e., greater volume of suspended sediment), route orientation in relation to currents, and more frequent occurrence of fine sediment in the area of seafloor disturbance. For the landfall approach scenarios, the tails of the plumes, with concentrations

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[9] In the Mid-Atlantic Bight, 10 mg/L is considered within the range of ambient TSS concentration conditions (Balthis et al. 2009).

of ≥10 mg/L, oscillated with the currents and higher concentrations (e.g., >650 mg/L) remained centered around the source, with the concentrations dissipating after the excavation subsided due to the strong hydrodynamic forcing conditions. Above-ambient TSS concentrations around the HDD pits dissipated within 12.3 hours for the Monmouth ECC HDD pit and 10.3 hours for the Northern ECC HDD pit. , The Monmouth HDD pit model's larger areas of TSS concentrations above thresholds and the longer time for the plume to diminish to ambient conditions may be attributed to sediments being released in deeper water, the higher fraction of fine sediments taking longer to settle, and slightly stronger currents transporting the sediments parallel with the shore.

Predicted above-ambient TSS concentrations stemming from sandwave clearance activities extended farther from the route centerline compared with cable installation or HDD simulations due to the introduction of sediments at the water surface and the orientation of the route to the currents. The representative inter-array cable sandwave clearance simulation was predicted to have the largest maximum extent to the 10 mg/L contour compared to all other construction activities. For all sandwave scenarios, above-ambient TSS concentrations were predicted to substantially dissipate within 4 to 6 hours and fully dissipated in less than 14.3 hours.

The Atlantic Shores model predictions agree with modeling results conducted for similar projects in similar sediment conditions (BOEM 2021; Elliot et al. 2017; West Point Partners, LLC 2013; ASA 2008). Actual suspended sediment concentrations and sediment transport during installation may be even lower given that environmental monitoring surveys conducted during installation of the Block Island Wind Farm submarine cable found that suspended sediment levels measured during jet plow installation were up to 100 times lower than those predicted by the modeling (Elliot et al. 2017).

Impacts to water quality from elevated TSS concentrations are therefore expected to be temporary and localized, and no long-term impacts to water quality conditions are anticipated. Additional information on the effects of suspended sediment transport is provided in Section 4.5 Benthic Resources and Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat.

Atlantic Shores will select cable installation techniques (e.g., jet plow embedment) that minimize sediment suspension to the maximum extent practicable. Atlantic Shores will also use anchor midline buoys and dynamically positioned vessels as practicable to minimize seafloor disturbance.

As indicated in New Jersey's Integrated Water Quality Assessment Report, here are several areas along the coast near the Atlantic and Monmouth ECCs and landfall sites that NJDEP has determined do not meet their designated uses (NJDEP, 2016). None of the New Jersey coastal waters along the Monmouth and Northern ECCs and New Jersey landfall locations are deemed supportive of general aquatic life and only portions of the waters support shellfish harvesting and recreational use. Similarly, Lower New York Bay is considered an impaired waterbody mainly due to stormwater and wastewater inputs, industrial pollution and contamination of sediments from industry over many years. Aquatic life is generally supported in the area, with a number of species migrating through the area throughout the year. Fish consumption is limited due to PCB contamination of sediments that may affect certain species.

Swimming and other recreational uses are thought to experience minor impacts due to pathogens, floatable debris and various other pollutants from urban/stormwater runoff (NYCDEP 2022 GIS). Any localized Project-related increases in turbidity would not further degrade the quality of surrounding marine waters in these areas because of the limited extent and duration of seafloor-disturbing activities and associated suspension and dispersion of sediments within the water column.

HDD installation of the export cables at the landfall locations will require the use of HDD drilling fluid, which typically consists of a water and bentonite mixture. While the mixture is not anticipated to significantly affect water quality if released, Atlantic Shores will implement BMPs during construction to minimize potential release of the fluid. These measures may include returning the drilling fluid to surface pits and collecting it for reuse. The HDD also creates a potential for frac-out during drilling activities. A frac-out occurs when the drilling fluids migrate unpredictably to the surface through factures, fissures, or other conduits in the underlying rock or unconsolidated sediments. In the unlikely event of a frac-out, the inadvertent release of bentonite into the water column could result in temporary and localized impacts to water quality in the nearshore marine environment. However, design considerations, operational controls and contingency planning will greatly diminish the likelihood of accidental releases. Furthermore, Atlantic Shores will develop an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid prior to construction to further minimize the potential effects to water quality associated with a frac-out.

During O&M, the degree of suspended sediment and increased turbidity will be significantly lower than during construction because any needed maintenance activities will be limited to discrete portions of offshore cables or structures. Any effects during O&M are expected to be short-term and temporary due to the predominantly sandy sea floor in the Offshore Project Area. Decommissioning of structures and cables is expected to have short-term and localized impacts similar to those described for construction because of seafloor disturbance from the removal of structures or cables.

**Onshore**

Atlantic Shores prioritizes the siting of onshore facilities in previously disturbed and developed areas away from water supplies and surface waters to minimize the disturbance of terrestrial soils and the risk of sedimentation of nearby wetlands and waterbodies. Atlantic Shores also proposes to use specialized cable installation technologies (e.g., trenchless technologies) in certain areas to minimize environmental impacts (see Section 4.8.3 of Volume I). For example, HDD will be used to complete export cable landfall (i.e., offshore-to-onshore transition), which will minimize the amount of sediment and soil disturbance at the landfall sites, both offshore and onshore. Atlantic Shores will also use trenchless techniques (e.g., pipe jacking, jack-and-bore, and HDD) to install the onshore interconnection cables under wetlands, waterbodies, or roadways, which will minimize soil disturbances at these locations (see Section 4.1 Wetlands and Waterbodies).

As previously discussed, proper cable installation design and operational planning greatly diminishes the risk of accidental releases of drilling fluids (i.e., frac out) during HDD operations. Drilling fluids will consist of non-hazardous material such as bentonite and all drilling returns will be collected after use and recycled (see Section 4.7.1 of Volume I). Although accidental releases of HDD drilling fluids are expected to be a low probability event and not expected to affect water quality, an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid will be developed and implemented to further minimize potential effects.

During all onshore construction activities, Atlantic Shores will follow BMPs to properly contain excavated soils and sediments, stabilize disturbed soil areas, and minimize erosion and sediment runoff into waterbodies. Onshore Project activities have already targeted developed and previously disturbed areas for installing Project components. Prior to construction, appropriate soil erosion and sedimentation controls (e.g., silt fencing, filter socks, inlet protections and dust abatement) will be installed and maintained until site restoration has been achieved. Regular monitoring of disturbed areas and BMPs will be conducted by qualified inspectors. Post-construction, work sites will also be stabilized and restored with proper vegetation and landscape, in accordance with state and local permits. Disturbed areas along the onshore interconnection cable route options and the potential landfall sites will be returned to their preconstruction condition, except for manholes and stormwater features that will be installed for maintenance access.

During routine O&M, impact to onshore water quality is not expected as any specific maintenance to the below-ground components (i.e., onshore interconnection cables and splice/transition vaults) will be accessed via manholes. Onshore substation equipment would be repaired or replaced as needed but would not affect water quality. If any activities have the potential to impact water quality, Atlantic Shores will consult with the necessary regulatory agency and apply for applicable permits. Decommissioning of the onshore facilities would not impact water quality because the onshore facilities (i.e., onshore substations and buried duct banks) will be retired in place or reused for other purposes in consultation with state and municipal agencies (see Section 6.2.6 of Volume I).

#### 3.2.2.2 Land Disturbance

Land disturbance will result from onshore Project activities that directly disturb the soil through trenching and excavation in uplands and previously disturbed areas. As previously discussed, land disturbance can lead to temporary increases in turbidity and related surface water quality impacts from erosion and sedimentation of terrestrial soils (potential effects of Project-related land disturbances on wetlands and waterbodies are addressed in Section 4.1.) Land disturbance is the trenching, excavation, and grading associated with the installation of the onshore interconnection cables and splice vaults, the transition vault at the landfall sites, and construction of the onshore substations. In addition, land disturbance will occur in construction workspaces, staging areas, and access roads for construction equipment and materials.

As detailed in Section 3.2.1.2, portions of the Onshore Project Area occur near some New Jersey community wellhead protection areas (see Figures 3.2-4 and 3.2-5). There are no mapped or regulated wellheads in the vicinity of the New York landfall locations. In New Jersey, NJDEP regulates activities that adversely affect public well viability (i.e., groundwater withdrawals and excavation dewatering) or discharge to groundwater (i.e., contamination). The land disturbing activities associated with the trenching of the onshore interconnection cables will occur within previously developed or disturbed ROWs where there is a lower likelihood of encountering groundwater. As a result, these installation activities are not expected to result in any discharges to groundwater or significant groundwater withdrawals. If shallow groundwater incursion occurs in limited areas during excavation of the onshore cable installation trench, dewatering may be necessary. Any discharge from dewatering will be managed according to applicable Federal and State regulations.

Where wetlands, waterbodies and other sensitive resources need to be crossed, the onshore interconnection cable will be installed using trenchless techniques such as jack-and-bore, pipe jacking and HDD. Installing the onshore interconnection cable in this manner will minimize the land disturbance in these areas and as discussed in Section 3.2.2.1, reduce potential water quality effects.

A stormwater management system will also be implemented at the onshore substation that includes but is not limited to, grassed water quality swales to capture and convey site runoff, deep sump catch basin(s) to pretreat surface runoff, and other approved measures to capture and treat stormwater runoff prior to groundwater recharge or surface water discharge. These systems will further reduce potential impacts to water resources during construction and O&M.

Construction equipment and material storage will be limited to designated work and staging areas within the Onshore Project Area to avoid any private wells that may be located along the onshore interconnection cable routes. Compliance with applicable environmental laws and regulations, and implementation of BMPs will prevent releases of oil and hazardous materials from Project vehicles or equipment. Spill containment measures around fuel tanks and refueling areas will be implemented in accordance with an SPCC plan (see Section 9.2.4).

Atlantic Shores will implement appropriate BMPs (e.g., silt fence, filter socks, inlet filters, dust abatement) and will restore temporarily disturbed areas (i.e., reseeding or repaving) in accordance with approved Soil Erosion and Sediment Control Plans and Stormwater Pollution Prevention Plan within the Onshore Project Area to avoid and minimize water quality impacts to nearby aquatic habitats.

Land disturbing activities are not anticipated as part of routine O&M or decommissioning because below ground facilities (e.g., splice vaults and transition vaults) will be accessed through manholes and decommissioning will involve retirement of the onshore facilities (i.e., onshore substations and buried duct banks) in place or used for other purposes in consultation with state and municipal agencies (see Section 6.2.6 of Volume I).

#### 3.2.2.3 Anchoring and Jack-up Vessels

Seafloor disturbance and consequent suspension of sediments and turbidity increases will result from the positioning of anchors and jack-up vessel spuds as well as anchor chain contact with the seafloor (i.e., chain sweep). These vessel-related impacts are expected to result in localized, short-term increases in suspended sediment concentrations near the seafloor, limited to areas immediately adjacent to spuds, anchors, or jack-up legs. As detailed in the installation and O&M sections (see Sections 4.2, 4.4, 4.5, and 5.6 of Volume I), seabed disturbance from anchors and jack-up vessels will be temporary; therefore, no long-term impacts to water quality are anticipated.

The maximum PDE analyzed for anchoring and jack-up vessels is the maximum offshore build-out of the Project, assuming use of anchored vessels for all export cables. Temporary anchoring and use of jack-up vessels within the Offshore Project Area will occur during construction and decommissioning and to a lesser extent during O&M with variations in duration and extent according to the specific work activity. The maximum seabed disturbance resulting from jack-up or anchored vessel use during construction for various Project components is summarized in the following tables from Volume I: Table 4.2-1 for WTG foundations, Tables 4.4-2 and 4.4-4 for OSS foundations, Table 4.5-1 for export cables, and Table 4.5-2 for inter-array and inter-link cables.

### 3.2.2.4 Summary of Proposed Environmental Protection Measures

Project design and construction planning has focused on avoiding and minimizing potential adverse effects to water quality. Both onshore and offshore water quality effects will be avoided and minimized through carefully locating Project infrastructure and use of specialized construction techniques and design considerations inclusive of the following measures.

**Offshore**

- Offshore construction techniques have been selected that minimize the disturbance and suspension of sediment and protect water quality:
    - Anchor midline buoys will be used on anchored construction vessels, where feasible, to minimize disturbance to the seafloor and sediments.
    - Dynamically positioned vessels and jet plow embedment will be used to the maximum extent practicable to minimize sediment disturbance and alteration during cable-laying process.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP that meets USCG and the BSEE requirements (see Appendix I-C).
- HDD will be used to install the export cable to the landfall sites. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. All drilling fluids will be collected and recycled upon HDD completion.
- Vessels will operate in compliance with regulatory requirements related to the prevention and control of discharges and accidental spills.

**Onshore**

- Project facilities will be sited and routed in previously disturbed areas and along existing ROWs as much as practicable.
- The Project facilities will avoid public water supplies/wellhead protection areas to the maximum extent practicable.

- Trenchless cable installation methods (e.g., jack-and-bore, HDD) will be used to avoid impacts to wetlands and waterbodies. HDD will be used to install the export cable to the landfall sites. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to minimize the potential effects from an accidental release of drilling fluid on marine and inland surface waters. All drilling fluids will be collected and recycled upon HDD completion.

- BMPs such as silt fence, filter socks, inlet protection, dust abatement and other approved BMPs will be implemented in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts to water quality. Additionally, the Project will be constructed in accordance with an approved Soil Erosion and Sediment Control Plans and Stormwater Pollution Prevention Plan to avoid and minimize Project-related water quality impacts to nearby aquatic habitats (see Section 4.1 Wetlands and Waterbodies for additional discussion on the protection of wetlands and waterbodies).

- Temporarily disturbed areas will be stabilized through seeding or re-paving as appropriate and in accordance with the approved Soil Erosion and Sediment Control Plan.

- Project activities will be conducted in compliance with NJDPES, the NYS SPDES General Permit, an approved SWPPP and SPCC plans.

- Environmental/Construction Monitor(s) will be assigned to ensure compliance with applicable permit conditions and to ensure that BMPs are functional.

# 4.0 Biological Resources

This section provides a detailed description of the biological resources within the Onshore and Offshore Project Areas including wetlands and waterbodies; coastal and terrestrial habitat and fauna; birds, bats, benthic resources; finfish, invertebrates, and Essential Fish Habitat (EFH); marine mammals; and sea turtles.

## 4.1 Wetlands and Waterbodies

This section describes wetlands and other waterbodies such as vernal pools, streams, and rivers, within the Onshore Project Area in New Jersey and New York, associated impact producing factors (IPFs), and measures to avoid and minimize potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning.

Wetlands and waterbodies are a critical and valuable component of the ecosystem. Wetlands and waterbodies present within the Onshore Project Area have been assessed using targeted field surveys (e.g., wetland and waterbody delineations) and through consultation with Federal and State resource agencies, the primary purpose of which was to develop an in-depth understanding of wetland resources within and proximate to the Project and identify steps to avoid and minimize impacts to these resources.

Wetlands and waterbodies in New Jersey are under the jurisdiction of the New Jersey Department of Environmental Protection (NJDEP) according to the Freshwater Wetlands Protection Act. NJDEP has formally assumed Federal jurisdiction based on a memorandum of agreement with the U.S. Army Corps of Engineers (USACE) for all non-tidal freshwater wetlands greater than 1,000 feet (ft) (305 meters [m]) from the head of tide (NJDEPE and USACE 1993). Wetlands that occur less than 1,000 ft (305 m) from the head of tide, including tidal wetlands are under joint jurisdiction of the USACE and NJDEP.

Wetlands and waterbodies in New York are under the jurisdiction of the New York State Department of Conservation (NYSDEC) through the Freshwater Wetlands Act (Article 24 and Title 23 of Article 71 of the Environmental Conservation Law [ECL]) and Tidal Wetlands Regulations (Article 25 under the ECL). The Freshwater Wetlands Act requires the NYSDEC to map all state-protected wetlands to allow landowners and other interested parties a means of determining where state-jurisdictional wetlands exist. To implement the policy established by this act, regulations were promulgated by the state under 6 NYCRR Parts 663 and 664. Tidal wetlands are regulated based on the Tidal Wetlands Land Use Regulations (6 NYCRR Part 661) and tidal wetlands maps developed by the NYSDEC. The wetland categories used in these regulations are identified by the presence of a tide and the types of vegetation present. The categories of wetlands and the restrictions placed on activities in and around them are defined in detail in Part 661 (NYSDEC 2022). In addition, upland areas within 100-feet of freshwater wetlands and 300-feet of tidal wetlands (or 150-feet of tidal wetlands within the boundaries of the City of New York) are regulated "adjacent areas" as buffers to jurisdictional wetlands.

Additionally, existing site conditions such as the presence of a lawfully and presently existing structure (as of August 20, 1977) or elevation above mean sea level may reduce the regulated extent/jurisdiction of the "adjacent area" of a tidal wetland (NYSDOS Division of Administrative Rules, 2021). Streams and waterbodies are regulated by NYSDEC according to Article 15 of the ECL which specifically addresses surface water quality standards and classifications. Additional information on water quality is provided in Section 3.2 of Volume II.

All Project activities within regulated wetlands and waterbodies will be conducted in compliance with applicable regulatory requirements and conditions of federal nationwide or individual permits and State permits that may be required for onshore Project activities.

### 4.1.1 Affected Environment

The affected environment for the purposes of this section consists of wetlands and waterbodies within the New Jersey and New York Onshore Project Areas, inclusive of the landfall location options, onshore interconnection cable route options, onshore substations and/or converter station site options, and Points of Interconnection (POIs) (see Figures 4.1-1 and 4.1-2 for New Jersey and New York, respectively) The Project Area, as defined, was utilized for the purposes of identifying and detailing resources within the anticipated area of construction and analyzing potential land disturbance effects associated with Project activities. The Study Area was utilized for identifying and detailing resources within the Wetland and Stream Delineation Reports provided in Appendix II-D1 and Appendix II-D2 which fully encompasses the Project Area and additional areas proximate to the Study Area. This was done to ensure complete mapping of resources within and proximate to the Project Area and to inform avoidance and minimization measures. The Study Area and the Project Area are defined as follows:

The Study Area encompasses the following:

- 150-foot buffer around the onshore interconnection cable route (75 feet on either side)
- 75-foot buffer around the substation(s) and/or converter station(s) site options
- 75-foot buffer around the point(s) of interconnection
- The landfall site.

The Project Area encompasses the following:

- 40-foot buffer around the onshore interconnection cable route (20 feet on either side)
- The substation(s) and/or converter station(s) site options
- The point(s) of interconnection
- The Monmouth landfall site.

Due to the larger spatial extent of the Study Area, all Project Area locations are a subset of, and are encompassed within, the Study Area. Tables 4.1-1 through 4.1-4 include a subset of calculations and information provided in Appendix II-D1 and II-D2. Furthermore, there are resources (i.e., estuarine and marine wetlands) that are identified in Appendix II-D1 and II-D2 which are not located within the Project Area and, therefore, are not discussed and identified in the following subsections.

The New Jersey and New York Project Areas currently include 5 parcels and 3 parcels, respectively, that have been identified as options for the proposed substation(s) and/or converter station(s). Only 1 parcel will be selected and advanced for each route based on real estate availability.

The New Jersey Onshore Project Area lies within the New Jersey Atlantic Coastal Plain along the coastal zone of New Jersey and the New York Onshore Project Area lies within the State Coastal Area of New York within the Raritan Bay Basin. The coastal zone of New Jersey and New York generally includes tidal and non-tidal waters (including wetlands), dune and beach areas, and forest areas as well as urban and suburban residential, commercial, industrial, and linear development. Additional detail regarding land use types within the Onshore Project Area in New Jersey and New York is provided in Section 7.5 of Volume II.

In New Jersey, the coastal zone is managed by the NJDEP as the New Jersey Coastal Management Zone administrator under New Jersey Administrative Code (N.J.A.C.) 7:7 and encompasses approximately 1,800 miles (mi) (2,897 kilometers [km]) of tidal shoreline including 126 mi (203 km) of oceanfront from Sandy Hook to Cape May. The boundaries of the coastal zone include inland, seaward, and interstate areas (NJDEP 2020). In New York, the coastal zone is managed by the New York State Department of State (NYSDOS) and more specifically, within New York City, the Department of City Planning through the city’s NYSDOS approved Local Waterfront Revitalization Program (Article 42 of the Executive Law).

A wetland is an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation (NJ DLRP 2020). The area's glacial history plays a large role in wetland formation throughout the region. Geological processes, and more recent events like sea level rise and erosion along rivers landward of the barrier islands, continue to influence wetland formation (Tiner et al. 1985). Five general wetland types occur throughout New Jersey and New York based on the Cowardin Classification of wetlands: marine, estuarine, riverine, lacustrine, and palustrine (Cowardin et al. 1979). However, only riverine, palustrine, and/or estuarine wetlands occur within or adjacent to the New Jersey and/or New York Onshore Project Areas.

Specific information regarding wetland and waterbody characteristics within the Onshore Project Areas were obtained from publicly available sources and wetland/stream field delineations as outlined within the Wetland and Stream Delineation Reports (Appendix II-D1 and Appendix II-D2). NJDEP and NYSDEC mapped wetlands and United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapping was used as a basis to determine areas of potential wetlands within the New Jersey and New York Onshore Project Areas.

NJDEP and NYSDEC mapped wetlands and NWI mapping within the Onshore Project Areas are shown in Figure 4 in each Appendix II-D1 and Appendix II-D2. Wetland and stream delineations to validate these mapped resources as well as vernal pool surveys were completed in 2022 and 2023.

Sections 4.1.2 and 4.1.3 provide a summary of the wetland and waterbody resources delineated and mapped within the New Jersey and New York Onshore Project Areas based on publicly available information.

#### 4.1.1.1 Wetlands and Waterbodies – New Jersey Onshore Project Area

The main Project facilities within the New Jersey Onshore Project Area include the landfall site options, onshore interconnection cable route options, onshore substation and/or onshore converter station site options, and POIs. These facilities were located to avoid wetlands and other waterbodies to the maximum extent practicable. Based upon the wetland and stream delineation no delineated or mapped wetlands and streams have been identified at any of the landfall site options or at the Larrabee or Atlantic POIs. All field-delineated wetlands and waterbodies within the New Jersey Onshore Project Area are limited to areas situated adjacent to, or cross under the pavement of roadways via bridge or culvert, electric utility lines and other developed areas along the onshore interconnection cable route options.

There are two wetland classes (palustrine and riverine) that were field delineated and are mapped within the New Jersey Onshore Project Area. Mapped wetlands include resources located on parcels where commercial control has not been obtained to conduct field delineations. These wetland types are described as a characterization of typical wetlands in the Wetland and Stream Delineation Report for New Jersey in Appendix II-D1. Palustrine wetlands are a diverse class of wetland and includes freshwater marshes, bogs, swamps, and bottomland forests. Riverine wetlands systems include all wetlands and deepwater habitats contained within a channel, except for wetlands dominated by vegetation made up of trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens that usually consist of flowing water with uplands on either side. Table 4.1-1 summarizes the acreage of wetland classes within the New Jersey Onshore Project Area.

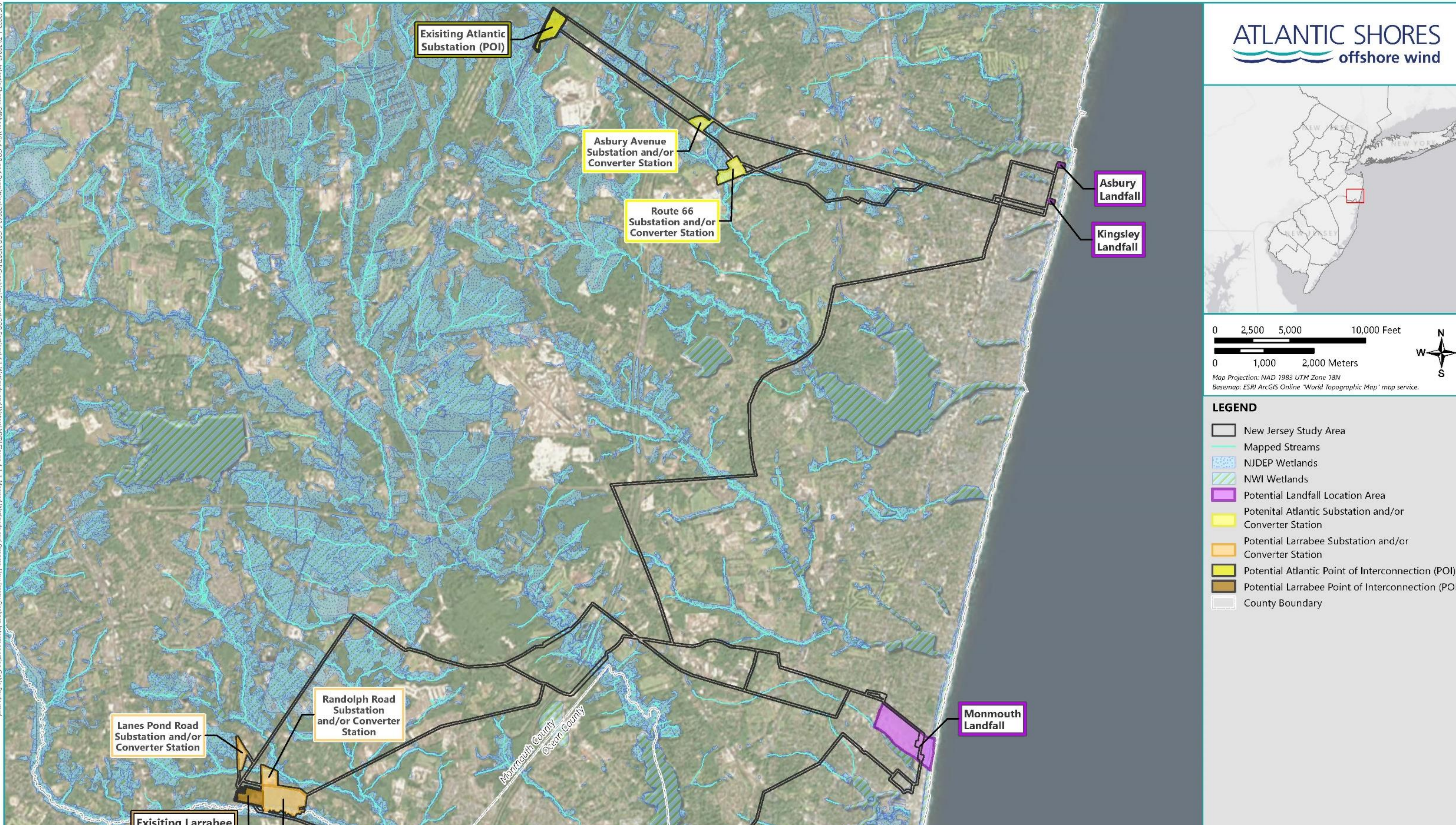



**Figure 4.1-1**

*Mapped Wetland and Streams*
*Onshore Interconnection Cable Route*
*Monmouth and Ocean County, New Jersey*


ATLANTIC SHORES offshore wind

0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- New York Study Area
- NYS DEC Wetlands
- NWI Wetlands
- Potential Landfall Location Area
- Potential Fresh Kills/Goethals Substation and/or Converter Station
- Potential Fresh Kills/Goethals Point of Interconnection (POI)
- County Boundary

**Figure 4.1-2**
**Sheet 1 of 2**

*Mapped Wetlands and Streams*
*Onshore Interconnection Cable Route*
*Richmond and Kings County, New York*

9/1/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\4.1 Wetlands and Waters\MXD\Figure 4.1 2 Mapped Wetlands and Streams New York Onshore Interconnection Cable Route.mxd

9/7/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\4.1 Wetlands and Waters\MXD\Figure 4.1 2 Mapped Wetlands and Streams New York Onshore Interconnection Cable Route.mxd


**Figure 4.1-2**
**Sheet 2 of 2**

*Mapped Wetlands and Streams*
*Onshore Interconnection Cable Route*
*Richmond and Kings County, New York*

### Table 4.1-1. Field Delineated and Mapped Wetlands within the New Jersey Onshore Project Area

| Wetland Type | Field Delineated and Mapped Wetlands[1] (acres / $m^2$) |
|---|---|
| Palustrine Emergent | 0.2 acres (809.4 $m^2$) |
| Palustrine Forested/Shrub | 39.2 acres (158,636.8 $m^2$) |
| Riverine | 0.03 acres (121.4 $m^2$) |
| Total | 39.5 acres (159,850.8 $m^2$) |

[1] Mapped wetland acreages were derived from USFWS NWI spatial data.

New Jersey National Hydrology Dataset (NHD) mapping and field delineations identified 18 waterways within the New Jersey Study Area, which fall under the Riverine classification detailed in Table 4.1-1. Streams that were field delineated correspond to mapped streams. The NHD mapped waterways within the New Jersey Study Area total approximately 4,189.1 feet (1,276.8 m) and are summarized, by name, in Table 4.1-2.

### Table 4.1-2. Field Delineated and Mapped Waters within the New Jersey Onshore Project Area

| New Jersey NHD ID | Total Length in New Jersey Project Area (feet) | Total Length in New Jersey Project Area (meters) |
|---|---|---|
| Beaverdam Creek | 87.8 ft | 26.8 m |
| Dicks Brook | 930.9 ft | 283.7 m |
| Hannabrand Brook | 44.4 ft | 13.5 m |
| Haystack Brook | 81.0 ft | 24.7 m |
| Hollow Brook | 736.5 ft | 224.5 m |
| Judas Creek | 224.9 ft | 68.5 m |
| Jumping Brook | 1,292.0 ft | 393.8 m |
| Laurel Gully Brook | 42.4 ft | 12.9 m |
| Manasquan River | 243.8 ft | 74.3 m |
| Muddy Ford Brook | 42.3 ft | 12.9 m |
| North Branch Metedeconk River | 126.1 ft | 38.4 m |
| Roberts Swamp Brook | 40 ft | 12.2 m |
| Sandyhill Brook | 50 ft | 15.2 m |
| Shark River | 40 ft | 12.2 m |
| Squankum Brook | 40.4 ft | 12.3 m |

| New Jersey NHD ID | Total Length in New Jersey Project Area (feet) | Total Length in New Jersey Project Area (meters) |
|---|---|---|
| Tarkiln Brook | 40.6 ft | 12.4 m |
| Watson Creek | 82.0 ft | 25.0 m |
| Wreck Pond Brook | 43.4 ft | 13.2 m |
| Total | 4,189.1 ft | 1,276.8 m |

All delineated wetland communities are part of the larger ecosystem associated with freshwater, non-tidal and tidal wetlands and waterbodies that occur well beyond the New Jersey Onshore Project Area. The delineated wetlands within the Project Area are associated with freshwater perennial watercourses that ultimately flow south to the Manasquan and Shark Rivers which ultimately have a connection to the Atlantic Ocean.

#### 4.1.1.2 Wetlands and Waterbodies – New York Onshore Project Area

Like the New Jersey Onshore Project Area, the Project facilities located in the New York Onshore Project Area have been located to avoid and minimize impacts to wetlands and waterbodies to the maximum extent practicable. Wetlands and/or streams do not occur at the landfall site options, or the Fresh Kills, Goethals, or Gowanus POIs. All field-delineated wetlands and waterbodies are situated adjacent to or cross under roadways and other developed/disturbed areas along the onshore interconnection cable route options. The only exception is the in-water interconnection cable route options that utilize export cable landfall site options on Staten Island for interconnection at the Gowanus POI (see Figure 1.1-2 in Volume I).

There are four wetland classes (palustrine, estuarine, marine, and riverine) that were field delineated and are mapped within the New York Onshore Project Area. Mapped wetlands include resources located on parcels where commercial control has not been obtained to conduct field delineations. The wetland classes are described in the Wetland and Stream Delineation Report for New York in Appendix II-D2. Table 4.1-3 summarizes the acreage of wetlands within the New York Onshore Project Area.

### Table 4.1-3. Field Delineated and Mapped Wetlands within the New York Onshore Project Area

| Wetland Type | Field Delineated and Mapped Wetlands[1] (acres / $m^2$) |
|---|---|
| Estuarine and Marine | 93.5 acres (378,382.6 $m^2$) |
| Estuarine and Marine Deepwater | 33.1 acres (133,951.5 $m^2$) |
| Palustrine Forested/Shrub Wetland | 1.2 acres (4,856.2 $m^2$) |
| Palustrine Emergent | 2.0 acres (8,093.7 $m^2$) |

| Wetland Type | Field Delineated and Mapped Wetlands[1] (acres / $m^2$) |
|---|---|
| Palustrine Pond | 0.8 acres (3,237.5 $m^2$) |
| Riverine | 2.1 acres (8,498.4 $m^2$) |
| Total | 132.7 (537,020.0 $m^2$) |

[1] Mapped wetland acreages were derived from NYSDEC spatial data.

Tidal, perennial, and intermittent streams (Mill Creek, Fresh Kills, Arbutus Creek, Richmond Creek, Pralls Creek, Saw Mill Creek, Lemon Creek, Gowanus Canal and associated tributaries) occur within the New York Onshore Project Area. Non-tidal features are located within deciduous and mixed forest habitats along the onshore interconnection cable route options and cross potential routes under existing paved roads via culvert or bridge. Tidal systems are associated with the Arthur Kill, Raritan Bay, Sandy Hook Bay, Upper New York Bay, and other tidal estuarine and deep-water mapped areas and include sandy shorelines or emergent estuarine habitats. Intermittent systems also occur within the New York Onshore Project Area and are typically identified in roadside ditches with hydrologic connection to either a perennial watercourse or palustrine wetland. Table 4.1-4 summarizes the linear footage (meters) of field delineated waters and waters observed on publicly available databases within the New York Onshore Project Area.

### Table 4.1-4. Field Delineated and Mapped Waters within the New York Onshore Project Area

| Waterbody Type[1] | Total Length in New York Project Area (feet) | Total Length in New York Project Area (meters) |
|---|---|---|
| Class B | 11.8 ft | 3.5 m |
| Class SC | 1.302.2 ft | 396.9 m |
| Class SC/B | 2.3 ft | 0.7 m |
| Class SD | 575.3 ft | 175.3 m |
| Class SD/C | 692.2 ft | 211.0 m |
| Total | 2,608.1 ft | 795.0 m |

[1] Information on water quality and classification types per Article 15 of the ECL is provided in Section 3.2 of Volume II.

All field delineated and mapped wetlands are connected to, and part of, the larger freshwater and tidal ecosystems that occur well beyond the New York Onshore Project Area. Mill Creek, Arbutus Creek, Pralls Creek, Saw Mill Creek, Lemon Creek, Fresh Kills and associated tributaries drain directly to the Arthur Kill, Raritan Bay, Sandy Hook Bay, and ultimately to the Atlantic Ocean. Gowanus Canal drains directly to Upper New York Bay, and ultimately to the Atlantic Ocean.

### 4.1.2 Potential Impacts and Proposed Environmental Protection Measures

The New Jersey and New York Onshore Project Areas have been sited to maximize the use of existing linear infrastructure, such as roadway and electric utility ROWs. The landfall site options, and onshore substations have also been intentionally located in previously disturbed or developed areas to avoid and minimize potential impacts to wetlands and waterbodies. In addition, trenchless construction techniques such as jack-and-bore, pipe jacking and horizontal directional drilling (HDD) will be used at all wetland and water crossings to further avoid impacts to these resources. As a result, direct impacts to wetlands and waterbodies will be avoided. Soil erosion and sedimentation and/or stormwater runoff during construction will have a low likelihood of occurrence due to the implementation of construction Best Management Practices (BMPs) and other protocols that will limit impacts. (Table 4.1-5). No direct or indirect impacts to wetlands are anticipated during routine O&M or decommissioning.

**Table 4.1-5. Impact Producing Factors for Wetlands and Waters of the U.S.**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Land Disturbance | • | | |

Wetlands and waterbodies may also be inadvertently affected by discharges from accidental releases of fuel, fluids, and trash and debris. These potential impacts are considered to have a low likelihood of occurrence and are discussed in Sections 9.2.3 and 9.2.4.

The maximum Project Design Envelope (PDE) analyzed for potential impacts to wetlands and waterbodies is the maximum onshore build-out options of the Project (see Subsection 4.1.1 of this Section and Section 4.11 of Volume I). Details describing the construction of the onshore Project components are presented in Sections 4.7, 4.8, and 4.9 of Volume I.

#### 4.1.2.1 Land Disturbance

Land disturbance associated with the construction of underground onshore Project components will involve trenching and excavation in upland and developed/disturbed areas within the Onshore Project Area. Where wetlands or waterbodies occur within the Project Area, trenchless technology such as HDD, jack-and-bore or pipe jacking will be used, thereby avoiding direct impact to wetlands and waterbodies.

Trenching and excavation for cable conduit, duct banks, splice vaults, transition vaults, substation and/or converter station structure foundations will require earth-moving vehicles and equipment, which causes land disturbance; however, these facilities will be installed within existing rights-of-way (ROWs) (e.g., highway or utility line ROWs), and developed areas that are disturbed and/or regularly maintained. Additional construction workspace for excavators and other construction equipment and excavated material will also be required. Specific cable design and installation details are provided in

Section 4.8.3 of Volume I. Where wetlands or waterbodies occur within the Project Area, the onshore interconnection cables will be installed using trenchless technology (e.g., jack-and-bore, pipe jacking, and HDD) where crossing is necessary to avoid direct impacts to these resources. Entry/exit work areas will be in disturbed upland areas to further avoid impacts to wetlands and waterbodies. Tables 4.1-6 and 4.1-7 provide a summary of the potential temporary and permanent impacts to wetlands and waterbodies resulting from construction of the Project as well as impacts (permanent and temporary) avoided using trenchless installation technologies for New Jersey and New York, respectively.

The Onshore Project Area has been sited to be located in upland and previously disturbed or developed areas to the maximum extent practicable to avoid construction activity impacts to wetlands and waterbodies that are located adjacent or proximate to the Onshore Project Area. Project activities will not directly impact wetlands and waterbodies that are located adjacent to the Onshore Project Area because construction is not proposed in these areas.

There are no wetlands or waterbodies located in upland locations (e.g., existing roadways and ROWs) along the onshore interconnection cable route or any of the previously disturbed and developed upland areas identified for the landfall site options. At the substation and/or converter station site(s), all facilities will be developed in previously disturbed upland areas. As discussed above, Atlantic Shores will utilize trenchless technology (e.g., jack-and-bore, pipe jacking, and HDD) where the onshore interconnection cable corridor requires crossing wetlands and waterbodies to avoid impacts to these resources.

### Table 4.1-6. Delineated New Jersey Wetlands and Waters of the United States Potential Impact Summary[1]

| Wetland/Waterbody Type | Potential Project Impacts (acres/m$^2$) | | Impacts Avoided Using Trenchless Installation (acres/m$^2$) |
|---|---|---|---|
| | Temporary | Permanent | |
| Palustrine Forested | 0.84 acres (3,418.5 m$^2$) | 0.30 acres (1,210.6 m$^2$) | 0.56 acres (2,263.2 m$^2$) |
| Palustrine Emergent | 0.0008 acres (3.1 m$^2$) | 0.19 acres (785.9 m$^2$) | - |
| Palustrine Scrub-Shrub | - | - | 0.001 acres (4.2 m$^2$) |
| Tidal/Riverine | 0.04 acres (152.6 m$^2$) | 0.02 acres (92.2 m$^2$) | 0.94 acres (3,820.7 m$^2$) |
| Non-tidal/Perennial | 0.04 acres (161.9 m$^2$) | 0.02 acres (77.2 m$^2$) | 0.17 acres (693.6 m$^2$) |
| Non-tidal/Intermittent | 0.005 acres (21.8 m$^2$) | - | - |

[1] Impact calculations are only for wetlands that have been field delineated within New Jersey at the landfall site(s) and along the onshore interconnection cable route. At the substation and/or converter station site(s), all facilities will be developed in previously disturbed upland areas.

### Table 4.1-7. Delineated New York Wetlands and Waters of the United States Potential Impact Summary[1]

| Wetland/Waterbody Type | Potential Project Impacts (acres/m²) | | Impacts Avoided Using Trenchless Installation (acres/m²) |
|---|---|---|---|
| | Temporary | Permanent | |
| Estuarine Emergent | 0.2 acres (966.2 m²) | 0.003 acres (12.0 m²) | 1.32 acres (5,326.9 m²) |
| Estuarine Open Water | 0.005 acres (19.2 m²) | | |
| Palustrine Forested | 0.1 acres (404.7 m²) | 0.25 acres (1,008.6 m²) | - |
| Palustrine Scrub-Shrub | 0.003 acres (11.1 m²) | | |
| Palustrine Emergent | 0.004 acres (14.4 m²) | - | - |
| Tidal/Riverine | 0.009 acres (36.1 m²) | - | - |
| Non-tidal/Perennial | 0.001 acres (5.0 m²) | - | 1.15 acres (4,645.3 m²) |
| Intermittent | 0.01 acres (44.5 m²) | - | - |
| Ephemeral | 0.005 acres (21.8 m²) | - | - |

[1] Impact calculations are only for wetlands that have been field delineated within New York at the landfall site(s) and along the onshore interconnection cable route. At the substation and/or converter station site(s), all facilities will be developed in previously disturbed upland areas.

To prevent indirect impacts to wetlands and waterbodies, such as soil erosion and sedimentation from land disturbing construction activities, Atlantic Shores will comply with an approved Soil Erosion and Sediment Control Plan, New Jersey Pollutant Discharge Elimination System (NJPDES) permit, New York State Pollutant Discharge Elimination System (SPDES) Permit, and a Stormwater Pollution Prevention Plan (SWPPP). In accordance with these plans, best management practices (BMPs) including, but not limited to dust abatement, installation of silt fencing, filter socks, and inlet filters, will be implemented to minimize and/or avoid potential effects. Additionally, once construction is completed, areas of temporary disturbance will be returned to pre-construction conditions and at the onshore substations land will be appropriately graded, graveled, or grassed to prevent future erosion. Section 3.2 Water Quality provides additional detail on potential effects on water quality and the proposed BMPs to avoid or reduce impacts. An Environmental/Construction monitor will also be onsite to ensure that BMPs are installed in accordance with the approved Soil Erosion and Sediment Control Plan, NJPDES, SPDES, and other permit conditions.

During routine O&M and future decommissioning, land disturbing activities are not anticipated. Vehicle and equipment use would occur along roads using the manholes within the splice vaults and transition vaults for access and within previously developed areas such as onshore substations. As a result, impacts to wetlands and/or waterbodies are not anticipated during these phases of the Project.

#### 4.1.2.2 Summary of Proposed Environmental Protection Measures

Atlantic Shores has routed the onshore interconnection cable route options along previously disturbed ROWs and sited its onshore substations and landfall site options on previously disturbed lands to avoid and/or minimize impacts to wetlands and waterbodies. Potential impacts have further been avoided by using trenchless installation methods such as jack-and-bore, pipe jacking, and HDD to install the onshore interconnection cables where wetlands and waterbodies are crossed.

To avoid and minimize effects resulting from land disturbance during construction, Atlantic Shores has sited Project facilities to avoid and minimize impacts to wetlands and waterbodies and has incorporated mitigation measures into design elements, construction, O&M, and decommissioning plans.

The following environmental protection measures are proposed to mitigate potential Project-related impacts to wetlands and waterbodies. As the Project progresses through development and permitting, Atlantic Shores will continue discussions with resource agencies such as USACE, NJDEP, NYSDEC, and NYS Department of Public Service (NYSDPS), NYS Department of State (NYSDOS), and New York City Department of City Planning (NYCDCP) to determine the need for appropriate avoidance/mitigation measures and will comply with applicable permit conditions.

- Project facilities have been sited/routed in previously disturbed areas and along existing ROWs.
- Onshore interconnection cables will be installed underground and use trenchless installation such as jack-and-bore, pipe jacking, and/or HDD, at all wetland and waterbody crossings, to avoid direct impacts to wetlands and waterbodies. All entry/exit work areas will be in disturbed upland areas to further avoid impacts to wetlands and waterbodies.
- BMPs such as silt fence, filter socks, inlet protection, dust abatement and other approved BMPs will be implemented in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts to water quality. Additionally, the Project will be constructed in accordance with an approved Soil Erosion and Sediment Control Plans and Stormwater Pollution Prevention Plan to avoid and minimize Project-related water quality impacts to nearby aquatic habitats (see Section 3.2 Water Quality).
- All temporarily disturbed areas will be returned to pre-construction conditions and all onshore substation areas will be graded, grassed, graveled, or paved to prevent future erosion.
- Environmental/Construction Monitor(s) to comply with applicable plans and permit conditions, and to ensure that BMPs are functional.

## 4.2 Coastal and Terrestrial Habitat and Fauna

This section describes the coastal and terrestrial habitat and fauna in the Onshore Project Area in New Jersey and New York (including threatened and endangered species), associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations, and maintenance (O&M), and decommissioning. Terrestrial birds and bats are described in Sections 4.3 and 4.4 and therefore, are not addressed in this section.

### 4.2.1 Affected Environment

The affected environment for the purposes of this section is made up of the New Jersey and New York Onshore Project Areas inclusive of the potential landfall and onshore interconnection cable route options, onshore substations and/or converter stations, and POIs (see Figures 4.8-1, 4.8-2, 4.9-1, 4.9-2 of Volume 1). The Project Area, as defined, was utilized for the purposes of identifying and detailing resources within the anticipated area of construction and analyzing potential effects associated with Project activities. The Study Area was utilized for identifying and detailing resources within the Habitat Suitability Assessment Reports provided in Appendix II-E1 and Appendix II-E2 which fully encompasses the Project Area and additional areas proximate to the Study Area. This was done to ensure complete mapping of resources within and proximate to the Project Area and to inform avoidance and minimization measures. The Study Area and the Project Area are defined as follows:

The Study Area encompasses the following:

- 150-foot buffer around the onshore interconnection cable route (75-feet on either side)
- 75-foot buffer around the substation(s) and/or converter station(s) site options
- 75-foot buffer around the point(s) of interconnection
- The landfall site.

The Project Area encompasses the following:

- 40-foot buffer around the onshore interconnection cable route (20-feet on either side)
- The substation(s) and/or converter station(s) site options
- The point(s) of interconnection
- The landfall site.

The New Jersey and New York Project Areas currently include five and three parcels, respectively, that have been identified as options for the proposed substation(s) and/or converter station(s). Only one parcel will be selected and advanced for each route based on real estate availability.

The New Jersey Onshore Project Area occurs along the coastal area of New Jersey, which generally includes tidal and non-tidal waters (including wetlands), dune and beach areas, forest areas and significant residential, commercial, industrial, and linear development. This coastal area is managed by the NJDEP as the New Jersey Coastal Management Zone (coastal zone) under New Jersey Administrative Code (N.J.A.C.) 7:7 and encompasses approximately 1,800 miles (mi) (2,897 kilometers [km]) of tidal shoreline including 126 mi (203 km) of oceanfront from Sandy Hook to Cape May. The boundaries of the coastal zone include inland, seaward, and interstate areas (NJDEP 2020).

The New York Onshore Protect Area occurs along the coastal area of Staten Island and western Long Island. Most of this area is densely developed residential, commercial, industrial, and linear development up to the water's edge. The exception is the southern portion of Staten Island which includes tidal and non-tidal waters (including wetlands), beach areas, and isolated forests. The coastal area is managed by the New York State Department of State (NYSDOS) which implements the State Coastal Management Program (CMP) and the New York City Department of City Planning (NYCDCP) through the City's approved Local Waterfront Revitalization Program (LWRP) consistent with Executive Conservation Law, Article 42. In-water lands within New York City are also managed by the New York State Office of General Services (NYSOGS).

Through desktop analyses, targeted field surveys, and consultations with Federal and State environmental agencies, Atlantic Shores has developed an in-depth understanding of the wildlife and habitats that occur and/or are mapped within and proximate to the New Jersey and New York Onshore Project Area and is taking reasonable and prudent measures to avoid, minimize, and mitigate potential effects to terrestrial wildlife and habitat communities. The following types of data sources were used to characterize the Onshore Project Areas:

- Public data sources including information related to coastal and terrestrial habitats in New Jersey and New York
- Published documents from Federal and State agencies including United State Fish and Wildlife Service (USFWS), New Jersey Coastal Management Program, New Jersey Department of Environmental Protection (NJDEP), NYSDOS, and New York Department of Environmental Conservation (NYSDEC)
- USFWS, NJDEP Natural Heritage Program (NHP), and NYSDEC NHP threatened and endangered species consultations.

Desktop surveys were conducted to identify terrestrial habitat present in the New Jersey and New York Onshore Study Areas. In addition, Atlantic Shores surveyed the terrestrial ecological resources within the New Jersey and New York Onshore Study Areas. Field surveys included delineations for wetlands, waterbodies, terrestrial habitat, and vernal pools within the Study Area. The purpose of these studies was to identify and evaluate sensitive ecological resources including the identification of habitat that could potentially support threatened and endangered species (i.e., critical habitat assessments). The results of these collective surveys are provided in the Habitat Suitability Assessment Reports in

Appendix II-E1 and Appendix II-E2 and the Wetland and Stream Delineation Reports in Appendix II-D1 and Appendix II-D2.

The onshore Project facilities and their proposed locations within the New Jersey and New York Onshore Project Areas are detailed in Sections 4.7, 4.8, 4.9, and 5.5 of Volume I. The observed habitat types for New Jersey and New York Onshore Project Areas are detailed in Sections 4.2.1.1 and 4.2.1.2, respectively. A detailed description of each of those typical and observed habitat types within the Project Areas is provided in the Habitat Suitability Assessment Desktop Reports in Appendix II-E1 and Appendix II-E2.

#### 4.2.1.1 Coastal Terrestrial Habitat and Fauna – New Jersey Onshore Project Area

Atlantic Shores has preferentially sited the New Jersey Onshore Project Area within previously developed areas to avoid impacts to wildlife habitat to the maximum extent practicable. More specifically, the majority of the onshore interconnection route options are co-located within existing roadway and utility ROWs and the landfall options all use developed or disturbed areas such as parking lots and streets. Based on desktop and field surveys, the New Jersey Onshore Project Area is comprised of approximately 67% developed or disturbed areas. The remaining documented habitat within the New Jersey Onshore Project Area consists of forests (mixed, deciduous, and evergreen), wetlands (herbaceous, scrub-shrub, and forested), open water, herbaceous fields, upland scrub-shrub, evergreen scrub-shrub, and agricultural field. Much of this habitat occurs along the edge of already developed or disturbed areas in the New Jersey Onshore Project Area and was determined to be marginal edge habitat.

To further avoid potential impacts to these habitats, the onshore interconnection cable will be installed using trenchless installation techniques (e.g., jack-and-bore, pipe jacking or horizontal directional drilling [HDD]) at all wetland/water crossings (e.g., tidal emergent wetlands, non-tidal wetlands, and surface waters). Trenching will be used to install the onshore interconnection cable within previously disturbed and developed upland areas such as along existing road and utility line rights-of-way (ROWs).

Surveys were conducted to identify and document wildlife habitat with specific attention to those habitats potentially suitable to support federal and/or state-listed threatened and endangered species. The Habitat Suitability Assessment report in Appendix II-E1 provides details on the types of habitats present within the New Jersey Onshore Project Area. Table 4.2-1 summarizes the acreage of each habitat type observed within the New Jersey Onshore Project Area according to the Atlantic Shores Habitat Suitability Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in Appendix D of the Habitat Suitability Assessment Report in Appendix II-E1.

### Table 4.2-1. Estimated Area and Percent Cover of Habitat Types within the New Jersey Onshore Project Area

| Habitat Type | Acres | Percentage |
|---|---|---|
| Developed / Disturbed | 288.5 acres (1,167,692.0 $m^2$) | 66.6% |
| Forest – Mixed | 19.0 acres (76,808.6 $m^2$) | 4.4% |
| Forest – Deciduous | 40.3 acres (163,136.2 $m^2$) | 9.3% |
| Forest – Evergreen | 1.4 acres (5,795.2 $m^2$) | 0.3% |
| Forested Wetland | 30.0 acres (121,212.0 $m^2$) | 6.9% |
| Herbaceous Wetland | 1.2 acres (4,856.2 $m^2$) | 0.3% |
| Herbaceous Field | 12.8 acres (51,812.0 $m^2$) | 3.0% |
| Water/Open Water Wetland | 2.7 acres (11,046.7 $m^2$) | 0.6% |
| Scrub-Shrub | 5.4 acres (21,997.1 $m^2$) | 1.3% |
| Scrub-Shrub - Evergreen | 15.7 acres (63,678.4 $m^2$) | 3.6% |
| Scrub-Shrub Wetland | 6.6 acres (26,833.8 $m^2$) | 1.5% |
| Agricultural | 9.5 acres (38,445.1 $m^2$) | 2.2% |

As discussed in the Habitat Suitability Assessment Report (see Appendix II-E1), there are Federal and State records for threatened and endangered species and/or their habitat within the New Jersey Onshore Study Area, primarily along the onshore interconnection cable route and substation and/or converter station options. However, the Study Area includes locations adjacent and proximate to the Project Area where Project activities will not occur. Most of the New Jersey Onshore Project Area consists of, or is surrounded by, developed areas (e.g., residential, commercial, and industrial development, highways, railroads, and utility transmission lines) that experience frequent and ongoing anthropogenic effects. Therefore, while habitat for threatened and endangered species may be present within the Project Area, ongoing anthropogenic disturbances are likely to deter these species, thereby making these areas unsuitable for protected species.

The only wildlife species observed within the New Jersey Onshore Project Area were transient individuals flying overhead and included species such as: herring gull (*Larus argentatus*), laughing gull (*Leucophaeus atricilla*), house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*) and other common avian species adapted to developed/disturbed habitat types. No reptile, amphibian or mammal species were observed. Additionally, no federal and state-listed threatened and endangered species were observed within the New Jersey Onshore Project Area during field studies. Furthermore, no vernal pool habitat was observed within the New Jersey Onshore Project Area as discussed in the Habitat Suitability Assessment Report in Appendix II-E1.

The landfall site and POI options are comprised of already disturbed or developed parcels of land or paved streets. As such it was determined that none of these sites have habitat suitable for supporting wildlife species. The beach habitat adjacent to the landfall site options will be entirely avoided because the export cable makes landfall via HDD from an offshore location beyond the toe-of-slope of the beach.

### 4.2.1.2 Coastal Terrestrial Habitat and Fauna – New York Onshore Project Area

Atlantic Shores has also preferentially sited the New York Onshore Project Area to avoid or minimize impacts to wildlife habitat to the maximum extent practicable by locating Project activities in urbanized and previously developed areas. Based on field surveys and desktop analysis, the New York Onshore Project Area is comprised of approximately 69% developed or disturbed areas. The remaining documented habitat within the New York Onshore Project Area consists of forests (mixed and deciduous), wetlands (herbaceous and scrub-shrub), open water, herbaceous fields, and scrub-shrub. Much of this habitat occurs along the edge of already developed or disturbed areas in the New York Onshore Project Area and was determined to be marginal edge habitat.

To further avoid potential impacts to these habitats, the onshore interconnection cable will be installed using trenchless installation techniques (e.g., jack-and-bore, pipe jacking or HDD) at all wetland/water crossings (e.g., tidal emergent wetlands, non-tidal wetlands, and surface waters). Trenching will be used to install the onshore interconnection cable within previously disturbed and developed upland areas such as along existing road ROWs.

Surveys were conducted to identify and document wildlife habitat with specific attention to those habitats potentially suitable to support Federal and State-listed threatened and endangered species. The Habitat Suitability Assessment Report in Appendix II-E2 provides details on the types of habitats present within the New York Onshore Project Area. Table 4.2-2 summarizes the acreage of each habitat type observed within the New York Onshore Project Area according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in Appendix D of the Habitat Suitability Assessment Report in Appendix II-E2.

**Table 4.2-2. Estimated Area and Percent Cover of Habitat Types within the New York Onshore Project Area**

| Habitat Type | Acres | Percentage |
|---|---|---|
| Developed / Disturbed | 464.6 acres (1,880,177.0 m$^2$) | 69.0% |
| Forest – Mixed | 0.9 acres (3,642.2 m$^2$) | 0.1% |
| Forest – Deciduous | 37.3 acres (150,948.3 m$^2$) | 5.5% |
| Forested Wetland | 10.6 acres (42,896.8 m$^2$) | 1.6% |
| Herbaceous Wetland | 81.7 acres (330,629.5 m$^2$) | 12.1% |
| Herbaceous Field | 24.8 acres (100,362.4 m$^2$) | 3.7% |
| Open Water Wetland | 4.7 acres (19,020.3 m$^2$) | 0.7% |
| Water | 36.4 acres (147,306.2 m$^2$) | 5.4% |
| Scrub-Shrub | 12.5 acres (50,585.9 m$^2$) | 1.9% |
| Scrub-Shrub Wetland | 0.003 acres (12.1 m$^2$) | <0.1% |

NYSDEC maintains a database of significant natural communities which are determined using occurrence quality ranks in conjunction with global and state rarity ranks (NYSDEC 2011).

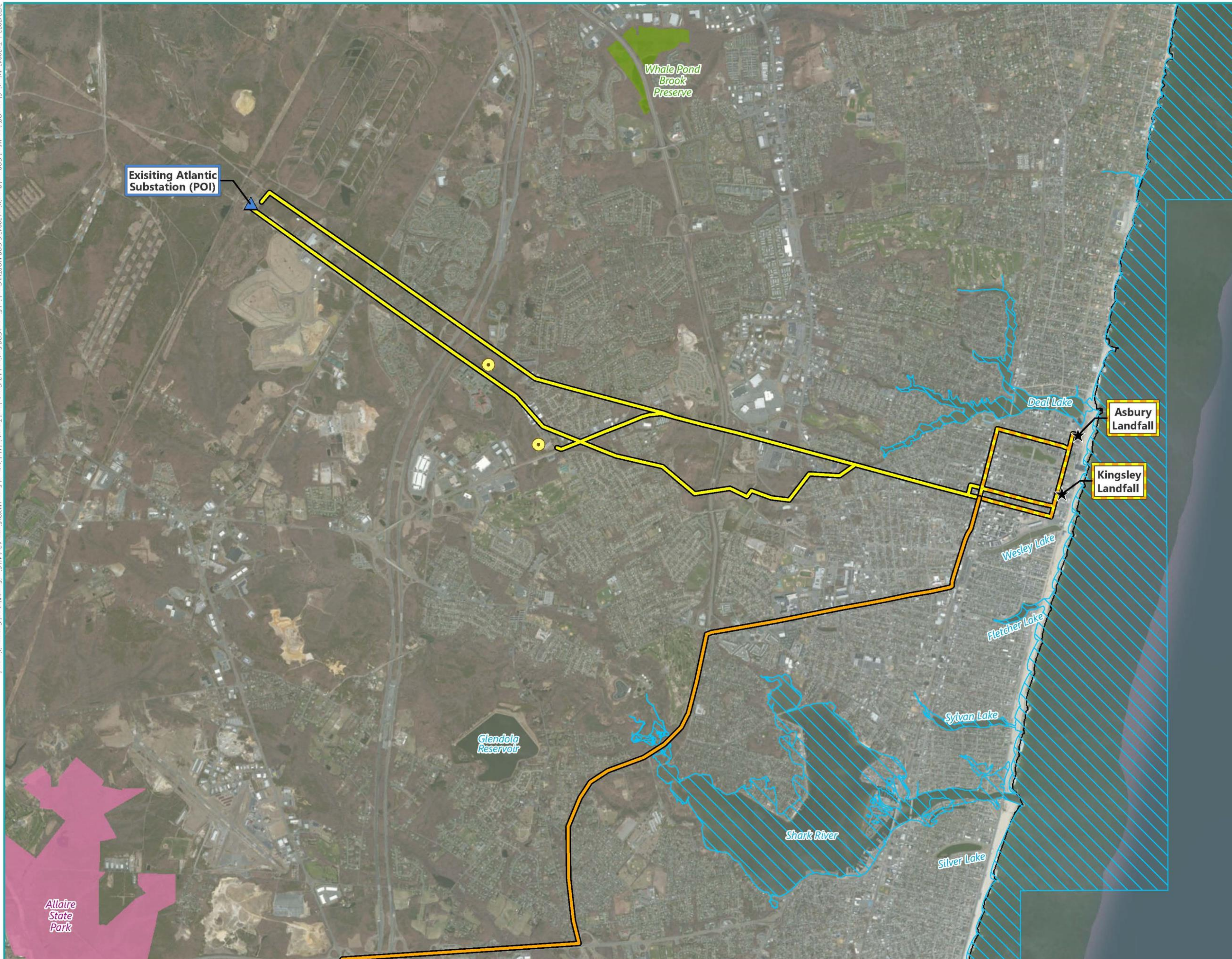
Given the co-location of the onshore interconnection cable route options within paved roadways or developed roadside edges and the developed nature of the landfall and onshore substation and/or converter station site options, these significant natural communities would be largely avoided. However, some portions of the onshore interconnection cable route and substation and/or converter station site options occur within and proximate to the following significant natural communities as shown in Figure 4.2-2 and as follows:

- Coastal oak-beech forest
- Red maple-sweetgum swamp
- Post oak-blackjack oak barrens.

In addition to significant natural communities, the NYSDOS maintains a database of significant coastal fish and wildlife habitat which identifies areas that provide habitat for wildlife that are economically important (NYSDOS 2022). These features are largely avoided due to the co-location of Project components within developed or disturbed areas (e.g., paved roadways); however, the following significant coastal fish and wildlife habitats are mapped within and proximate to portions of the onshore interconnection cable route and substation and/or converter station site options:

- Fresh Kills Coastal Habitat
- Sawmill Creek Marshes Coastal Habitat
- Lemon Creek Coastal Habitat.

As discussed in the Habitat Suitability Assessment Report (see Appendix II-E2), there are federal and state records for threatened and endangered species and/or their habitat within the New York Onshore Study Area, primarily along the onshore interconnection cable route and proximate to the substation and/or converter station options. However, the Project Area largely consists of, or is surrounded by, developed areas (e.g., high-density commercial, residential, and industrial development, highways, roadways) that experience frequent and ongoing anthropogenic effects. Therefore, while habitat for threatened and endangered species may be present within the Project Area, ongoing anthropogenic disturbances are likely to deter these species, thereby making these areas unsuitable for protected species.




ATLANTIC SHORES offshore wind

NEW JERSEY
NEW YORK
NEW JERSEY

0 1,500 3,000 6,000 Feet

0 500 1,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: Esri ArcGIS Online "World Imagery" map service.

N W E S

**LEGEND**

- Tidelands
- Preserve
- State Park
- Potential Landfall
- Potential Atlantic Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Larrabee Onshore Interconnection Cable Route Option
- Atlantic Onshore Interconnection Cable Route Option
- Atlantic or Larrabee Onshore Interconnection Cable Route Option

**Figure 4.2-1**

*Sheet 1 of 2*

*NJ Significant Natural Communities Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County, New Jersey*

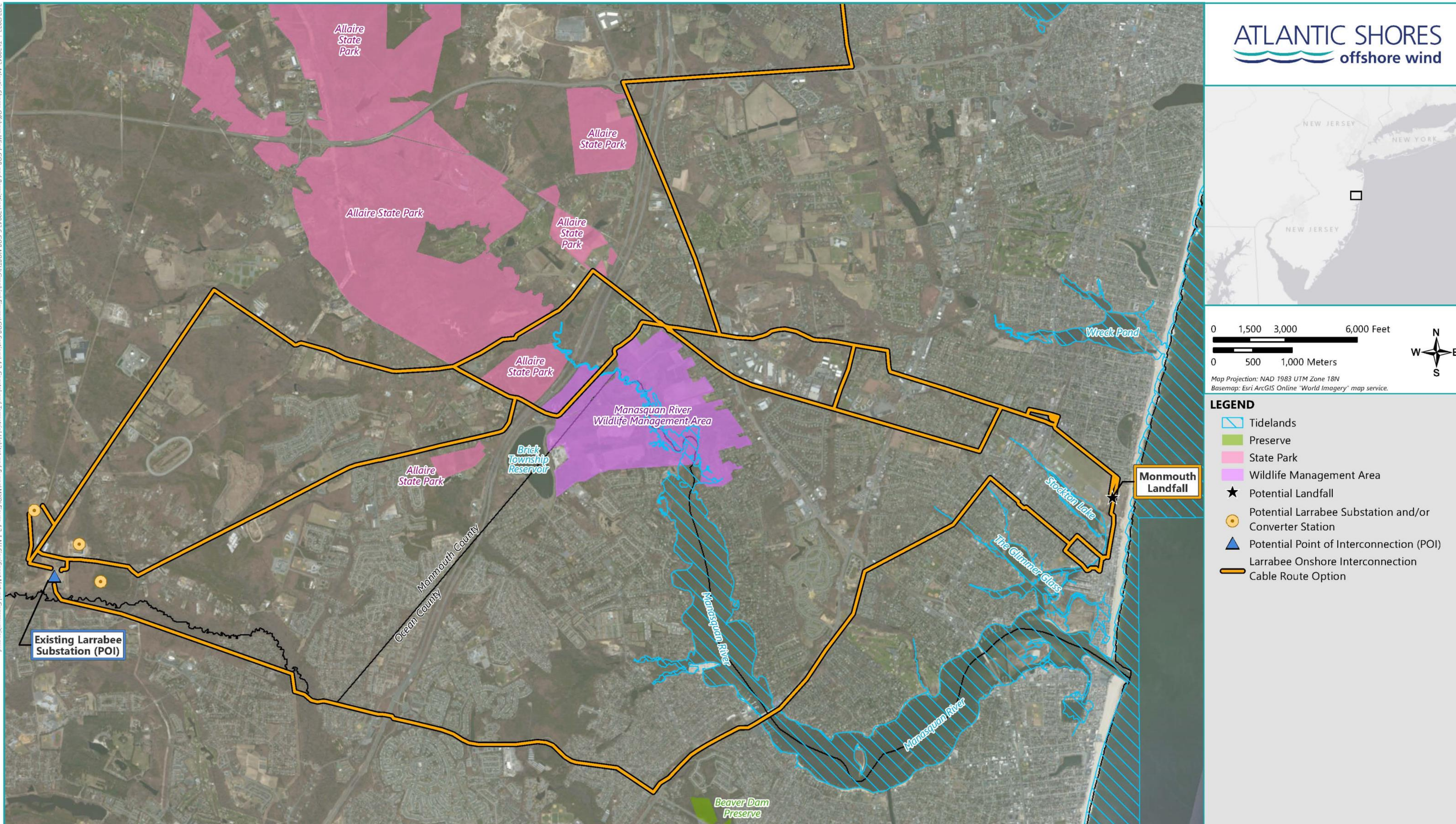



**Figure 4.2-1**

*Sheet 2 of 2*

*NJ Significant Natural Communities Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County, New Jersey*

3/22/2023 | T:\20043_Atlantic Shores Offshore Wind_COP and Permitting\20043.6_COP NORTH\Graphics\Figures\COP Sections\4.2_Coastal and Terrestrial Habitat and Fuana\MXD\Figure 4.2-1 NJ Significant Natural Communities.mxd

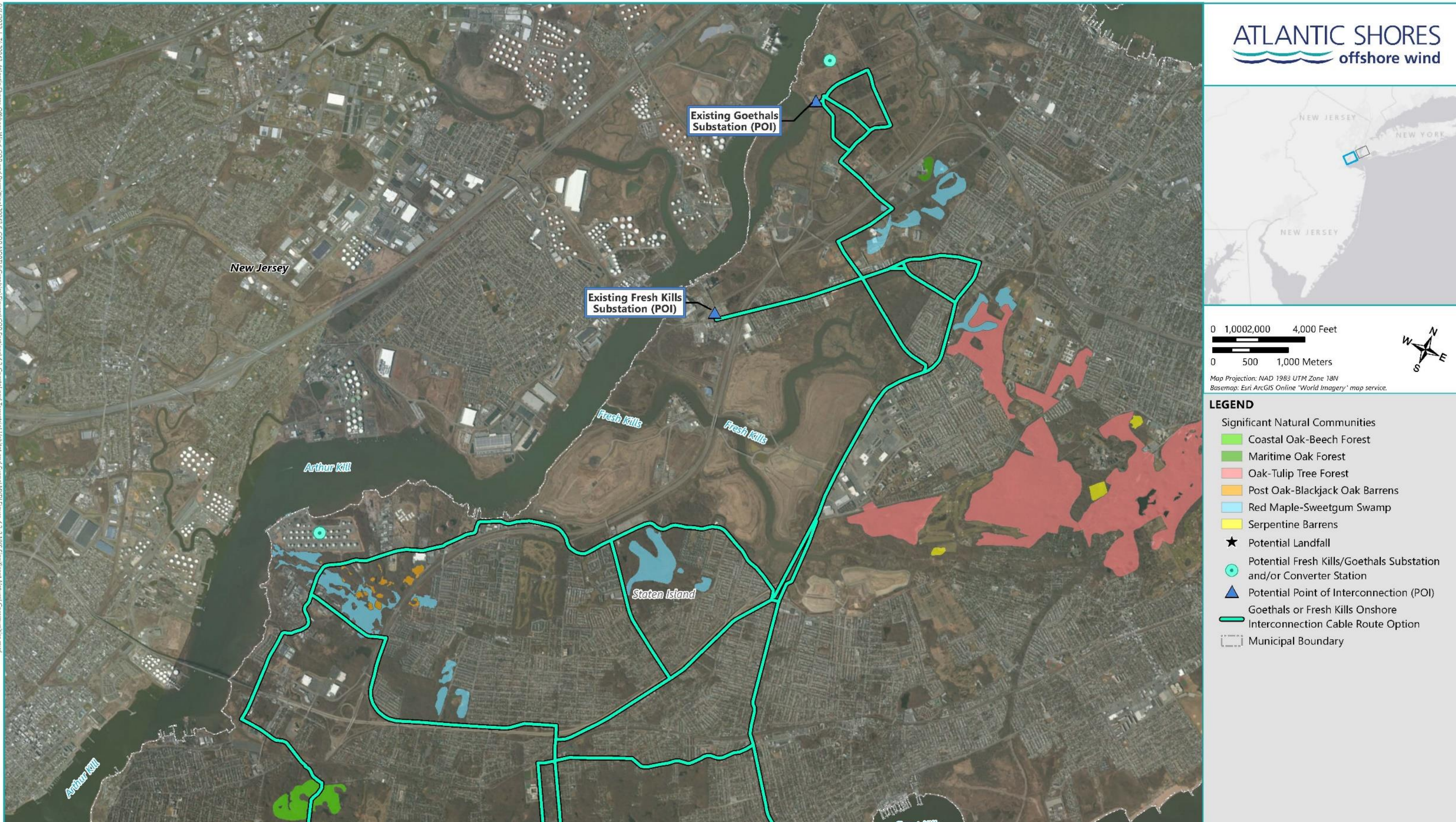



**Figure 4.2-2**

*Sheet 1 of 2*

*NYS Significant Natural Communities Landfall and Onshore Interconnection Cable Route Options Richmond County, NY*


ATLANTIC SHORES offshore wind


0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

N E S W

Map Projection: NAD 1983 UTM Zone 18N
Basemap: Esri ArcGIS Online "World Imagery" map service.

**LEGEND**

- Potential Landfall
- Potential Gowanus Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Gowanus Onshore Interconnection Cable Route Option
- Municipal Boundary

**Figure 4.2-2**

*Sheet 2 of 2*

*NYS Significant Natural Communities Landfall and Onshore Interconnection Cable Route Options Richmond and Kings County, NY*

9/7/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\4.2 Coastal and Terrestrial Habitat and Fauna\MXD\Figure 4.2-2 NYS Significant Natural Communities.mxd

The only wildlife species observed within the New York Onshore Project Area were transient individuals flying overhead and included species such as: herring gull (*Larus argentatus*), laughing gull (*Leucophaeus atricilla*), house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), and other common avian species adapted to developed/disturbed habitat types. No reptile, amphibian or mammal species were observed. Additionally, no federal or state-listed threatened and endangered species were observed within the New York Onshore Project Area during field studies. Furthermore, no vernal pool habitat was observed within the New York Onshore Project Area as discussed in the Habitat Suitability Assessment Report in Appendix II-E1.

The landfall site and substation and/or converter station site options are comprised of already disturbed or developed areas (e.g., parking areas, existing utilities, industrial activities). As such, it was determined that none of these sites have habitat suitable for supporting federal or state listed threatened and endangered wildlife and/or plant species. The beach habitat adjacent to the landfall site along the southern shore of Staten Island will be entirely avoided because the export cable makes landfall via HDD from an offshore location beyond the toe-of-slope of the beach. All other landfall locations have developed waterfronts where beach habitat does not occur.

### 4.2.2 Potential Impacts and Proposed Environmental Protection Measures

The New Jersey and New York onshore interconnection cable route options have largely been co-located within existing linear infrastructure such as roadways and utility line ROWs. The landfall site options, onshore substations and/or converter station site options, and POIs have been located in disturbed or developed areas to the maximum extent practicable to avoid and minimize potential impacts to wildlife and their habitat. Most impacts will be avoided, and the remaining potential IPFs that may affect coastal and terrestrial habitat and fauna during Project construction, O&M, or decommissioning are presented in Table 4.2-3. This section also provides an evaluation of potential effects during each Project phase for a given IPF and the anticipated environmental protection measures to be implemented to avoid potential effects.

**Table 4.2-3. Impact Producing Factors for Coastal and Terrestrial Habitat and Fauna**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Land Disturbance | ● | | |
| Noise and Vibration | ● | ● | ● |
| Presence of Structures and Cables | | ● | ● |
| Traffic (Vehicles and Equipment) | ● | ● | ● |
| Light | ● | ● | ● |

Coastal and terrestrial habitat and fauna may also be affected by discharges from onshore point and non-point sources and accidental releases, including fuel, fluids, hazardous materials, and trash/debris. These potential impacts are considered to have a low likelihood of occurrence and are discussed in Sections 9.2.3 and 9.2.4.

The maximum Project Design Envelope (PDE) analyzed for potential impacts to coastal and terrestrial habitat and fauna is the maximum onshore build-out options of the Project (see Section 4.11 of Volume I). The construction of each onshore Project component is described in Sections 4.7, 4.8, and 4.9 of Volume I. Also included in Volume I are details of the anticipated routine O&M activities for the onshore facilities (see Section 5.4.5) and decommissioning (See Section 6.2.6).

#### 4.2.2.1 Land Disturbance

As detailed in Section 4.2.1, construction of the Project's onshore facilities would occur predominantly within existing roadways, and other established ROWs and/or developed and disturbed areas. Due to current human activity, the New Jersey and New York Onshore Project Areas provide limited habitat for common wildlife. As such, any impacts to wildlife and their habitat from Project land disturbing activities (e.g., trenching/excavating, grading) are expected to be temporary and localized to the designated construction work areas.

The specific land disturbances associated with the installation of underground onshore interconnection cable duct banks and splice vaults will include direct trenching and excavation in uplands and disturbed areas of these established ROWs at a width sufficient to accommodate these components plus construction work areas. In locations where the onshore interconnection cables cross surface waters, wetlands or other sensitive habitats, trenchless installation of the onshore interconnection cables will be used such as jack-and-bore, jack piping, and HDD. Work areas for these installation types will be located in adjacent disturbed upland areas to entirely avoid impacts to wildlife habitats. Limited tree trimming/clearing may be necessary along portions of the onshore interconnection cable routes or at the substation and/or converter station site options but will be the minimum necessary to install the project components, will not include mature trees, and will be conducted during the winter months to avoid impacts to avian and bat species to the maximum extent practicable (see Section 4.3 Birds and Section 4.4 Bats).

Impacts to wildlife and their habitats are expected to be avoided entirely at the proposed landfall sites. The proposed cable transition vaults will be located in upland areas that are already developed and/or disturbed. Sensitive beach and dune habitats located proximate to some of the landfall options will also be avoided by landing the export cable with HDD installation methods from the landfall site to a point in the ocean beyond the toe-of-slope of the beach. Tables 4.2-4 and 4.2-5 provide a summary of the potential temporary and permanent impacts to habitats within the Project Area. Permanent and temporary impacts that would be avoided using trenchless installation technologies for New Jersey and New York are also included.

## Table 4.2-4. New Jersey Habitat Potential Impact Summary

| Habitat Type | Potential Project Impacts (acres/m²) | | Impacts Avoided Using Trenchless Installation (acres/m²) |
|---|---|---|---|
| | Temporary | Permanent | |
| Developed / Disturbed | 147.3 acres (596,104.3 m²) | 137.1 acres (554,826.2 m²) | 4.4 acres (17,806.2 m²) |
| Forest – Mixed | 3.8 acres (15,378.1 m²) | 12.2 acres (49,371.8 m²) | 3.0 acres (12,140.6 m²) |
| Forest – Deciduous | 1.1 acres (4,451.6 m²) | 39.0 acres (157,828.0 m²) | 0.3 acres (1,214.1 m²) |
| Forest – Evergreen | 0.9 acres (3,642.2 m²) | 0.6 acres (2,428.1 m²) | - |
| Forested Wetland | 1.5 acres (6,070.3 m²) | 27.7 acres (112,098.4 m²) | 0.8 acres (3,237.5 m²) |
| Herbaceous Wetland | 0.6 acres (2,428.1 m²) | 0.6 acres (2,428.1 m²) | - |
| Herbaceous Field | 5.2 acres (21,043.7 m²) | 6.8 acres (27,518.7 m²) | 0.8 acres (3,237.5 m²) |
| Water/Open Water Wetland | 0.6 acres (2,428.1 m²) | 1.0 acres (4,046.9 m²) | 1.1 acres (4,451.5 m²) |
| Scrub-Shrub | 3.2 acres (12,950.0 m²) | 2.2 acres (8,903.1 m²) | - |
| Scrub-Shrub - Evergreen | - | 15.7 acres (63,535.9 m²) | 0.1 acre (404.7 m²) |
| Scrub-Shrub Wetland | 4.1 acres (16,592.1 m²) | 2.4 acres (9,712.5 m²) | 0.03 acres (121.4 m²) |
| Agricultural | <0.1 acres (<404.1 m²) | 9.5 acres (38,445.1 m²) | - |

## Table 4.2-5. New York Habitat Potential Impact Summary

| Habitat Type | Potential Project Impacts (acres/m²) | | Impacts Avoided Using Trenchless Installation (acres/m²) |
|---|---|---|---|
| | Temporary | Permanent | |
| Developed / Disturbed | 145.0 acres (586,796.5 m²) | 3283.6 acres (1,147,693.1 m²) | 1.9 acres (7,869.1 m²) |
| Forest – Mixed | 0.1 acres (404.7 m²) | <0.1 acres (<404.7 m²) | 0.7 acres (2,832.8 m²) |

| Habitat Type | Potential Project Impacts (acres/$m^2$) | | Impacts Avoided Using Trenchless Installation (acres/$m^2$) |
|---|---|---|---|
| | Temporary | Permanent | |
| Forest – Deciduous | 1.4 acres (5,665.6 $m^2$) | 35.7 acres (144,472.8 $m^2$) | 0.1 acre (404.7 $m^2$) |
| Forested Wetland | 0.1 acre (404.7 $m^2$) | 10.5 acres (42,492.2 $m^2$) | - |
| Herbaceous Wetland | 0.4 acres (1,618.7 $m^2$) | 76.5 acres (309,585.7 $m^2$) | 2.2 acres (8,093.1 $m^2$) |
| Herbaceous Field | 0.1 acres (404.7 $m^2$) | 23.2 acres (93,887.4 $m^2$) | 1.1 acres (4,451.6 $m^2$) |
| Water/Open Water Wetland | <0.1 acres (<404.1 $m^2$) | 38.6 acres (156,209.3 $m^2$) | 1.2 acres (4,856.2 $m^2$) |
| Scrub-Shrub | 0.1 acres (404.7 $m^2$) | 11.2 acres (45,325.0 $m^2$) | 0.6 acres (2,428.1 $m^2$) |
| Scrub-Shrub Wetland | <0.1 acres (<404.1 $m^2$) | - | - |

Limited effects to wildlife habitat in and around the POI locations are expected because these facilities are sited within previously disturbed areas. Existing forested habitat around the Larrabee and Atlantic POI does not support any federal or state threatened or endangered species because of the surrounding land uses and fragmented forest characteristic of this area. The areas surrounding the Fresh Kills, Goethals and Gowanus POI are significantly developed and/or disturbed and virtually no natural habitat is mapped. Limited tree clearing may occur around POIs with adjacent forests, which could have a short-term effect on local wildlife, particularly bird and bat species (see Section 4.3 Birds and 4.4 Bats, respectively); however, any tree clearing would be limited to non-mature trees in fragmented wooded areas, the minimum necessary, and will only be conducted during the winter months to the maximum extent practicable. Moreover, the surrounding land uses at these locations are industrial/commercial with no natural wildlife habitat proximate to the sites.

There are no wetlands or waterbodies located at the landfall site options (see Section 4.1 Wetlands and Waterbodies and Appendix II-D1 and Appendix II-D2). Along the onshore interconnection cable route options, Atlantic Shores will avoid wetland and waterbody habitats by installing the cables using trenchless technology such as jack-and-bore, jack piping or HDD. To prevent indirect impacts to sensitive habitats, such as soil erosion and sedimentation from land disturbing construction activities, Atlantic Shores will comply with an approved Soil Erosion and Sediment Control Plan, New Jersey Pollutant Discharge Elimination System (NJPDES) permit and/or New York State Pollutant Discharge Elimination System (SPDES) permit and a Stormwater Pollution Prevention Plan (SWPPP). Best management practices (BMP) that would be implemented include dust abatement, installation of silt fencing, filter socks, inlet filters, and other State-approved BMPs. Section 3.2 Water Quality provides additional detail on potential effects on water quality and the proposed BMPs to avoid or reduce impacts.

An Environmental/Construction monitor will also be onsite to ensure that BMPs are installed in accordance with the approved Soil Erosion and Sediment Control Plan, NJPDES, SPDES and other permit conditions. All temporarily disturbed areas will be restored to preconstruction conditions as required and where necessary such as seeding or repaving.

Land disturbing activities are not anticipated as part of routine O&M or decommissioning. Vehicle and equipment use would occur along roads using the manholes within the splice vaults and transition vaults for access and within previously developed areas such as onshore substations and/or converter stations.

#### 4.2.2.2 Noise and Vibration

Project-related noise and vibrations generated from onshore Project construction activities are discussed in detail in Section 8.1 In-Air Noise and the Onshore Noise Report in Appendix II-V. The Onshore Project Area is situated within or adjacent to busy roadways or in industrial/commercial development where significant background noise and vibration regularly occurs. Area wildlife populations are expected to be habituated to the background noise and vibration levels and will either be unaffected by the additional noise and vibration during construction activities or will temporarily relocate away from the area. As a result, impacts are expected to be localized and short-term. Construction equipment will generate noise and vibrations at levels that could temporarily displace common wildlife species inhabiting areas near construction activities during the time of equipment usage. The localized and short-term impacts are not expected to result in population level impacts. To address the intermittent increases in noise levels during construction, Atlantic Shores will make reasonable efforts to minimize noise impacts from construction such as adhering to permitted hours of construction in each municipality and using lower decibel producing equipment (e.g., smaller backhoes) when feasible.

Anticipated O&M activities such as inspections of facilities, repair of substation and/or converter station equipment, and other routine O&M activities may generate noises and vibrations that could disturb nearby wildlife. However, the duration and severity of the disturbance would depend on the nature, and level of noise produced by the O&M activity and proximity of wildlife. Maintenance and other required repair activities to either cables or substations and/or converter stations may generate noise that could cause localized wildlife to be temporarily displaced but is consistent with the existing uses and activities within the Onshore Project Area and are not considered an impact.

When in operation, substation and/or converter station transformers and cooling fans would be the loudest equipment in use and generate relatively low-level, continuous noise. However, the substation and/or converter station site options are located within commercial/industrial areas with existing industrial sound sources and relatively high ambient noise levels (Appendix II-V). Noise generated from project equipment is not expected to significantly increase the background noise in the area to a level that would impact local wildlife and will be mitigated by the incorporation of noise-reducing design features such as strategically placed noise barriers on equipment and other features required to comply with local noise ordinances.

Decommissioning activities are not expected to result in any noise impacts to wildlife. The onshore Project facilities are expected to remain in place or repurposed for other uses. Occasional vehicle uses along the existing roadways or within the fenced area of the substation and/or converter station may cause additional noise and vibration but is expected to be of the magnitude and duration consistent with routine O&M activities and not have any impact to local wildlife. Any incidental impacts to wildlife species would be localized and short-term and not be materially different from existing conditions.

#### 4.2.2.3 Presence of Structures and Cables

All substation and/or converter station locations are proposed in or proximate to developed or disturbed areas. Any interactions between installed electrical components (such as cable and substation and/or converter station structures) and wildlife during routine O&M and decommissioning are expected to be incidental and infrequent with limited, if any, effect on wildlife, including threatened and endangered species. The cables, splice vaults, and transition vaults will be underground within existing roads and other linear development ROWs and will not impact wildlife or their habitat.

#### 4.2.2.4 Vehicle Traffic

Impacts to wildlife and their habitat from Project-related vehicle traffic are not anticipated in the portions of the Onshore Project Area that are within developed areas and currently experience regular traffic. Vehicle traffic associated with the construction and operation of onshore facilities will represent incremental increases in traffic volume mainly during construction and will be concentrated along the onshore interconnection cable routes and at the substations and/or converter stations. The anticipated Project-related vehicle traffic over the phases of the Project is discussed in Section 7.9 Onshore Transportation and Traffic. There would not be any increase in vehicle traffic volume during routine O&M as the area roadways have high levels of traffic concentrated near ports, and substations/converter stations. Wildlife will not be exposed to greater risk of disturbance or injury from Project-related vehicle traffic because most Project-related vehicle traffic will travel along existing roadways, accesses, and ROWs, which already experience a substantial daily traffic volume.

Risks of impacts to wildlife from Project-related vehicle traffic may increase along the portions of the Onshore Project Area that occur within areas that do not currently experience consistent vehicular traffic (e.g., electric utility ROWs). During construction, mechanized equipment traffic could disturb or displace local wildlife, but these impacts would be similar to those caused by human presence, land disturbance, and noise/vibration that already occur. Any vehicle-related impacts on wildlife are expected to be localized and limited to the duration of construction. Limited mobility species, such as snakes and turtles, have a low probability of directly encountering vehicles because of the limited populations of these types of species proximate to the current high traffic use areas within the Onshore Project Area. Use of standard erosion and sedimentation control BMPs such as silt fences along the limits of construction would prevent these species from entering the construction work areas. Additionally, vehicle-related impacts on wildlife during routine O&M and decommissioning activities would be accidental and rare. All other species are expected to temporarily avoid areas of higher vehicle traffic but return once activities have ceased. Any impacts are expected to be highly localized, short term and not result in any population level impacts.

### 4.2.2.5 Light

During construction, it may be necessary to illuminate portions of the Onshore Project Area in order to maintain safety standards for workers and the surrounding communities. However, nighttime work is expected to be limited for a variety of reasons, including adherence to local zoning ordinances, building permit conditions, and community agreements. Many of the areas along the Onshore Project Area are already illuminated by artificial light due to dense development in the area (i.e., existing substations/converter stations, commercial/industrial areas, or roadways within or proximate to the Onshore Project Area). Impacts to wildlife foraging, nesting, and/or navigation behavior from Project construction lighting during low light hours could occur if nighttime construction is conducted. Any such impacts would be incidental, localized, and short term and the presence of construction workers, equipment, and overall traffic of roadways would likely deter most wildlife species that may be attracted to the light.

The onshore substation and converter stations will require security lighting on buildings during O&M. The lighting will be the minimum necessary to comply with security/safety guidelines and local laws and ordinances. Use of ground-directed lighting may be used so areas adjacent to the onshore substation and/or converter stations are not illuminated. No other portions of the Onshore Project Area will have permanent lighting. As a result, there are no impacts anticipated to wildlife species or their habitats anticipated.

### 4.2.2.6 Summary of Proposed Environmental Protection Measures

Atlantic Shores has preferentially co-located the onshore interconnection cable route options within previously disturbed ROWs and sited its landfall site options on previously disturbed lands to avoid and minimize impacts to wildlife and associated habitat. Impacts to wetlands and streams will be further avoided by installing the onshore interconnection cables using trenchless installation techniques such as jack-and-bore, pipe jacking, and HDD. Additionally, HDD will be used to landfall the export cable from the landfall site options to a point in the ocean beyond the toe-of-slope of the beach (see Section 4.1 Wetlands and Waterbodies). No vernal pools are mapped along the Onshore Project Area. Critical habitat for Federal and State-listed threatened and endangered species could potentially be present in the Onshore Project Area; however, much of the habitat is surrounded by developed areas with frequent and ongoing anthropogenic effects. Therefore, while the habitat may be present, such disturbances likely deter listed species with specific habitat requirements (see Appendix II-E1 and Appendix II-E2). To further avoid and minimize potential impacts to wildlife and their habitat, Atlantic Shores has incorporated the following environmental protection measures, best management practices, and monitoring into design elements and construction, O&M, and decommissioning plans.

- Project facilities and work areas/construction zones have been sited in previously disturbed areas and along existing ROWs to avoid sensitive habitats (e.g., wetlands, waterbodies, forest) to the maximum extent practicable.

- The Project will avoid removing mature trees, remove only the minimum necessary, and do so during the winter months to minimize potential impacts to wildlife species.
- Onshore interconnection cables will be installed underground and use trenchless installation methods such as jack-and-bore, jack piping, and HDD, where there are wetlands, waterbodies, and other sensitive habitats.
- Lower decibel construction equipment (e.g., smaller backhoes) will be implemented when feasible.
- Construction will be conducted during permitted hours, to the maximum extent practicable, when ambient noise levels are highest.
- Time of year restrictions for construction will be followed, as required, through permitting and resource agency consultation (USFWS, NJDEP and/or NYSDEC).
- BMPs such as silt fence, filter socks, inlet protection, dust abatement and other approved BMPs will be implemented in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts to water quality. Additionally, the Project will be constructed in accordance with an approved Soil Erosion and Sediment Control Plans and Stormwater Pollution Prevention Plan to avoid and minimize Project-related water quality impacts to nearby aquatic habitats (see Section 3.2 Water Quality).
- Temporarily disturbed areas will be restored by seeding and/or repaving to preconstruction conditions, where required and as feasible.
- Environmental/Construction Monitor(s) will be assigned to ensure compliance with applicable permit conditions and that BMPs are functional.

As the Project progresses through development and permitting, Atlantic Shores will continue its discussions with the USFWS, NJDEP, and NYSDEC to determine the need for additional avoidance and/or environmental protection measures.

## 4.3 Birds

This section describes the presence of birds and suitable bird habitat in the Offshore and Onshore Project Areas, associated impact producing factors (IPFs), and proposed environmental protection measures to avoid or minimize potential effects to birds during Project construction, operations and maintenance (O&M), and decommissioning. Native birds are Federally protected under the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act (MBTA), and the Endangered Species Act (ESA), and at the State level.

Atlantic Shores recognizes the importance of birds from an ecological and recreational perspective and is committed to understanding patterns of species exposure throughout the Project Areas. Atlantic Shores is participating in ongoing consultation and a research partnership with the New Jersey Department of Environmental Protection (NJDEP), the U.S. Fish and Wildlife Service (USFWS), Wildlife Restoration Partnership (WRP), Biodiversity Research Institute, and New Jersey Audubon, as well as coordinating with the Bureau of Ocean Energy Management (BOEM), the USFWS, and the NJDEP as it implements a Project-specific Avian and Bat Survey Plan (Appendix II-F1) that includes digital aerial surveys and a satellite telemetry study of the Federally protected Red Knot (*Calidris canutus rufa*). Atlantic Shores is also participating in regional stakeholder efforts, including the New York State Environmental Technical Working Group (E-TWG)[10] and the bird and bat subcommittee of the Regional Wildlife Science Collaborative.[11] Atlantic Shores has worked with the USFWS to affix two Motus Wildlife Tracking System (Motus) receiving antennas to separate meteorological buoys in the adjacent Lease Area OCS-A 0499 to monitor the movement of tagged migratory bird species offshore. These studies are designed to build upon and fill gaps from previous survey efforts to support a more complete understanding of the spatial and temporal distributions of bird species throughout the Offshore Project Areas.

### 4.3.1 Affected Environment

The Project occurs within the Mid-Atlantic region, which includes an area from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, and has a gradually sloping sandy bottom without significant underwater features. This shelf area extends up to 93 mi (150 km) offshore, where the waters are approximately 650 ft (200 m) deep. Most of this Mid-Atlantic coastal region is influenced by cool Arctic waters introduced by the Labrador Current, and the region exhibits strong seasonal cycles, with sea surface temperatures ranging from 37 to 86 °F (3 to 30 °C; Williams et al. 2015).

A high diversity of birds may overlap with the Lease Area because it is located towards the middle of the Mid-Atlantic region. This area overlaps with the ranges of both northern and southern species, and falls within the Atlantic Flyway, which is a major migratory pathway for birds in the eastern United States and Canada. Many marine birds migrate along the Atlantic coast in spring and fall, leading to shifts in community composition and variable temporal and geographic patterns.

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[10] https://www.nyetwg.com/

[11] https://neoceanplanning.org/rwse/

The Mid-Atlantic region supports populations of coastal and marine birds in summer. A variety of terrestrial birds breed in the region, some of which breed in the vicinity of the Project. Grebes, waterfowl, wading birds, raptors, shorebirds, songbirds, cormorants, terns and gulls may breed in a variety of coastal and island habitats in the Mid-Atlantic region. ). Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed). In the fall, many of the summer residents leave the area and migrate south to warmer areas and are replaced by species that breed farther north and winter in the mid-Atlantic. Some migrant terrestrial species follow the coastline on their annual migrations, while others choose more direct flight routes over expanses of open water and may overlap with the Lease Area.

For the purpose of this assessment, the affected environment is defined by the bird species expected to occur in the Offshore Project Area and Onshore Project Area during all phases of the Project and the avian habitats that are associated with these areas. Bird species were identified by reviewing multiple, information sources that contain observations and predictions of bird usage in areas overlapping with the Offshore and Onshore Project Areas. For the Offshore Project Area, the primary information sources considered include the following:

- NJDEP Ocean/Wind Power Ecological Baseline Studies (NJDEP Baseline Studies) conducted by Geo-Marine, Inc. (2010). Surveys conducted from 2008-2009 across all seasons.
- Atlantic Shores digital aerial surveys (APEM surveys). Surveys conducted from 2020-2021 across fall, winter, and spring seasons.
- Marine-life Data and Analysis Team (MDAT) models (Curtice et al. 2019). Models based on Northwest Atlantic Seabird Catalog observations from 1978-2016.
- Northwest Atlantic Seabird Catalog (managed by NOAA). Catalog consists of observations from 1938-2019.
- Federal ESA tagging and tracking efforts from 2015-2017 (Loring et al. 2018, 2019, 2020).
- Atlantic Shores Red Knot satellite telemetry study (Appendix II_F3). Birds were tagged and tracked during southbound migrations from 2020-2022.

For birds with no available site-specific information, species accounts and the available scientific literature (see Table 4-6 in Appendix II-F2 for examples) were used to conduct a qualitative assessment. The NJDEP vessel-based surveys and the Atlantic Shores digital aerial surveys provide baseline data for the Lease Area.

#### 4.3.1.1 Offshore Project Area

Species that may pass through the Offshore Project Area include terrestrial migrants (e.g., songbirds), coastal birds (e.g., shorebirds), and marine birds (e.g., loons and sea ducks). Offshore waters provide habitat for marine bird species, including sea ducks, loons, gulls, scoters, terns, auks, gannets, shearwaters, and petrels.

The Project occurs in an area of relatively deep water (66 to 98 ft [20 to 30 m]) that could be used by marine birds such as terns, phalaropes, and shearwaters, which forage on surface prey in offshore waters. However, the MDAT marine bird relative density and distribution models, which integrate oceanographic features such as sea surface temperature that are linked with foraging behaviors (e.g., Jakubas et al. 2020), estimate that avian abundance within the Offshore Project Area will be relatively lower than closer to the New Jersey shore (Figure 4.3-1; Winship et al. 2018). (see Figure 4.3-1). Further, the exposure assessment conducted in Appendix II-F2, and summarized in Table 4.3-4, shows relatively lower use of the Offshore Project Area by marine birds than surrounding areas. In addition, the Atlantic Shores digital aerial surveys indicate that distribution of marine birds is variable between species and seasons, with a coastal and northerly influence for some species, particularly during fall migration (see Appendix II-F2). Due to their Federally protected status, the Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus*), and Roseate Tern (*Sterna dougallii*) are each discussed in more detail. Table 4.3-1 provides a summary of the avian species of conservation concern within the Project Region. The species list was derived from the NJDEP vessel-based surveys (which, in total, recorded 145 species), Atlantic Shores digital aerial surveys, federally listed species, and species that were cross-referenced with the USFWS Information for Planning and Consultation (IPaC) database.

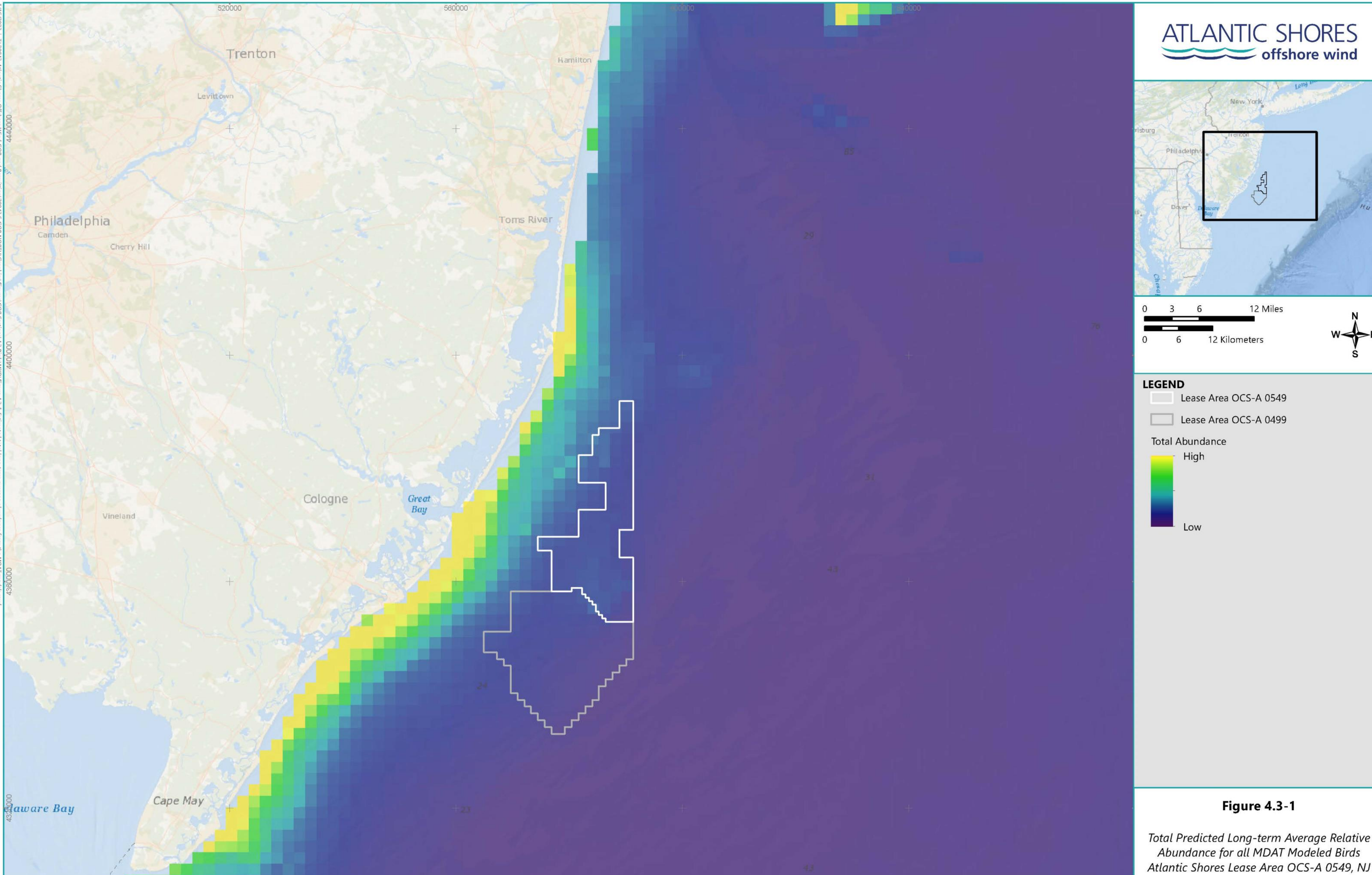



**Figure 4.3-1**

*Total Predicted Long-term Average Relative Abundance for all MDAT Modeled Birds Atlantic Shores Lease Area OCS-A 0549, NJ*

### Table 4.3-1. List of Species Detected or Predicted within the Lease Area and Federally Listed Species that may Occur in the Offshore Project Areas, including Conservation Status

| Common Name | Latin Name | Source | | | | Conservation Status[1] | |
|---|---|---|---|---|---|---|---|
| | | NJDEP | MDAT | APEM | IPaC | Federal | NJ State |
| **Ducks, geese, and swans** | | | | | | | |
| Northern Pintail | *Anas acuta* | • | | | | | |
| American Black Duck | *Anas rubripes* | • | | | | | |
| Gadwall | *Mareca strepera* | • | | | | | |
| **Sea ducks** | | | | | | | |
| Long-tailed Duck | *Clangula hyemalis* | • | • | | | | |
| Black Scoter | *Melanitta americana* | • | • | | | | |
| White-winged Scoter | *Melanitta fusca* | • | • | • | | | |
| Surf Scoter | *Melanitta perspicillata* | • | • | • | | | |
| Common Eider | *Somateria mollissima* | • | • | | | | |
| **Loons** | | | | | | | |
| Common Loon | *Gavia immer* | • | • | • | • | | |
| Red-throated Loon | *Gavia stellata* | • | • | • | • | | |
| **Shearwaters and petrels** | | | | | | | |
| Great Shearwater | *Ardenna gravis* | • | • | | | | |
| Cory's Shearwater | *Calonectris diomedea* | • | • | | | BCC | |
| Wilson's Storm-Petrel | *Oceanites oceanicus* | • | • | | • | | |
| **Gannets** | | | | | | | |
| Northern Gannet | *Morus bassanus* | • | • | • | | | |
| **Cormorants and pelicans** | | | | | | | |
| Brown Pelican | *Pelecanus occidentalis* | • | • | | | | |
| Double-crested Cormorant | *Phalacrocorax auritus* | • | • | | | | |
| **Jaegers and gulls** | | | | | | | |
| Bonaparte's Gull | *Chroicocephalus philadelphia* | • | • | • | | | |
| Herring Gull | *Larus argentatus* | • | • | • | | | |
| Ring-billed Gull | *Larus delawarensis* | • | • | • | | | |
| Lesser Black-backed Gull | *Larus fuscus* | • | | | | | |
| Great Black-backed Gull | *Larus marinus* | • | • | • | | | |
| Laughing Gull | *Leucophaeus atricilla* | • | • | • | | | |
| Black-legged Kittiwake | *Rissa tridactyla* | • | • | • | | | |

| Common Name | Latin Name | Source | | | | Conservation Status[1] | |
|---|---|---|---|---|---|---|---|
| | | NJDEP | MDAT | APEM | IPaC | Federal | NJ State |
| Parasitic Jaeger | *Stercorarius parasiticus* | • | • | | | | |
| Sabine's Gull | *Xema sabini* | • | | | | | |
| **Terns** | | | | | | | |
| Black Tern | *Chlidonias niger* | • | | | | | |
| Forster's Tern | *Sterna forsteri* | • | | | | | |
| Common Tern | *Sterna hirundo* | • | • | | | | SC |
| Royal Tern | *Thalasseus maximus* | • | • | | • | | |
| Roseate Tern | *Sterna dougallii* | | | | • | E | E |
| **Auks** | | | | | | | |
| Razorbill | *Alca torda* | • | • | • | • | | |
| Dovekie | *Alle alle* | • | • | | • | | |
| Common Murre | *Uria aalge* | • | • | | • | | |
| Atlantic Puffin | *Fratercula arctica* | | | | • | | |
| **Shorebirds** | | | | | | | |
| Pectoral Sandpiper | *Calidris melanotos* | • | | | | | |
| American Woodcock | *Scolopax minor* | • | | | | | |
| Red Knot | *Calidris canutus rufa* | | | | • | T | E |
| Piping Plover | *Charadrius melodus* | | | | • | T | E |
| **Passerines** | | | | | | | |
| Northern Flicker | *Colaptes auratus* | • | | | | | |
| Gray Catbird | *Dumetella carolinensis* | • | | | | | |
| Barn Swallow | *Hirundo rustica* | • | | | | | |
| Orchard Oriole | *Icterus spurius* | • | | | | | |
| Dark-eyed Junco | *Junco hyemalis* | • | | | | | |
| Song Sparrow | *Melospiza melodia* | • | | | | | |
| Brown-headed Cowbird | *Molothrus ater* | • | | | | | |
| Purple Martin | *Progne subis* | • | | | | | |
| Bank Swallow | *Riparia riparia* | • | | | | | |
| Ovenbird | *Seiurus aurocapilla* | • | | | | | |
| Northern Parula | *Setophaga americana* | • | | | | | SC |
| Yellow Warbler | *Setophaga petechia* | • | | | | | |
| **Grebes** | | | | | | | |
| Horned Grebe | *Podiceps auritus* | • | • | | | | |

| Common Name | Latin Name | Source | | | | Conservation Status[1] | |
|---|---|---|---|---|---|---|---|
| | | NJDEP | MDAT | APEM | IPaC | Federal | NJ State |
| **Raptors** | | | | | | | |
| Peregrine Falcon | *Falco peregrinus* | • | | | | | |
| Osprey | *Pandion haliaetus* | • | | | | | |

[1] E = Endangered, T = Threatened, SC = Special Concern, BCC = Birds of Conservation Concern

**Listed Species**

Three ESA-listed species may pass through the Offshore Project Area during migration—the Roseate Tern (Endangered), Piping Plover (Threatened), and Red Knot (Threatened). According to the New Jersey Baseline Studies, these protected species are rarely observed offshore near the Lease Area and occur primarily in coastal New Jersey in spring and summer (Geo-Marine 2010) and they were not detected during the Atlantic Shores digital aerial surveys. It should be noted that shorebirds are generally nocturnal migrants and would not necessarily be detected in visual surveys, and that the Red Knot tracking study, discussed below, did indicate the birds may cross the Lease Area during fall migration.

**Piping Plover**

The Atlantic Coast population of the Piping Plover breeds on beaches from Atlantic Canada to North Carolina, and winters in coastal areas of eastern Mexico and the Caribbean. Current tracking data indicates minimal use of the Lease Area by Piping Plovers (Loring et al. 2018; 2020). In a tracking study, involving 102 Piping Plovers, two individual tracks were calculated to overlap with the northern portion of the New Jersey Wind Energy Area (NJWEA; Loring et al. 2019). Modeled flight paths from the same study estimated that the tracks of four birds were in the Lease Area (Appendix 1-F2). It is important to note the terrestrial receiver stations did not fully cover the offshore environment and no Piping Plovers were tagged south of Rhode Island, so flight paths are interpolated from point data. Peak Piping Plover detections occurred on evenings in early August during southwest winds (Loring et al. 2019). The experimental placement of Motus antennas on two Atlantic Shores buoys in 2021 could provide information on Piping Plover movements within the Lease Area; to date, no Piping Plovers have been detected at either buoy.

**Red Knot**

Red Knots migrate each year from the Canadian Arctic, where they breed, to wintering grounds in the southern United States, Caribbean, Brazil, Mexico, and Argentina. On their way, they stop over at a few sites in the Mid-Atlantic region, including coastal New Jersey, to renew depleted energy reserves. This population of Red Knots has two distinct migratory strategies: long- and short-distance migrants. The long-distance migrants generally are expected to fly offshore from coastal New Jersey, while the short-distance migrants are expected to fly down the Atlantic coast.

A Motus study tracked Red Knots tagged in James Bay and the Mingan Islands in Canada, and in Massachusetts and New Jersey. The receiver network was primarily land-based and had limited offshore coverage. Out of 388 birds tagged, three birds (one from Massachusetts and two from New Jersey) were estimated to cross the New Jersey WEA (Loring et al. 2018) and coastal tracking stations indicating that some individuals may be flying offshore (Appendix II-F2). The tagged fall migrants' flights across Federal WEAs, from Massachusetts to Virginia, occurred during fair weather conditions when there were clear skies with little to no precipitation (Loring et al. 2018). The Motus receiving antennas offshore on the Atlantic Shores metocean buoys as well as GPS tracking could provide further information on Red Knot movements in the Lease Area.

Atlantic Shores is currently funding a multi-year study of the migratory patterns of Red Knots using GPS satellite tags deployed on birds staging in New Jersey. The study was initiated in 2020, in collaboration with Wildlife Restoration Partnerships, Normandeau Associates, and the USFWS. The second phase, in 2021, includes the New Jersey Audubon Society and Biodiversity Research Institute as partners. To date, a total of 61 tags have been deployed on Red Knots in New Jersey (29 in 2020, 31 in 2021, 2 in 2022). In 2020, 11 of the tags deployed returned data, while in 2021, 29 of the tags deployed returned data and in 2022, one tag returned data. Of the individuals with tags that provided data in 2020,2021, and 2022 no positions were recorded in the Lease Area. The straight-line flight paths of two birds in 2020, three birds in 2021, and the single bird in 2022 suggest they may have flown through or near to the Lease Area. Overall, for the 2020 birds, the altitude of individual birds varied during their offshore migratory flights, ranging from under 66 ft (20 m) to over 9,843 ft (3,000 m), suggesting that Red Knots adjust their flight height in response to wind and weather, or other factors (Appendix II-F2).

**Roseate Tern**

The northwest Atlantic population of the Roseate Tern has been Federally listed as Endangered under the ESA since 1987. This population breeds in Atlantic Canada and the northeastern United States, and migrates to wintering areas in South America, primarily eastern Brazil. There are no breeding colonies in New Jersey but migrating Roseate Terns can be expected off the coast from late-April to September (see records from the Northwest Atlantic Seabird Catalog in Appendix II-F2). Some data collected using radio-tracking indicate Roseate Terns may occur over 62 mi (100 km) from shore, and that offshore use is higher during morning hours and under high barometric conditions (i.e., fair weather; Goyert et al. 2014; Loring et al. 2019). However, no modeled Roseate Tern flight paths were estimated in the Lease Area by Loring et al. (2019; note that the detection range of coastal receivers is typically less than 9.3 mi [15 km] and the one estimated track of Roseate Terns in coastal New Jersey was well to the west of the Lease Area); no Roseate Terns were detected in the Lease Area during Atlantic Shores digital aerial surveys; and no Roseate Terns were recorded in the NJDEP Baseline Studies data in the Lease Area (Geo-Marine, Inc. 2010). These data suggest exposure events within the Lease Area are rare (Appendix II-F2).

**Black-capped Petrel**

The Black-capped Petrel (*Pterodroma hasitata*) is currently proposed for listing as Threatened under the ESA, due to a declining global population (estimated at fewer than 2,000 breeding pairs; USFWS 2018). Black-capped Petrels breed on Caribbean islands and forage over the deep waters (656 to 6,562 ft [200 to 2,000 m]) of the southwestern North Atlantic, the Caribbean basin, and the southern Gulf of Mexico (Simons et al. 2013). Outside the breeding season, they use U.S. Atlantic waters, especially along the shelf edge of the South Atlantic Bight and are found north to Cape Hatteras and occasionally beyond (Jodice et al. 2015).

Black-capped Petrels are expected to have little to no exposure to the Lease Area because they rarely use areas not directly influenced by the Gulf Stream (Haney 1987) and are found in Atlantic coastal waters of the United States usually only as a result of tropical storms (Lee 2000). None of the Black-capped Petrel observations in the Seabird Catalog (approximately 5,000 records; 1979–2006) are in shelf waters north of Virginia (O'Connell et al. 2009, Simons et al. 2013) and tracking of Black-capped Petrels with satellite transmitters indicates that the birds primarily use areas beyond the shelf break (Atlantic Seabirds 2019; Appendix II-F2). Because these birds have little to no exposure to the Lease Area, they will not be discussed further.

**Eagles**

Eagles are Federally protected under the BGEPA. Bald Eagles (*Haliaeetus leucocephalus*) generally nest and perch close to water in both freshwater and marine habitats, and often stay close to the shoreline. Bald Eagles were only observed within 3.7 mi (6 km) from shore in digital aerial surveys of the Mid-Atlantic offshore region (Williams et al. 2015b), and no eagles were observed offshore during the NJDEP vessel-based surveys, only in nearshore waters. Golden Eagles (*Aquila chrysaetos*) use open habitats and forested regions (Katzner et al. 2012). They commonly winter in the southern Appalachian Mountains and are observed in the Mid-Atlantic United States but are not expected to fly offshore. Because the general morphology of both species discourages long-distance movements in offshore settings (Kerlinger 1985)—they generally rely on thermal formation during long-distance movements, which develop poorly over the open ocean—they are not expected in the Lease Area and will not be discussed further.

### 4.3.1.2 Onshore Project Area

As detailed in Sections 4.7 and 4.9 of Volume I, the Project includes potential landfall sites in New Jersey and New York and associated onshore interconnection cable route options, substations, and/or converter stations. Onshore interconnection cables will travel underground primarily along existing roadways, utility rights-of-way (ROWs), and/or along bike paths. To the extent practicable, substations and/or converter stations will be sited and built on previously developed or disturbed land.

Because the onshore Project cable routes will be located entirely underground, limited bird habitat will be altered or lost (98 to 100% of these routes is co-located with existing linear infrastructure and 69 to 99% of the habitat adjacent to the routes is already disturbed [Appendix II-F2]). Eight substations and/or converter stations have been proposed for two separate parcels, one which includes previous agricultural land with patches of forested areas and one of which consist of entirely undeveloped deciduous and mixed forest and forested wetlands, which could result in modification of suitable bird habitat. Depending on the amount and type of habitat disturbance, bird and/or habitat assessment field surveys may be conducted in consultation with state and federal agencies. Otherwise, only temporary disturbances are expected to affect onshore areas during the construction phase, as other onshore Project components are almost entirely co-located with existing disturbed areas.

While little bird habitat is expected to be permanently altered by onshore Project components, there is a high diversity of birds present in the broader Onshore Project Area. Within a 9.3 mi (15 km)[12] radius of Onshore Project Area, eBird records indicate that 290 species have been recorded in the area (eBird 2022). Generally, waterfowl are most abundant between October and March, and that shorebird abundance peaks during spring and fall migration. Gull species are generally most abundant during the fall and winter, although some species such as the Herring Gull and Great Black-backed Gull can be observed year-round. Terns occur almost exclusively during spring, summer, and fall, with most arriving in April and May and leaving by October. Most raptor species that occur in the Onshore Project Area can be found throughout the year at varying levels of abundance; however, Broad-winged Hawks (*Buteo platypterus*) only occur during the summer and Rough-legged Hawks (*Buteo lagopus*) only occur in winter. Many species groups of songbirds are primarily spring and summer residents, including flycatchers, vireos, swallows, and warblers. Temporal trends of other songbirds are highly species-specific.

There are many State-listed species within the general Onshore Project Area (Table 4.3-2). However, disturbance of any habitat will be limited, and construction activities will be phased to limit impacts to discrete areas and therefore will impact only a specific area for a short period of time. Atlantic Shores will adhere to seasonal construction restrictions in coordination with local authorities at the landfall locations and for certain portions of the onshore interconnection cable routes to avoid impacts during peak usage periods (e.g., summer shore season which is generally from Memorial Day to Labor Day). To further avoid potential impacts, the onshore interconnection cable will be installed using trenchless installation techniques (e.g., jack-and-bore, pipe jackings or horizontal directional drilling [HDD]) at all wetland/water crossings (e.g., tidal emergent wetlands, non-tidal wetlands, and surface waters) to avoid impacts to these habitats. Trenching will be used to install the onshore interconnection cable within previously disturbed and developed upland areas such as along existing road and utility line rights-of-way (ROWs). By locating onshore Project activities in previously developed areas, away from sensitive ecological resources, most effects to State-listed bird species will be avoided.

Piping Plovers breed in New Jersey and New York, arriving in March and generally departing by October, with peak abundances between April and August (Appendix II-F2). Nesting could occur near the Export Cable Corridor (ECC) landfalls. Exact nesting locations are not made public, but the birds have been documented to nest close to the southern part of the Monmouth Landfall Area (Appendix

[12] The radius captures the onshore infrastructure associated with the Project plus a buffer to account for both variable eBird effort and the migratory birds that may occur but were not directly observed in the Onshore Project Area.

II-F2). Red Knots are observed in coastal New Jersey and New York during migration, with abundance peaks in May and August–October during most years, and they are largely absent from December to April. Red Knots do not breed in New Jersey or New York. Cable landfalls are not in areas being considered as critical habitat for Red Knots[13] (Appendix II-F2). Few Roseate Terns are observed in the onshore New Jersey region and in the general area around the New York landfalls (eBird 2020), and this species breeds on coastal islands from eastern Long Island (95% of New York's Roseate Terns breed on Great Gull Island [Southold]), New York, to Atlantic Canada (Gochfeld and Burger 2020).

[13] https://fws.gov/northeast/red-knot/

## Table 4.3-2. List of Listed Species Observed by eBird Users in the General Onshore Project Areas

| | | | New Jersey[1] | | | New York[2] | | |
|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Federally Listed** | **State Listed** | **SGCN** | **Focal Species** | **State Listed** | **SGCN** | **High Priority** |
| Brant | *Branta bernicla* | | | • | | | | |
| American Black Duck | *Anas rubripes* | | | • | | | • | • |
| Northern Pintail | *Anas acuta* | | | • | | | • | |
| Common Eider | *Somateria mollissima* | | | • | | | • | |
| Hooded Merganser | *Lophodytes cucullatus* | | • | | | | | |
| Pied-billed Grebe | *Podilymbus podiceps* | | • | • | • | | • | |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | | • | • | | | • | |
| Common Nighthawk | *Chordeiles minor* | | • | • | | | • | • |
| Chimney Swift | *Chaetura pelagica* | | | • | | | | |
| King Rail | *Rallus elegans* | | • | • | | | • | • |
| Clapper Rail | *Rallus crepitans* | | | • | | | | |
| Virginia Rail | *Rallus limicola* | | • | | | | | |
| Common Gallinule | *Gallinula galeata* | | • | | | | | |
| American Oystercatcher | *Haematopus palliatus* | | • | • | • | | | |
| Piping Plover | *Charadrius melodus* | T | • | • | • | • | • | • |
| Whimbrel | *Numenius phaeopus* | | • | • | | | • | • |
| Ruddy Turnstone | *Arenaria interpres* | | | • | • | | • | |
| Red Knot | *Calidris canutus* | T | • | • | • | | • | • |
| Sanderling | *Calidris alba* | | • | • | | | | |
| Purple Sandpiper | *Calidris maritima* | | | • | | | • | |
| Semipalmated Sandpiper | *Calidris pusilla* | | • | • | | | • | • |
| American Woodcock | *Scolopax minor* | | | • | • | | • | |
| Spotted Sandpiper | *Actitis macularius* | | • | | | | | |
| Willet | *Tringa semipalmata* | | | • | | | • | |
| Least Tern | *Sternula antillarum* | | • | • | • | | • | |
| Caspian Tern | *Hydroprogne caspia* | | • | | | | • | |

| | | | New Jersey[1] | | | New York[2] | | |
|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Federally Listed** | **State Listed** | **SGCN** | **Focal Species** | **State Listed** | **SGCN** | **High Priority** |
| Black Tern | *Chlidonias niger* | | | • | | • | • | • |
| Roseate Tern | *Sterna dougallii* | E | • | • | | • | • | • |
| Common Tern | *Sterna hirundo* | | • | • | • | | • | |
| Forster's Tern | *Sterna forsteri* | | | • | • | | • | |
| Black Skimmer | *Rynchops niger* | | • | • | • | | • | • |
| Common Loon | *Gavia immer* | | | • | | | • | |
| American Bittern | *Botaurus lentiginosus* | | • | • | | | • | |
| Great Blue Heron | *Ardea herodias* | | • | | | | | |
| Snowy Egret | *Egretta thula* | | • | • | • | | • | |
| Little Blue Heron | *Egretta caerulea* | | • | • | • | | • | |
| Tricolored Heron | *Egretta tricolor* | | • | • | • | | • | |
| Black-crowned Night-Heron | *Nycticorax nycticorax* | | • | • | | | • | |
| Yellow-crowned Night-Heron | *Nyctanassa violacea* | | • | • | | | • | |
| Glossy Ibis | *Plegadis falcinellus* | | • | | | | • | |
| Osprey | *Pandion haliaetus* | | • | • | | | | |
| Northern Harrier | *Circus hudsonius* | | • | • | • | | | |
| Sharp-shinned Hawk | *Accipiter striatus* | | • | | | | | |
| Cooper's Hawk | *Accipiter cooperii* | | • | | | | | |
| Bald Eagle | *Haliaeetus leucocephalus* | | • | • | | | • | |
| Red-shouldered Hawk | *Buteo lineatus* | | • | • | | | • | |
| Broad-winged Hawk | *Buteo platypterus* | | • | • | | | | |
| Barred Owl | *Strix varia* | | • | • | | | | |
| Short-eared Owl | *Asio flammeus* | | • | • | | • | • | • |
| Red-headed Woodpecker | *Melanerpes erythrocephalus* | | • | • | • | | • | • |
| American Kestrel | *Falco sparverius* | | • | • | | | • | |
| Peregrine Falcon | *Falco peregrinus* | | • | • | • | • | • | |
| Acadian Flycatcher | *Empidonax virescens* | | | • | | | | |
| Willow Flycatcher | *Empidonax traillii* | | | • | | | | |

| Common Name | Scientific Name | Federally Listed | New Jersey[1] State Listed | New Jersey[1] SGCN | New Jersey[1] Focal Species | New York[2] State Listed | New York[2] SGCN | New York[2] High Priority |
|---|---|---|---|---|---|---|---|---|
| Least Flycatcher | *Empidonax minimus* | | • | | | | | |
| Yellow-throated Vireo | *Vireo flavifrons* | | | • | | | | |
| Blue-headed Vireo | *Vireo solitarius* | | • | | | | | |
| Horned Lark | *Eremophila alpestris* | | • | • | | | • | • |
| Bank Swallow | *Riparia riparia* | | | • | | | | |
| Cliff Swallow | *Petrochelidon pyrrhonota* | | • | | | | | |
| Winter Wren | *Troglodytes hiemalis* | | • | | | | | |
| Marsh Wren | *Cistothorus palustris* | | | • | | | | |
| Brown Thrasher | *Toxostoma rufum* | | • | • | | | • | • |
| Veery | *Catharus fuscescens* | | • | • | | | | |
| Gray-cheeked Thrush | *Catharus minimus* | | • | | | | | |
| Wood Thrush | *Hylocichla mustelina* | | • | • | • | | • | |
| Grasshopper Sparrow | *Ammodramus savannarum* | | • | • | • | | • | • |
| Field Sparrow | *Spizella pusilla* | | | • | | | | |
| Vesper Sparrow | *Pooecetes gramineus* | | • | • | • | | • | • |
| Seaside Sparrow | *Ammospiza maritima* | | | • | | | | |
| Saltmarsh Sparrow | *Ammospiza caudacuta* | | • | • | | | | |
| Savannah Sparrow | *Passerculus sandwichensis* | | • | • | | | | |
| Eastern Towhee | *Pipilo erythrophthalmus* | | | • | | | | |
| Bobolink | *Dolichonyx oryzivorus* | | • | • | • | | • | • |
| Eastern Meadowlark | *Sturnella magna* | | • | • | • | | • | • |
| Rusty Blackbird | *Euphagus carolinus* | | | • | | | • | • |
| Worm-eating Warbler | *Helmitheros vermivorum* | | • | • | | | • | |
| Louisiana Waterthrush | *Parkesia motacilla* | | | • | | | • | |
| Blue-winged Warbler | *Vermivora cyanoptera* | | | • | • | | • | |
| Black-and-white Warbler | *Mniotilta varia* | | | • | | | | |
| Prothonotary Warbler | *Protonotaria citrea* | | | • | • | | • | • |
| Nashville Warbler | *Leiothlypis ruficapilla* | | • | | | | | |

| | | | New Jersey[1] | | | New York[2] | | |
|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Federally Listed | State Listed | SGCN | Focal Species | State Listed | SGCN | High Priority |
| Hooded Warbler | *Setophaga citrina* | | • | • | | | | |
| Cape May Warbler | *Setophaga tigrina* | | | • | | | | |
| Northern Parula | *Setophaga americana* | | • | • | | | | |
| Bay-breasted Warbler | *Setophaga castanea* | | | • | | | • | • |
| Blackburnian Warbler | *Setophaga fusca* | | • | • | | | | |
| Black-throated Blue Warbler | *Setophaga caerulescens* | | • | • | | | • | |
| Prairie Warbler | *Setophaga discolor* | | | • | | | • | |
| Black-throated Green Warbler | *Setophaga virens* | | • | • | | | | |
| Canada Warbler | *Cardellina canadensis* | | • | • | | | • | • |
| Scarlet Tanager | *Piranga olivacea* | | | • | • | | • | |
| Dickcissel | *Spiza americana* | | | • | | | | |

**Note**: Species reported on at least 30 separate days over the last 10 years.

1 http://www.conservewildlifenj.org/species/fieldguide/search/all/

2 https://www.dec.ny.gov/animals/7494.html

### 4.3.2 Potential Impacts and Proposed Environmental Protection Measures

There are several impact-producing factors (IPFs) that may potentially affect bird species occurring in the Offshore and Onshore Project Areas during the construction, O&M, or decommissioning of the Project (Table 4.3-3).

**Table 4.3-3. Impact-Producing Factors for Birds**

| Impact-Producing Factors | Construction & Installation | Operation & Maintenance | Decommissioning |
|---|---|---|---|
| Presence of structures | | ● | ● |
| Light | ● | ● | ● |
| Vessel traffic | ● | ● | ● |
| Noise | ● | ● | ● |
| Installation and maintenance of offshore new structures and cables | ● | ● | ● |
| Land disturbance: Onshore Construction | ● | ● | ● |

In addition, birds may also be affected by discharges from vessels and accidental releases. These potential effects are considered to have a low likelihood of occurrence and are discussed in Sections 9.2.3 and 9.2.4.

The maximum PDE analyzed for potential offshore effects to birds is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I). The PDE of WTG parameters are provided in Table 4.3-1 of Volume I, which serves as the basis for the discussion of potential collision and displacement effects. The rotor swept zone (RSZ)[14] is 78 to 1,048.8 ft (23.8 to 319.7 m) above mean lower low water (Section 4.3 of Volume I). The maximum PDE analyzed for potential effects to birds onshore are the build-out scenarios for onshore project components discussed in Sections 4.8 and 4.9 of Volume I.

The potential effects associated with the Project were evaluated using a risk assessment framework (see Appendix II-F2 for detailed methods and results). The framework uses a weight-of-evidence approach and combines an assessment of exposure and vulnerability within the context of the literature to establish potential risk. Exposure has both spatial and temporal components. Spatially, birds are exposed on the horizontal (i.e., habitat area) and vertical planes (i.e., flight altitude); temporally, bird exposure is dictated by a species' life history and may be limited to breeding, staging, migrating, or wintering. Therefore, to be at risk of potential effects, a bird must be both *exposed* to an offshore wind development (i.e., overlapping in distribution) and be *vulnerable* to either displacement or collision (Goodale and Stenhouse 2016).

[14] The rotor swept zone, or RSZ, is the diameter the WTG blades cover (this diameter is shown in Figure 4.3-1 in Volume I).

Exposure was evaluated based on the New Jersey Baseline Studies and version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models (Curtice et al. 2016). Densities and fine scale distributions of species were calculated from Atlantic Shores digital aerial surveys (Appendix II-F2). Due to gaps in knowledge on the relationship between the number of WTGs and risk, the assessment analyzed the exposure of birds to the total area of development, rather than to a specific number of WTGs.

Behavioral vulnerability (collision and displacement) was evaluated by combining ordinal scores across a range of key parameters, including those from the WTG design envelope (see Appendix II-F2 Section 4.1.6. for detailed methods).   This method was adapted from a published scoring process (Furness et al. 2013, Wade et al. 2016, Fliessbach et al. 2019, Willmott et al. 2013). The vulnerability results were interpreted using scientific literature and tracking studies from both the United States and Europe (Table 4-6 in Appendix II-F2 provides examples of literature used), a population vulnerability score by using Partners in Flight data, a local state conservation status, and an adult survival score. For species or species groups for which inputs are lacking, the literature was used to qualitatively determine a vulnerability ranking using the criteria in Appendix II-F2 Table 4-7  The results are summarized in Table 4.3-4.

### 4.3.2.1 Presence of Structures

Collision and displacement are the two primary potential effects to birds associated with the presence of offshore wind facility structures (Garthe and Hüppop 2004, Desholm 2009, Furness and Wade 2012, Furness et al. 2013, Robinson Willmott et al. 2013).

Bird collisions occur when an individual bird collides with a physical component of the Project (i.e., a WTG) while in flight. Collisions can occur with both stationary and moving infrastructure (e.g., spinning WTG blades; Fox et al. 2006a). Collision risk increases when birds exhibit flight behaviors that increase exposure to blades (e.g., foraging), and spend a greater portion of their time at altitudes equivalent to a WTG RSZ. Environmental conditions, such as poor visibility from fog, low cloud ceilings, or day/night variability, can also contribute to increased collision risk (Fox and Peterson 2019, Johnston 1955, Crawford and Engstrom 2001). Collisions at onshore facilities are not expected given that cables will be buried in the Onshore Project Area and above-ground onshore substations will occupy a limited footprint.

Displacement occurs when birds show an avoidance response to a wind farm or WTG. While avoidance can reduce collision risk, it can also reduce access to foraging and resting habitat, and potentially increase energy expenditures (Fox and Peterson 2019). The offshore wind facilities may also cause migration disturbance (Dierschke et al. 2016, Vanermen et al. 2019). Of note, most displacement studies have been conducted at wind arrays with smaller turbines spaced closer together than Atlantic Shores' WTGs (for example one study in Belgium was at a wind array with 3 MW turbines spaced 1,640 to 2,132 ft [500 to 650 m]; Vanermen et al. 2015). While there is uncertainty on bird's avoidance response to larger WTGs, BOEM anticipates that for larger WTGs that there will be enough space between them for most migratory birds to fly through a wind array without changing course or only needing to make minor course corrections (relative to the entire migration) and that any "additional energy expenditure would not be expected to result in individual fitness or population-level impacts" (BOEM 2021).

The presence of offshore structures, such as foundations, scour protection, cable protection, and buoys during Project O&M, could have beneficial effects on local bird populations due to consequent increases in fish aggregations near structures, known as the reef effect. This reef effect creates habitat for structure-orientated and hard-bottom fish species, which has the potential to increase foraging opportunities for piscivorous birds (Taormina et al. 2018). Although increases in fish aggregations may provide more foraging opportunities for birds, this could also cause increases in bird exposure to turbine blades and concomitant increases in collision risk. Similar increases in exposure could also occur due to perching on the WTGs, specifically for some species groups, such as gulls and cormorants, although the Project will utilize perch deterrents, where appropriate, to decrease the risks of these possible effects.

The presence of structures may also cause limited entanglement hazards if lost line or fishing gear is caught on structures. There is some documentation that birds could become entangled in fishing line and lost nets wrapped around the WTG or OSS foundations (Ryan 2018, Schrey and Vauk 1987). These potential effects can be effectively managed by the Project as Atlantic Shores commits to removing marine debris (e.g., derelict gear) from structures, when safe and practicable (see Section 9.2.4 of Volume I).

**Collision**

Collisions with WTGs has been identified as a potential effect on birds (Goodale and Milman 2016, Drewitt and Langston 2006, Fox et al. 2006). The exposure of non-marine migratory birds will be limited to migration, and marine bird exposure will vary by species and season.

**Non-marine migratory birds:** This group includes shorebirds, wading birds, raptors, and songbirds. In general, potential exposure and collision vulnerability of individual, non-marine birds to the proposed offshore wind farm is uncertain, as offshore observations and tracking data are limited, increasing the uncertainty of predictions at the population-level exposure and limiting quantitative risk assessments. Avoidance behavior, in particular, is not well studied and represents a significant source of uncertainty for assessing the potential impacts of offshore wind on migration patterns and seasonal use of the outer continental shelf by these taxa groups. Based on the available literature and telemetry studies, non-marine birds are expected to have low to medium collision risk with WTGs and will typically fly at heights above the RSZ. However, collision vulnerability may increase during poor weather conditions, as some migratory birds may reduce flight altitudes. Appendix II-F2 provides tables and maps used to support exposure and vulnerability assessments of non-marine migratory birds.

- Shorebirds: Even though shorebirds may fly through the Lease Area during migration and be exposed to the project (Loring et al. 2021; Appendix II-F2), shorebirds are expected to have low vulnerability to collision, as they often fly at heights above the RSZ and during fair weather conditions (Loring et al. 2020). However, shorebirds may reduce flight heights during periods of poor visibility and recent tracking studies indicate offshore flight heights can vary significantly (Biodiversity Research Institute 2021, Tjørnløv et al. 2023). Vulnerability of ESA-listed shorebirds is discussed in a later section.

- Wading Birds: This species group is expected to have low collision vulnerability, although there remains uncertainty and evidence from the literature is somewhat conflicting. Tracking studies estimate that individuals of some wading birds such as Blue Herons (*Ardea herodius*) may pass through the Lease Area and have the potential to fly within the RSZ (movebank.org, Egrets & Herons, study ID 17469219, Dolinski 2019; Appendix II-F2). However, wading birds may also fly at higher altitudes to take advantage of favorable tail winds (e.g., Mateos-Rodríguez and Liechti 2012). Some wading bird mortalities have been detected at terrestrial wind projects, though few records have been directly linked with WTG collisions (American Wind Wildlife Institute 2016).

- Raptors: Migrating raptor species are predicted to have low to medium vulnerability to WTG collisions and will have limited exposure to the Lease Area (Appendix II-F2). Among raptors, falcons are the most likely to be encountered offshore (Cochran 1985, DeSorbo et al. 2012, DeSorbo et al. 2018). There is little information on how Ospreys respond to WTGs, but falcons may be attracted to WTGs as perching sites. In Europe, Peregrine Falcons and kestrels have been observed landing on the platform deck of offshore WTGs (Hill et al. 2014; Skov et al. 2016). A radar and laser rangefinder study found evidence indicating that multiple migrating raptor species may be attracted to offshore WTGs along the Virginia coast (Normandeau 2022) and in Denmark (Skov et al. 2016), and satellite-tagged Ospreys and Peregrine Falcons have been confirmed perching on offshore barges and structures. However, mortalities have not been documented at offshore wind projects in Europe or at the CVOW project in Virginia (Normandeau 2022).

- Songbirds: Collision vulnerability of songbirds is expected to be low to medium. Given the limited understanding of songbird migration, exposure of migratory songbirds to the Lease Area is uncertain, but some birds will likely cross the Lease Area during fall migration. Songbirds typically migrate above the RSZ (NYSERDA 2010) but can fly lower during inclement weather or with headwinds. Songbirds are known to collide with illuminated terrestrial and marine structures (Fox et al. 2006), and movement during low visibility periods creates the highest collision risk conditions (e.g., Hüppop et al. 2006). However, there remains uncertainty about how songbirds will respond to offshore wind farms. Fatalities of songbirds have been documented at terrestrial WTGs (Erickson et al. 2014; Choi et al. 2020), but fewer collisions with offshore WTGs could occur due to differing behaviors or lower exposure (NYSERDA 2015). In some instances, songbirds may be able to avoid colliding with offshore WTGs (Petersen et al. 2006), as monitoring efforts at the Thanet Offshore Wind Farm did not detect any songbird collisions (Skov et al. 2018), and 2,400 hours of infrared monitoring at Nysted, Denmark detected only one collision of an unidentified small bird (Petersen et al. 2006). Furthermore, Atlantic Shores will minimize light illumination during construction and operations to reduce impacts to birds. In summary, under poor weather conditions, individual vulnerability to collision may increase as songbirds fly at lower altitudes and may be more likely to fly through

RSZs. Fatality is likely to be stochastic and infrequent. However, the fatality from all terrestrial WTGs in the US and Canada combined is predicted to have a small effect on passerine populations (Erickson et al. 2014).

**Marine birds:** Of the marine birds, gulls are identified as having the highest vulnerability to collisions (Table 4.3-4; Wade et al. 2016; note, due to limited exposure pelicans are not discussed in detail but are included in analysis detailed in Appendix II-F2). Sea ducks, auks, loons, petrels (including Black-capped Petrels), shearwaters, and storm-petrels are generally not considered vulnerable to collision because they avoid WTGs (Furness et al. 2013). Some studies indicate that terns and Northern Gannets may have limited vulnerability to collision. Appendix II-F2 includes the supporting tables and maps for each species group exposure and vulnerability assessment.

- Jaegers and Gulls: These avian families are grouped here due to their general similarities in natural history. Gulls received a low to medium collision vulnerability score.[15] Of the marine birds, they are identified as having higher collision vulnerability because they can fly in the RSZ (Johnston et al. 2014), have been document to be attracted to WTGs (Vanermen et al. 2015), and individual birds have been documented to collide with WTGs (Skov et al. 2018). Recent studies suggest that for most large gulls there is a zero macro-avoidance rate, reflecting that large gulls are not deterred from entering a wind farm area, but the meso-avoidance rate is high, conservatively calculated as 99.59% for Herring Gulls (*Larus argentatus*) and 99.82% for Lesser Black-backed Gulls (*L. fuscus*; Cook et al. 2018). As such, gulls are generally able to take action to avoid individual turbines and avoid collisions. For the three seasons surveyed during the Atlantic Shores digital aerial surveys in the Lease Area, gulls had higher densities in winter and lower densities in the spring and fall. During winter, densities were slightly higher in the Lease Area than in the entire survey area. Within the Lease Area, distribution varied by species and season, although the proportion of small gulls was higher in the northern portion in the fall, medium gulls were distributed relatively uniformly across the lease area in the winter, and large gull distribution varied by season. These results should be interpreted within the context that species distribution will vary from year to year, depending upon food availability. As a group, jaegers and gulls have minimal to low exposure, although some species have medium exposure in specific seasons: Parasitic Jaeger (*Stercorarius parasiticus*; fall), and Bonaparte's Gull (*Chroicocephalus philadelphia*; spring).

- Terns: Terns have a low to medium collision vulnerability score and may have some limited vulnerability to collision (Garthe and Hüppop 2004, Furness et al. 2013), but are expected to often fly below the RSZ (Loring et al. 2019), reducing the risk of colliding with WTGs. For the three seasons surveyed during the Atlantic Shores digital aerial surveys, there were not enough tern detections to model densities. However, terns were detected in the spring, summer, and

[15] A relative collision vulnerability score includes proportion of time within the RSZ, a measure of avoidance, and flight activity. The factors were combined to create a score that was translated into four vulnerability categories: minimal, low, medium, and high. The results provide a relative categorical vulnerability score among the species exposed to the Project—e.g., the species that are least likely to collide with turbines receive a minimal collision score—and is not intended to provide an absolute likelihood of collision. See Appendix II-F2 for detailed methods.

fall during the NJDEP vessel-based surveys. Terns have minimal to medium exposure overall, with the Common Tern (*Sterna hirundo*; low collision vulnerability score) having medium exposure in spring, summer, and fall, and all other species having minimal scores in all seasons (Note, Black Tern received a high score in the fall, but this is discounted due to few detections—see Appendix II-F2).

- Gannets: The Northern Gannet (*Morus bassanus*) has a medium collision vulnerability score. While Northern Gannets have been demonstrated to avoid WTGs (Garthe et al. 2017), individuals can enter wind arrays (Peschko et al. 2021) and some may be vulnerable to collision because they have the potential to fly within the RSZ (Garthe et al. 2014, Cleasby et al. 2015, Furness et al. 2013). Northern Gannets range widely within the offshore waters of the United States and a tracking study indicates use of the Lease Area (Stenhouse et al. 2020), particularly during the spring migration (Apendix II-F2). For the three seasons surveyed during the Atlantic Shores digital aerial surveys in the Lease Area, gannets had the highest density in winter. During winter, densities were higher in the Lease Area than in the entire survey area, were lower in the spring, and the same in the fall. Within the Lease Area, distribution varied with the proportion of birds being higher closer to shore in the fall (this corresponds to tracking studies), to the north and offshore in winter (tracking indicated higher use closer to shore), and to the south in spring (tracking studies show broader use of the region). These results should be interpreted within the context that Northern Gannets range widely across the Atlantic OCS during the non-breeding season as they follow ephemeral prey, and that the NJDEP vessel-based surveys show lower relative use. MDAT models predict lower relative use as well. Overall, Northern Gannets have minimal exposure.

- Cormorants: The Double-Crested Cormorant (*Phalacrocorax auritus*) has a medium collision vulnerability score because it has been documented to be attracted to WTGs (Lindeboom et al. 2011, Krijgsveld et al. 2011), and may fly through the RSZ. For the three seasons surveyed during Atlantic Shores digital aerial surveys, there were not enough cormorant detections to model densities, indicating low use, which aligns with low detections (only in summer) during the NJDEP vessel-based surveys. Overall, cormorants have low exposure.

In summary, while collisions with WTGs may impact individual non-listed marine birds, population-level impacts are not expected because the species with some vulnerability to collision have minimal to medium exposure to the Lease Area. Furthermore, gulls and cormorants have minimal to medium overall population vulnerability. Atlantic Shores will implement measures to reduce attracting birds through lighting best management practices and perch deterrents.

### Table 4.3-4. Summary of the Assessment of Potential Exposure and Vulnerability of Marine Birds

| Group | Exposure[1] | Relative Vulnerability to | | |
|---|---|---|---|---|
| | | Collision | Displacement | Population |
| Sea Ducks[2] | min–low | low | med–high | low–med |
| Auks | min–low | min–low | med–high | low–med |

| Group | Exposure[1] | Relative Vulnerability to | | |
|---|---|---|---|---|
| | | Collision | Displacement | Population |
| Jaegers & Gulls[3] | min–low | low–med | low–med | min–med |
| Terns | min–med | low–med | low–high | low–high |
| Loons | low | min-low | high | low–med |
| Shearwaters, Petrels and Storm-Petrels | min–low | low | med | low–med |
| Gannets, Cormorants, and Pelicans | min–low | low–med | low–med | min–low |

**Note**:
[1]Exposure scores represent the range for the species in each group. The individual species scores are derived from the rules in Table 4-5 in Appendix II-F2, which account for varying exposure by season.
[2]Excluding Red-breasted Merganser.
[3]Exposure ranking exclude a medium rank for Sabine's Gull and Lesser Black-backed Gull. These species had only a few overall observations, but they happened to fall within the Lease Area—see Appendix II-F2 for further explanation.

### Displacement

Habitat displacement due to the presence of WTGs may affect birds (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Milman 2016), but impacts to populations are uncertain.

**Non-marine migratory birds:** This group is not expected to be particularly vulnerable to displacement, with vulnerability determinations ranging from minimal to low across taxa groups, because these species do not use the offshore environment as a primary foraging area. However, there remains some uncertainty regarding displacement from migratory routes over the Atlantic OCS from the presence of WTGs. For shorebirds, any avoidance of the Offshore Project Area is unlikely to impact overall individual fitness due to the size of the lease area in relation to the entire migratory trip (BOEM 2021). Observations of raptors at offshore wind farms in Europe indicate some macro-avoidance behavior (i.e., avoiding the entire wind farm), which has the potential to cause a barrier for migrants in some locations, but may also reduce collision risk (Jacobsen et al. 2019). Raptors may also exhibit meso-avoidance, which involves significant changes in flight height prior to entering a wind farm (Jacobsen et al. 2019).

**Marine birds**: Displacement vulnerability of marine birds due to the presence of WTGs is predicted to range from low to high across taxa groups, but it is unlikely to cause population-level impacts because most would have limited exposure to the Offshore Project Area. Displacement effects, if they occur, are expected to be localized and concentrated during the construction and decommissioning periods. During O&M, some displacement may occur for certain species, while attraction to the Lease Area may increase due to improved foraging opportunities. Jaegers and gulls generally rank low in vulnerability to displacement assessments (Furness et al. 2013), and there is little evidence that cormorants are displaced by offshore wind arrays (results of exposure and vulnerability assessment are detailed in Table 4.3-4). Appendix II-F2 includes the supporting tables and maps for each species group exposure and vulnerability assessment.

- **Sea ducks**: Sea ducks have a medium to high displacement score[16] (medium was added to the range to account changes in displacement through time) as they have been identified as being vulnerable to habitat displacement (Furness et al. 2013), particularly scoters (MMO 2018). Avoidance of wind projects can lead to habitat displacement, resulting in effective habitat loss (Petersen and Fox 2007, Langston 2013, Percival 2010). However, for some species, this displacement may stop several years after construction (Petersen & Fox 2007, Leonhard et al. 2013) and avoidance of individual wind arrays is not expected to significantly increase energy expenditure (Masden et al. 2009). For the three seasons surveyed during the Atlantic Shores digital aerial surveys in the Lease Area, sea ducks had the highest density in winter, lower densities in spring, and few detections in the fall. During winter, densities were lower in the Lease Area than in the entire survey area. Within the Atlantic Shores Lease Area, the proportion of scoters was generally higher closer to shore in all three seasons and to the north, which corresponds to tracking data. As a group, sea ducks have minimal to low exposure.

- **Auks**: Auks have medium to high displacement score, due to a sensitivity to disturbance from boat traffic, a high habitat specialization, and vulnerability to displacement (Dierschke et al. 2016, Wade et al. 2016). The rates of displacement and reuse of a wind farm by Razorbills seems to vary by site. Two U.K. studies showed that auk displacement was most likely to occur during the summer breeding season (i.e., the period during which razorbills have not been recorded in the Lease Area; APEM 2016, 2017). In these two studies, auks showed significant declines between pre-construction and construction; however, their densities showed some recovery within the turbine array within 1-year post-construction (APEM 2016, 2017). Other studies have reported auk displacement between 61 and 75% from wind farms (Vanermen et al. 2015, Welcker and Nehls 2016, Peschko et al. 2020). For the three seasons surveyed during the Atlantic Shores digital aerial surveys, there were not enough auk detections to model densities at the species level. However, group models indicate higher densities in the spring compared to the winter and no detections in fall and variable use of the Lease Area with a greater proportion of birds in the north in spring. As a group, auks have minimal to low exposure, with Razorbills having medium exposure in spring.

- **Terns**: Terns receive a medium to high displacement score, but since there is considerable uncertainty on tern avoidance responses (Wade et al. 2016), a lower range was added to the displacement score (See Appendix II-F2 for discussion). Tern avoidance has not been well studied, but terns have been shown to avoid smaller turbines at the Horns Rev facility (Cook et al. 2012, Petersen et al. 2006). Common Terns typically forage within approximately 5.5 mi to 9.4 mi (9 to 15.2 km) of their nest sites (Perrow et al. 2011, Safina and Burger 1985, Duffy 1986, Thaxter et al. 2012, Nisbet et al. 2017) but are known to forage farther offshore during the post-breeding period (Goyert et al. 2014). For the three seasons surveyed during the

[16] The relative displacement score includes two factors—disturbance and habitat flexibility—that were combined to create a score that was translated into four vulnerability categories: minimal, low, medium, and high. The results provide a relative categorical vulnerability score among the species exposed to the Project—e.g., the species that are least likely to be displaced receive a minimal collision score—and is not intended to provide an absolute likelihood of displacement. See Appendix II-F2 for detailed methods.

Atlantic Shores digital aerial surveys, there were not enough tern detections to model species or group densities. However, terns were detected in the spring, summer, and fall during the NJDEP vessel-based surveys. Terns have minimal to medium exposure, with Common Terns having medium exposure in spring, summer, and fall (see note above about Black Tern).

- **Loons**: Loons have a high displacement score because they are consistently identified as being vulnerable to displacement (MMO 2018, Garthe and Hüppop 2004, Furness et al. 2013), due to a strong avoidance response by red-throated loons (*Gavia stellata*), which can be initiated from as far away as 10 mi (16 km) from a wind energy facility (Mendel et al. 2019). The distance and duration of loon displacement varies between sites (Allen et al. 2020), as does reuse of the site. Some monitoring data from wind farms in Europe indicate loons largely avoid offshore wind farms, leading to displacement from some offshore areas, with displacement effects seen out to 2.5 mi (4 km) from WTGs, especially during construction (Petersen et al. 2006, Percival 2010). Other studies indicate loons appear to avoid areas within 5.6 mi (9 km) of WTGs during construction (Petersen et al. 2006, Percival 2010, APEM 2016, Allen et al. 2020). While these birds are vulnerable to displacement, there is uncertainty about how displacement will affect individual fitness (e.g., changes in energy expenditure due to avoidance), and effective methodologies for assessing population-level displacement effects are lacking (Mendel et al. 2019, Fox and Petersen 2019). For the three seasons surveyed during the Atlantic Shores digital aerial surveys in the Lease Area, Common Loon (*G. immer*) had the highest density in winter and lowest densities in the fall. Red-throated Loon had lower densities than Common Loons, which were highest in the spring. For both species during winter, densities were higher in the Lease Area than in the entire survey area, similar in the spring, and for Common Loon higher in the fall. Within the Lease Area, distribution varied by season although proportion of loons tended to be higher in the north during the fall. Tracking studies indicate Red-throated Loon use areas closer to shore in the winter and fall, and that in spring some migratory birds may pass through the Lease Area. Overall loons have a low exposure score: Red-throated Loons have minimal to medium exposure depending on the season, and Common Loons have low exposure for winter, summer, and fall, and medium for spring.

- **Petrels and Shearwaters**: The petrel group has a medium displacement score; however, petrels, shearwaters, and storm-petrels are not generally considered vulnerable to habitat displacement (Furness et al. 2013), although displacement has not been well studied for this group. For the three seasons surveyed during the Atlantic Shores digital aerial surveys, there were not enough detections to model densities. However, species in the petrel group were detected in the summer and fall during the NJDEP vessel-based surveys. As a group, these birds have minimal to low exposure, with Greater Shearwaters (*Puffinus gravis*) having medium exposure in summer.

- **Gannet**: Northern Gannets have a medium vulnerability score to displacement because studies indicate they actively avoid offshore wind developments (Hartman et al. 2012, Garthe et al. 2017, Vanermen et al. 2015, Cook et al. 2012, Dierschke et al. 2016, Krijgsveld et al. 2011). There is evidence that between 92 and 96% of northern gannets avoid turbine arrays (Welcker and

Nehls 2016, Rehfisch et al. 2014), and Rehfisch et al. (2014) suggest they demonstrate an overall avoidance of 99.5%. While Northern Gannets were detected in the Atlantic Shores digital aerial surveys and were tracked through the area, gannets have minimal exposure, except for spring (low), indicating that they are unlikely to be displaced from important foraging areas.

**Potential Collision and Displacement Risk of Federally listed Threatened and Endangered Species**

Based on the best available information, impacts to individual Piping Plovers and Roseate Terns are unlikely, due to low exposure. While there are historical records of Roseate Terns near the Lease Area, no Roseate Terns were recorded in the Lease Area in the Loring et al. (2019) studies, NJDEP Baseline Studies data, or Atlantic Shores digital aerial surveys, indicating that exposure to the Lease Area is rare. Furthermore, flight height estimates from Loring et al. (2019), and flight height records in the Northwest Atlantic Seabird Catalog from vessel-based surveys (can be biased low), suggest that Roseate Terns fly primarily below 82 ft (25 m), and thus have a low probability of flying within the RSZ. Available data for Piping Plovers suggest that, while some individuals may cross the Lease Area (Loring et al. 2019), there is minimal overall use. Flight height estimates from Motus tags suggest that plovers generally fly relatively high in the WEAs (mean height 1,040 ft [317 m), and that plover migration peaks in early August, and on nights with high visibility, little to no precipitation, and high atmospheric pressure (Loring et al. 2019), further reducing the potential for collision. Plovers also have good visual acuity and maneuverability in the air (Burger et al. 2011), and there is little evidence to suggest that they are particularly vulnerable to collisions during migration.

For Red Knots, tracking data suggest that some individual long-distance southbound migratory knots may pass through the Lease Area. Three knots tagged with Motus tags were estimated to pass through the New Jersey WEAs (Loring et al. 2018). None of 41 birds tagged in coastal New Jersey with GPS, which returned migratory data, had positions in Lease Area, but the straight-line flight paths of six other birds suggest they may have flown through or near to the Lease Area (Appendix II-F2). Flight heights during long-distance migrations are thought to normally be 3,280 to 9,843 ft (1,000 to 3,000 m), except during takeoff and landing at terrestrial locations (Burger *et al.* 2011). However, Red Knots likely adjust their altitude to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2020), or during periods of poor weather and high winds (Burger et al. 2011). While flight height data from Motus studies have large error estimates (i.e., >656 ft [>200 m]), Loring et al. (2018) found Red Knots to have a wide range of flight heights from 72 ft (22 m) to 2,893 ft (882 m), indicating some potential exposure to the RSZ. These results align with the estimated flight heights of migratory shorebirds in Federal waters, where the mean spring flight altitude is 2,999 ft (914 m) and the mean altitude in the fall is 1,788 (545 m; Loring et al. 2021). The bird carrying a GPS that passed directly to the south of the Lease Area had an altitude of 1,886 ft (575 m), which is above the Project's RSZ. During fall migration, Red Knot flights across WEAs occurred under clear skies with little to no precipitation (Loring et al. 2018). Therefore, while Red Knots may pass through the Lease Area, they would be expected to fly during fair weather conditions when collision risk is likely lower.

Atlantic Shores is committed to continue supporting additional data gathering on these, and other, avian species and their potential use of the Lease Area. Specifically, Atlantic Shores is continuing a multi-year satellite tagging surveys of Red Knots and affixed two Motus antennas on separate metocean buoys in the adjacent Atlantic Shores Lease Area OCS-A 0499 in 2021. The Red Knot satellite tagging surveys will help Atlantic Shores and its research partners gain a better understanding of potential Red Knot movements offshore, calibrated for season, weather, and flight height.

#### 4.3.2.2 Light

Artificial lighting to promote safe operation of the Project onshore and offshore will be required during construction, O&M, and decommissioning. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels that have navigational lights, deck lights, and interior lights. During O&M, vessel traffic and associated vessel lighting will also occur but at a lower frequency than during construction and decommissioning. In addition, operational WTGs will require lighting that complies with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines. Other temporary lighting (e.g., helicopter hoist status lights) may be used for safety purposes, when necessary.

To minimize the offshore effects of lighting, Atlantic Shores is considering the use of an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval, which will substantially reduce the time the aviation obstruction lighting mounted on WTGs is illuminated. An assessment of the activation frequency of an ADLS indicates that it would be approximately 20 hours and 25 minutes per year (see Appendix II-M2). An ADLS automatically activates all aviation obstruction lighting (i.e., any FAA lighting on nacelles or towers) when aircraft approach the WTGs; at all other times, the lighting is off. The use of ADLS is expected to further reduce bird exposure to operational lighting. Yellow flashing marine navigation lights will be used on the WTGs instead of constant white light to reduce further bird attraction. As a result of these lighting modifications and precautions, only short-term, localized effects from artificial lighting on birds are likely. Further, lighting will be limited to Project vessels, vehicles, equipment, and structures, most of which will be associated with other activities that would deter birds. As practicable, down-lighting and down-shielded lighting will be used to avoid and minimize effects.

The Onshore Project Area is situated within and/or immediately adjacent to urbanized areas, thus effects from additional light emitted by the Project's activities and installations (e.g., substations) are expected to be very limited. Artificial lighting will be needed onshore during construction to light vehicle pathways and construction activity. Like offshore, construction lighting will be temporary, localized to the work area, and downlighted/shielded to the maximum extent practicable. Effects from lighting during decommissioning are expected to be like those during construction and will be temporary. During decommissioning all artificial lighting will be removed.

#### 4.3.2.3 Noise

Noise effects to birds may occur when intense sound interferes with normal breeding, foraging, and resting periods (Ortega 2012). Though the noise intensity of each source varies considerably, birds have the potential to be affected by noise in all phases of the Project, from sources such as aircraft, impact pile-driving, vehicle and vessel traffic, and onshore and offshore construction equipment, in general. Aircraft may be used to transport construction/maintenance personnel and for wildlife surveys (Section 5.6 of Volume I). Low-flying aircraft could cause birds to flush and expend extra energy (Brown 1990); however, this effect would be temporary and limited to offshore areas near the aircraft flight path. Noise from vessel traffic is expected to be minimal and not to directly affect birds compared to actual vessel movements.

Impact pile-driving associated with the installation of piled foundation concepts (Section 8.0 In-Air Noise and Hydroacoustics) has the potential to produce noise that could disturb birds occurring within the Lease Area (Teachout 2012). Pile-driving creates noise above the water that could temporarily displace birds from the area of construction, as well as underwater that could temporarily displace diving birds and associated prey species. The extent of these potential effects on birds known to frequent the Lease Area largely depends on the equipment used, duration of activity, and noise levels. Displaced birds would have large areas of ocean to relocate to, away from pile-driving, and are expected to return post-disturbance.

Onshore construction noise from the operation of vehicles and equipment could temporarily displace birds from nearby habitats (Bottalico et al. 2015), although these effects are expected to be temporary and highly localized. As discussed in Section 4.2 Coastal and Terrestrial Habitat and Fauna, the Onshore Project Area consists predominantly of previously disturbed and developed areas, so birds in the area are expected to be habituated to ambient noises typical of urban areas or would move away from construction noise. During O&M, noise from onshore substations during operations is expected to be minimal and not to affect birds because they are habituated to the ambient sounds of the area (see Section 8.0 In-Air Noise and Hydroacoustics).

Onshore noise effects during decommissioning are expected to be similar to onshore construction. Offshore noise effects during decommissioning are expected to be less than offshore construction as some activities, such as pile-driving, will not occur.

#### 4.3.2.4 Vessel Traffic

The potential effects of vessel-related noise and lighting were addressed in Section 4.3.2.2 and 4.3.2.3. Vessels operating in the ocean have the potential to disturb birds on the water, or in flight, during all phases of the Project. These disturbances can cause incremental increased energy expenditure as birds take flight to avoid the vessel, and, among studied marine birds, loons are the most sensitive to ship traffic (Schwemmer et al. 2011). The greatest volume of vessel traffic would be anticipated during construction, and to a lesser extent decommissioning (Section 4.10 of Volume I); however, this traffic will be concentrated in the Lease Area or along segments of the ECC for relatively short periods of time. Movement of these vessels will be associated with other construction activities that will also temporarily disturb birds. Birds that are exposed to disturbing levels of activity, including vessel traffic, are likely to fly away to other areas to forage or roost, and are expected to return post-disturbance. Furthermore, vessel traffic associated with the Project is estimated to be, on average, two to six vessel roundtrips per day collectively between construction staging port facilities under consideration and the offshore construction areas, which is low in comparison to existing commercial and recreational vessel traffic in these waters (see 7.6 Navigation and Vessel Traffic).

### 4.3.2.5 Installation and Maintenance of New Offshore Structures and Cables

The focus of this IPF discussion is the installation of offshore cables (i.e., export, inter-array, and inter-link cables), WTGs, and OSSs, and any localized, short-term disturbances of the seafloor (see Section 4.0 of Volume I) that could influence prey species for birds foraging offshore. Offshore cable and foundation installation may temporarily disrupt the foraging behavior of diving species groups (e.g., loons) within the area of disturbance, as described previously in Sections 4.3.2.3 and 4.3.2.4 on Project-related noise and vessel activity, respectively (BERR 2008, Niras Consulting 2015).

As addressed in Section 3.2 Water Quality, Section 4.5 Benthic Resources, and Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat, seafloor disturbances, caused by seafloor preparation for foundations, pile-driving, offshore cable installation, and vessel anchoring, will result in localized, short-term suspension of sediment in the water column during construction. Increases in suspended sediment are likely to affect the turbidity lower in the water column, and not likely to reduce underwater visibility that birds rely on for foraging (Cezilly 1992). Effects on birds of this nature would be isolated events and expected to be temporary and highly localized. Once disturbance ceases, suspended sediment will settle back to the seafloor.

### 4.3.2.6 Land Disturbance: Onshore Construction

As stated, installation of onshore interconnection cables is expected to occur in existing corridors (i.e., along existing roadway, utility rights-of-way (ROWs), and/or along bike paths). While most of the onshore interconnection cable routes will be installed via open trenching, Atlantic Shores will employ trenchless specialty installation techniques, such as jack-and-bore, pipe jacking, and HDD, to avoid impacts to wetland and watercourse habitats. While most of the proposed substation and/or converter station sites would be located in previously disturbed areas and not require tree clearing, tree clearing may occur at the Asbury Ave Substation/Converter Station Site. This limited tree clearing will be the minimum required to install facility components and will be conducted during the winter months. Habitat disturbance could reduce foraging and nesting habitat for birds, in general; however, these effects will be highly localized, and birds can move to other undisturbed areas (Cook and Burton 2010).

During O&M, periodic maintenance of the onshore facilities may be required. Any necessary maintenance will be accessed through manholes, thereby avoiding and minimizing land disturbance. Land disturbance during the decommissioning phase is expected to be similar to construction, except that further land clearing is not expected. Heavy equipment used to remove infrastructure could disturb some land, but most of this activity is expected to occur in already disturbed areas and will be temporary.

The use of HDD at the landfall site, and trenchless cable installation techniques for wetland crossings, will avoid effects to wetland and shoreline habitats (including any potential shoreline nesting areas) that are important for the Federally Threatened piping plover and red knot (Baker et al. 2020, Elliott-Smith and Haig 2020).

### 4.3.2.7 Summary of Potential Effects and Proposed Environmental Protection Measures

Of the avian species known to occur in the Offshore Project Areas, the vast majority are at low risk of collision and displacement due to limited exposure in the Lease Area, primarily due to the distance of the Project from shore and the lack of significant underwater structures (e.g., shoals). Federally listed Piping Plovers and Roseate Terns are expected to have limited exposure to the Lease Area during migration. If individuals pass through the Lease Area, Roseate Terns would generally be expected to fly below the RSZ, while Piping Plovers would be expected to fly above the RSZ. Individual Red Knots may fly over the Lease Area but are generally expected to fly during fair weather conditions and can fly at altitudes above the RSZ, which would reduce collision risk. For the Onshore Project Area, impacts to bird habitat will largely be avoided because the onshore project components are nearly completely co-located with areas of existing development.

Atlantic Shores will continue to study avian activity in the Onshore and Offshore Project Areas and has already taken precautionary steps and commitments to avoid and minimize Project-related effects on birds during construction, O&M, and decommissioning. Furthermore, Atlantic Shores will develop a post-construction monitoring plan and will document any dead or injured birds incidentally encountered on vessels or structures.

Additional avoidance and minimization measures and tools will be evaluated further as the Project progresses through development and permitting, in coordination with Federal and State jurisdictional agencies and other stakeholders. Atlantic Shores proposes to implement the following avoidance and minimization measures to reduce impacts to birds throughout the Onshore and Offshore Project Areas.

**Offshore**

- An Avian and Bat Survey Plan has been implemented that applies to both OCS-A 0499 and OCS-A 0549, in conjunction with BOEM and the USFWS, that includes digital aerial surveys and a satellite telemetry study of the Federally protected Red Knot to further characterize the Lease Area and support consultations.

- Two Motus receiving antennas have been installed on separate metocean buoys to track the offshore movement of tagged bird species within the adjacent Atlantic Shores Lease Area OCS-A 0499.

- Lighting during operations will be limited to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.

- Attraction to structures will be reduced by using perch deterrents to the maximum extent practicable.

- Red flashing FAA lights and yellow flashing marine navigation lights will be used on the WTGs, instead of constant white light, to reduce further bird attraction, and ADLS is being considered to significantly reduce the number hours FAA lighting will be illuminated.

- Down-lighting and down-shielding lighting will be used to the maximum extent practicable.
- Marine debris caught on offshore project structures will be removed, when safe and practicable, to reduce the risk of bird entanglement (see Section 9.2.4 of Volume I).
- An avian post-construction monitoring plan will be developed.
- Any dead or injured birds will be reported to BOEM on an annual basis. Any birds with USFWS bands will be reported to the USGS Bird Banding Lab.

**Onshore**

- Onshore cables will be buried entirely underground, thus avoiding collision risks to birds associated with overhead structures and conductors.
- HDD at the landfall site and trenchless cable installation techniques for wetland and watercourse crossings will be used to avoid impacts to wetlands and shoreline habitats, including any potential shoreline nesting areas, such as those for the Federally listed threatened Piping Plover and Red Knot.
- Tree clearing will be minimized to the maximum extent practicable. Any tree clearing will be the minimum required to install facility components and will be conducted during the winter months.
- At the one substation and/or converter station site, depending on the amount and type of habitat disturbance, bird and/or species-specific habitat assessment field surveys may be conducted in consultation with state and federal agencies.
- Onshore construction lighting will be temporary and localized to the work area.
- Lighting during operations will be limited to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.

## 4.4 Bats

This section describes bats that may be present in the Atlantic Shores Offshore and Onshore Project Areas, associated impact-producing factors (IPFs) and environmental protection measures to be considered during construction, operations and maintenance (O&M), and decommissioning. The Offshore Project Area includes the OCS-A 0549 Lease Area (Lease Area), Monmouth Export Cable Corridor (ECC), and Northern ECC. The Onshore Project Area includes the Potential Landfall Sites, Onshore Interconnection Cable Routes, and Onshore Substations and/or Converter Stations.

### 4.4.1 Affected Environment

This section synthesizes the state of the science on bat activity and focuses on the species with the potential to occur within the Offshore and Onshore Project Areas. This information includes scientific literature, and publicly available data. Published studies of offshore bat activity were reviewed, as well as data from Sjollema et al. (2014) made publicly available as part of the NJDEP Baseline Studies[17] (Geo-Marine, Inc. 2010), to investigate spatial relationships between bat observations and the Lease Area.

Atlantic Shores conducted a desktop assessment of onshore and offshore bat presence and has also implemented an offshore Avian and Bat Survey Plan (Survey Plan) that builds upon, and fills gaps from, previous survey efforts. The Survey Plan includes pre-construction vessel-based acoustic bat surveys throughout the Lease Area and was developed in consultation with the New Jersey Department of Environmental Protection (NJDEP), U.S. Fish and Wildlife Service (USFWS), and the Bureau of Ocean Energy Management (BOEM). This Survey Plan provides data to assess the spatial and temporal distributions of bat species throughout the Lease Area and will support characterizing bat exposure to the Project Areas.

#### 4.4.1.1 Offshore

**Bat Presence Offshore**

This section focuses on the potential for bat presence offshore and within the Lease Area. At its nearest point, the Lease Area is located approximately 8.4 miles (mi) (13.5 kilometers [km]) from the New Jersey coastline and approximately 60 mi (96.6 km) from the New York coastline. Most scientific literature related to bats in the offshore environment are natural history accounts documenting species compositions, phenology, and observation locations of individuals (reviewed in Peterson et al. 2014). Older accounts of offshore bat activity were documented by natural historians with in-person encounters from ships or coastlines; however, recently researchers have used passive acoustic monitoring on offshore land masses, platforms, buoys, and/or boats. Some publications on offshore bat activity have concluded that the primary drivers of bat presence are seasonality, weather, and wind

[17] Some figures in this document were developed using NJDEP Geographic Information Systems (GIS) digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

speeds (Johnson et al. 2011; Pelletier and Peterson 2013; Pelletier et al. 2013; Peterson 2016), echoing similar findings from onshore studies.

Within the eastern United States, long-distance (270–1,080 nm [500–2,000 km]; Fleming and Eby 2003) migratory tree bat species make up the majority of species observed offshore (Peterson 2016). The species identified offshore include eastern red bats (*Lasiurus borealis)*, hoary bats *(Lasiurus cinereus)*, and silver-haired bats *(Lasionycteris noctivagans)* (Peterson 2016), with the eastern red bat being the most prevalent offshore (see Appendix 1 in Peterson et al. 2014). Although less common, *Myotids*[18] have also been detected offshore and on islands.

The following studies have detected bats as far offshore as the Lease Area:

- Peterson et al. (2016) detected bats from 2.8 nm (5.3 km) to 70.1 nm (130 km) offshore with a mean distance from shore of 32.6 nm (60.3 km [n = 35]) over 52 nights of acoustic monitoring from mid-July through September 2014, none of which were confirmed as *Myotids*.

- Sjollema et al. (2014) found that on average bats were detected 4.7 nm (8.7 km) [n = 166] from shore after over 86 nights of acoustic monitoring throughout the Mid-Atlantic. Eastern red bats were the most widely distributed species in the Mid-Atlantic, being detected both nearest (0.6 nm [1.2 km]) and farthest from shore (11.8 nm [21.9 km]).

- Hatch et al. (2013) observed bats up to 22.6 nm (41.8 km) offshore during surveys in the Mid-Atlantic using vessel-based observers and digital imagery.

- New York State Energy Research Development Authority (NYSERDA) recorded silver-haired bats at an offshore bat monitoring buoy deployed 37.8 nm (70 km) from shore in the New York Bight (NYSERDA on remote.normandeau.com).

Additionally, although *Myotids* are less common in the offshore environment than long-distance migratory species, the following studies have detected *Myotids* offshore within the eastern United States:

- Sjollema et al. (2014) detected *Myotids* as far as 6.2 nm (11.5 km) from the Mid-Atlantic coast during vessel-based surveys.

- Peterson et al. (2014) detected *Myotids* using a stationary acoustic monitor located on a small island containing only a lighthouse 22.5 nm (41.6 km) from the coast of mainland Maine.

- Thompson et al. (2015) reports *Myotids* (most likely little brown bats *[Myotis lucifugus]*) using a commercial fishing vessel as a roost approximately 60 nm (110 km) from the nearest land in the Gulf of Maine.

[18] Such as the *Myotis lucifugus*, also known as the little brown bat.

- Peterson (2016) detected *Myotids* during a buoy-based survey in the Gulf of Maine, albeit in very low numbers (four passes over 1,609 detector nights).
- Dowling et al. (2017) reports tri-colored bats active throughout the maternity season on Martha's Vineyard, Massachusetts.

**Bat Presence Within the Lease Area**

To further investigate bats that may occur in the Lease Area, the subset of data collected by Sjollema et al. (2014) during the NJDEP Baseline Studies (see Volume 1 Appendix B in Geo-Marine, Inc. 2010) was reanalyzed (see Table 4.4-1). The NJDEP Study Area extends from the 33 feet (ft) (10 meters [m]) isobath to its boundary, roughly 20 nm (37 km) from the New Jersey coastline. In the NJDEP Study Area there were 55 observations of bats (53 acoustic detections and two visual detections) with no detection occurring within the Lease Area as presented in Figure 4.4-1.

Despite a lack of detections in the Lease Area, 41.8% of observations were collected beyond 7.6 nm (14.0 km), the westernmost edge of the Lease Area. As in the complete Sjollema et al. (2014) dataset, eastern red bats were the most abundant species and had the greatest frequency of occurrence beyond the westernmost edge of the Lease Area. One additional difference was found between the reanalysis and Sjollema et al. (2014): using the U.S. base layer (ESRI, USA) to estimate the distance from shore for each observation, one *Myotid* was recorded 8.5 nm (15.75 km) from shore (see Figure 4.4-1), 2.3 nm (4.25 km) farther than the maximum distance from shore reported in Sjollema et al. (2014). Finally, the dataset contains nine sets of observations occurring within 5 minutes of each other. This suggests that bats either passed the survey vessel in numbers greater than one, individuals were interested in the vessels and made multiple passes of investigation, or some combination of the two. There are no threatened and/or endangered bats that occurred in the records in the NJDEP Study Area (see Table 4.4-1).

In 2020 and 2021, Atlantic Shores conducted pre-construction vessel-based acoustic bat surveys throughout the Lease Area. The Avian and Bat Survey Plan (Appendix II-F1) was developed in consultation with the NJDEP, USFWS, and BOEM. Surveys were focused on the southern portion of the Lease Area in 2020, and in the central portion in 2021. In 2020, the detector was deployed from August 16 – November 18 for 65 nights; in 2021, the detector was deployed from June 30 – November 1 for 115 nights. Combining both years of data, detections included the eastern red bat ($n$=495), big brown/silver-haired bat group ($n$=478), silver-haired bat ($n$=80), hoary bat ($n$=37), big brown bat ($n$=26), and *Myotis* species ($n$=3). No Federally listed northern long-eared bats or Indiana bats were detected. Bats were detected from July to October, with spikes of detections in late August and early September. The last detection was on November 1, 2020, and October 24, 2021. The Bat Monitoring Report is provided as Appendix II-F4.

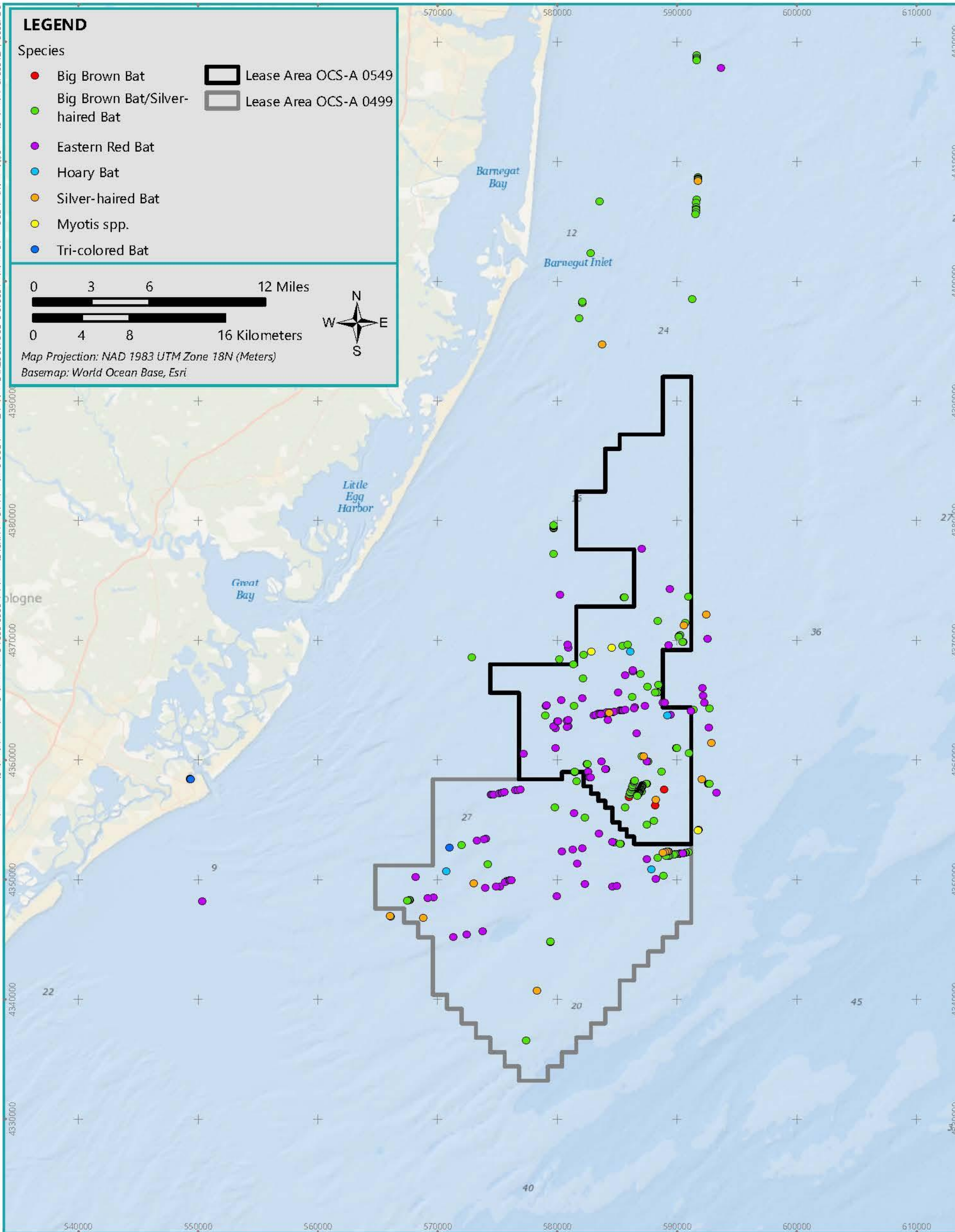
## Table 4.4-1. Offshore Bat Occurrence Records in the NJDEP Study Area

| Common Name | Scientific Name | Federal Status (Endangered Species Act [ESA]) | State Status (NJDEP Division of Fish and Wildlife) | Active Period | Peak Offshore Occurrence | Migratory Habitat | Max Distance Observed Offshore in NJDEP Study Area | Observations | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | <7.6 nm (14.0 km) | >7.6 nm (14.0 km) |
| Eastern Red Bat | *Lasiurus borealis* | Not Listed | Not Listed | Apr 31–Oct 15 | Aug–Sep | Latitudinal: Up to 2,000 km | 16.4 km | 13 | 6 |
| Hoary Bat | *Lasiurus cinereus* | Not Listed | Not Listed | Apr 31–Oct 15 | Aug–Sep | Latitudinal: Up to 2,000 km | 5.18 km | 1 | 0 |
| Silver-haired Bat | *Lasionycteris noctivagans* | Not Listed | Not Listed | Apr 31–Oct 15 | Aug–Sep | Latitudinal: Up to 2,000 km | 18.9 km** | 4 | 1 |
| Little Brown Bat | *Myotis lucifigus* | Not Listed | Not Listed | Apr 31–Oct 15 | NA | Regional: Generally <500 km | NA | NA | NA |
| Eastern Small-footed Bat | *Myotis leibii* | Not Listed | Not Listed | Apr 31–Oct 15 | NA | Regional: Generally <500 km | NA | NA | NA |
| Big Brown Bat | *Eptesicus fucscus* | Not Listed | Not Listed | Apr 31–Oct 15 | NA | Regional: Generally <500 km | NA | NA | NA |

| Common Name | Scientific Name | Federal Status (Endangered Species Act [ESA]) | State Status (NJDEP Division of Fish and Wildlife) | Active Period | Peak Offshore Occurrence | Migratory Habitat | Max Distance Observed Offshore in NJDEP Study Area | Observations | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | <7.6 nm (14.0 km) | >7.6 nm (14.0 km) |
| Tri-colored Bat*** | *Perimyotis subflavus* | Not Listed | Not Listed | Apr 31–Oct 15 | NA | Regional: Generally <500 km | NA | NA | NA |
| Myotis spp. | *NA* | NA | NA | Apr 31–Oct 15 | Aug–Sep | Regional: Generally <500 km | 15.7 km | 2 | 1 |

Notes:
*Observations less than 7.6 nm (14.0 km) from shore represent records west of the Lease Area and observations greater than 7.6 nm (14.0 km) represent records east of the westernmost Lease Area boundary. Rows containing NA result from the species not being detected in the NJDEP Study Area despite having the potential of being observed in the area based on their known distributions.
**Silver-haired bats were classified as silver-haired bat/big brown bat because their acoustic calls are often ambiguous, though big brown bats have not been reported offshore elsewhere and silver-haired bats are one of the most common species offshore and we therefore concluded that the calls are likely silver-haired bats.
***Tri-colored bat is proposed for listing under the Endangered Species Act.

Source:
Geo-Marine, Inc. (2010).




ATLANTIC SHORES offshore wind

**Figure 4.4-1**

*2020-2021 Bat Acoustic Detections Atlantic Shores Lease Areas OCS-A 0499 and OCS-A 0549*

Acoustic monitoring efforts recorded bats at a maximum of 10.2 nm (18.9 km) from shore in the NJDEP Study Area. In addition, two eastern red bats were visually observed 9.5 nm (17.6 km) and 12.9 nm (23.9 km) from shore by human observers on the deck of the vessel conducting bird surveys (Geo-Marine 2010). Both bats were observed during daylight hours.

**Patterns in Offshore Bat Activity**

Bats have been detected offshore from April through November; however, offshore bat activity peaks significantly throughout the autumn migration period of August to October across all records (Peterson et al. 2014; Lagerveld 2015, 2017, 2020; Peterson 2016; Sjollema et al. 2014). The coincidence of offshore presence within the known migratory period suggests that the offshore environment is related to the migratory behavior of certain species. Individuals migrating long distances south from northeastern Canada and U.S. may achieve a rapid and energetically beneficial migration by traveling a more direct route between summering and wintering locales rather than following the coastline (Alerstam 2000, 2008; Gill et al. 2009; Hedenström 2009; Bauer et al. 2010). Bats may also be seen offshore in pursuit of other landmasses (Allen 1923; Van Gelder and Wingate 1961) or for foraging opportunities during migration. However, bats are more likely following foraging opportunities that begin on the coast and end up at various distances offshore where they take advantage of ephemeral pulses of high-quality prey (Shannon 1916, Russell et al. 1998, Wikelski et al. 2006, May 2013, Westbrook et al. 2016).

Bat activity offshore is consistently negatively correlated with wind speed (Ahlén et al. 2009, Cryan and Brown 2007, Sjollema et al. 2014, Peterson et al. 2014, Hüppop and Hill 2016, Peterson 2016). Peterson (2016) found that mean nightly wind speed had a negative effect on activity up to 22.4 miles per hour (mph) (10 meters per second [m/s]). Sjollema et al. (2014) found bats active up to 15.4 mph (6.9 m/s), and in Europe, Ahlén et al. (2009) found that the majority of bat flights across the Baltic Sea took place at wind speeds less than 11.2 mph (5 m/s), although flights in winds of 22.4 mph (10 m/s) have been observed. In at least one study, ambient temperature was correlated with bat activity, finding that bat detection was greatest between a nightly range of 44.6 and 68°F (7 and 20°C) (Peterson 2016). During the 2020 and 2021 acoustic surveys aboard geophysical and geotechnical (G&G) vessels, the mean wind speed when bats were detected was 10.3 mph (4.6 m/s), ranging from 1 to 30 mph (0.5 to 12.5 m/s), but varied by species. The mean temperature when bats were detected was 74.6° F (23.7° C), ranging from 58.3 to 83.6° F (14.6 to 28.7° C); however, the temperature readings may have been influenced by heat generated by the survey vessel itself (see Appendix II-F4).

Reports of flight heights are mixed (Ahlén et al. 2009, Hatch et al. 2013). Ahlén et al. (2009) reports consistent flight heights less than 32.8 ft (10 m) and then rapidly increasing altitude in response to structures such as lighthouses, wind turbine generators (WTGs), and ships. However, Brabant *et al.* (2018) reported that offshore acoustic bat activity recorded at nacelle height is significantly less than at lower heights. Despite a maximum observed flight height of approximately 656 ft (approximately 200 m; Hatch et al. 2013) in the offshore environment, tree bats have been observed at much greater flight altitudes onshore. Peurach (2003) recorded a hoary bat being struck by an aircraft in October at 7,999 ft (2,438 m) above sea level. The incident was during the peak migratory period, suggesting that hoary bats can travel at altitudes many times greater than the Project's rotor swept zone (with a maximum height of 1,047 ft [319 m]) (see Figure 4.3-1 in Volume I). Furthermore, based on their conclusions that bats were using an offshore platform in the North Sea as a migratory refuge, Hüppop and Hill (2016) speculate that offshore migratory behavior may be associated with high altitude flights and low altitude activity may be associated with interruptions in those migratory flights.

#### 4.4.1.2 Onshore

There are eight species of bats in New Jersey and New York with ranges that overlap the Onshore Project Area (potential landfall sites, onshore interconnection cable route options, onshore substations and/or converter stations, and points of interconnection [POI]). These species are often classified as short-distance regional migrants (i.e., species that migrate less than 311 mi [500 km]) or long-distance migrants (i.e., species that migrate up to 1,243 mi [2,000 km]).

Short-distance regional migrants include the following:

- Big brown bat (*Eptesicus fuscus*)
- Eastern small-footed bat (*Myotis leibii*)
- Little brown bat (*Myotis lucifugus*)
- Northern long-eared bat (ESA-listed) (*Myotis septentrionalis*)
- Tri-colored bat (*Perimyotis subflavus*)

Long-distance migrants include the following:

- Eastern red bat (*Lasiurus borealis*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Hoary bat (*Lasiurus cinereus*)

Of the species found in the Onshore Project Area, only northern long-eared bats are currently listed under the Endangered Species Act (ESA) of 1973 (U.S.C. 16 § 1531 et seq.). The tri-colored bat is currently proposed for listing as Endangered under the ESA, and a decision is expected in fall 2023. In New Jersey, northern long-eared bat and little brown bat are listed as a Focal Species of Greatest Conservation Concern (NJDEP 2018). Further, little brown bats and tri-colored bats are listed on the national work plan for ESA review (USFWS 2019). Despite severe population declines, northern long-eared bats have historically been known to occur across all New York state counties (with the exception of the five New York City counties: New York County [Manhattan], Kings County [Brooklyn], Bronx County [The Bronx], Richmond County [Staten Island], and Queens County [Queens]; NYSDEC

2019). Before the spread of the fungal disease known as white-nose syndrome (WNS),[19] the species was known to occur across the state of New Jersey (BRI unpublished data; USFWS NJFO 2017). However, northern long-eared bats have not been confirmed in the towns where the New York onshore portions of the Project are located.[20]

Northern long-eared bats are considered regional migrants, as they travel from summering grounds back to thermally buffered hibernacula in caves, mines, and sometimes older buildings where they stay throughout the winter (Caceres and Barclay 2000, Henderson and Broders 2008). They spend the remainder of the year active in forested habitats (USFWS 2016). Between March and November, they have home ranges that can be up to 170 mi (275 km) from hibernation sites (Griffin 1945). They have small foraging ranges of less than 25 acres (10.1 hectares) from day roost sites (Dowling et al. 2017). Maternity colonies are hard to identify as they are in trees and move every 2 to 14 days (Menzel et al. 2002). The young are volant by mid-July and both adults and young remain within their maternity colonies until mid-August before commencing return migrations to hibernacula (Carter and Feldhamer 2005, Menzel et al. 2002).

As detailed in Section 4.7 of Volume I, potential landfall sites and associated onshore interconnection cable routes, have been identified in southern Monmouth County, New Jersey; in the vicinity of Asbury in northern Monmouth County, New Jersey; on southwest Staten Island, New York; on northeast Staten Island and in Brooklyn, New York. Onshore interconnection cables will travel underground primarily along existing roadways and/or utility rights-of-way (ROWs).

WNS is the primary threat to northern long-eared bat and the USFWS does not consider ROW development or expansion a significant threat to the species given the small portion of forested habitat that it affects (USFWS 2016). Furthermore, summer habitat is not a limiting factor for the species; thus, management priority should be placed on protecting hibernacula (USFWS 2016). In November 2022, the USFWS reclassified the northern long-eared bat as Endangered under the ESA. This reclassification was extended 60 days by USFWS and is anticipated to take effect on March 31, 2023 (USFWS. 2023). While further details are forthcoming, conservation strategies will likely be similar to those implemented for other endangered bats, such as the Indiana bat. Atlantic Shores will adhere to new guidance as it becomes available, and in consultation with state and Federal regulators. In addition, the Atlantic Shores will consult with relevant state agencies in New Jersey and New York to request current information on northern long-eared bat maternity roosts and hibernacula.

### 4.4.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect bats during construction, O&M, or decommissioning of the Project are presented in 4.4-2.

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[19] WNS is a fungal disease (*Pseudogymnoascus destructans*) that affects hibernating bats and can cause them to fly outside during the winter. The fungus causes a white coloring to the nose and face of the bats (for more information https://www.whitenosesyndrome.org/).

[20] https://www.dec.ny.gov/docs/wildlife_pdf/nlebtowns.pdf

## Table 4.4-2. Impact Producing Factors for Bats

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Presence of Structures | | ● | |
| Light | ● | ● | ● |
| Noise | ● | ● | ● |
| Land Disturbance: Onshore Construction | ● | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for potential offshore and onshore effects to bats is the maximum offshore and onshore build-out of the Project (see Sections 4.3.1. and 4.11 of Volume I).

### 4.4.2.1 Presence of Structures

The presence of structures in the offshore environment may have direct and indirect impacts on bats via WTG collision and migration disturbances during the O&M phase (Arnett et al. 2008; Arnett and Baerwald 2013; Arnett et al. 2016; Zimmerling and Francis 2016; Frick et al. 2017). Although the diversity of species and density of bats in the Lease Area is lower relative to the onshore environment, structures may disrupt migration as bats use structures as potential roosting habitat and/or investigate the area for foraging resources or mating/social interactions (Cryan 2008; Cryan and Barclay 2009; Cryan et al. 2012; Cryan et al. 2014).

Bats will be most exposed to the Lease Area during the migratory period, particularly autumn (Peterson et al. 2014; Lagerveld 2015, 2017, 2020; Peterson 2016). The species with the highest mortality rates at onshore WTG arrays are also the species most commonly detected offshore (eastern red bat, hoary bat, and silver-haired bat). However, these species are less abundant offshore, so, if collisions were to occur, only a limited number of individuals would be expected to be affected and population level effects are unlikely.

Although WTGs are proposed 7.6 nm (14 km) offshore, and there is significant uncertainty on bat movement and behavior offshore, it is possible that they may impede migratory flyways and interfere with other life history traits, such as migratory refueling, and potential mating behavior that occurs throughout migration (Drueker 1972, Cryan et al. 2012). However, the range at which bats are drawn to WTGs is currently unknown, and these indirect effects are largely unknown.

Recent evidence onshore suggests that insects may be attracted to WTG nacelles and could be used as swarming sites (Jansson et al. 2020). While information on whether this phenomenon occurs offshore is currently lacking, it may be possible that migrating or swarming insects could temporarily congregate near or within the Lease Area, briefly creating foraging opportunities for bats and increasing the chance of WTG collisions (Ahlén et al. 2009; Rydell et al. 2010a; Jansson et al. 2020).

Although bats use offshore structures to opportunistically forage and temporarily roost (Ahlén et al. 2009), the frequency of such interactions is temporally and spatially isolated and relatively low compared to onshore WTG arrays.

In a meta-analysis investigating drivers of bat mortality at onshore wind farms, Thompson et al. (2017) showed that open landscapes (i.e., increased grasslands relative to more heterogeneous environments) had an inverse relationship with bat mortality. The authors suggest this may result from fewer individuals using massive open grasslands during migration translating into fewer encounters with wind energy facilities. Further, in heterogeneous landscapes there are features such as ridgelines that can concentrate migrating individuals into WTG arrays, resulting in increased exposure. Rydell et al. (2010b) echo these findings in northwestern Europe by showing that mortality rates associated with WTGs in open landscapes were significantly lower than WTGs within more complex habitat matrices. Given that bats are relatively uncommon offshore and that the offshore landscape is open (i.e., there are no landscape features), it is expected that mortality rates will be relatively low offshore and population level impacts are unlikely. There are no anticipated impacts associated with bats interacting with onshore structures such as substations.

### 4.4.2.2 Light

The effect of lights on bats is species-specific, depends on behavioral contexts, and may affect foraging (Haddock et al. 2019; Bailey et al. 2019; Russo et al. 2019), commuting (Stone 2015; Stone et al. 2009), emergence, roosting, and breeding (reviewed in Stone et al. 2015). Lighting can disrupt the composition and abundance of prey (Davies et al. 2012) and thus shift bat foraging strategies between lit and unlit sites (Cravens et al. 2018). Migratory species in Europe have a diverse set of responses to light-emitting diode light source (LED) lighting, exhibiting increased foraging when exposed to warm-white light and exhibiting phototaxis attraction when exposed to red and green LED light (Voigt et al. 2017, 2018). In the U.S., Cravens and Boyles (2019) found that of seven observed species, eastern red bats were the only species to prefer LED lit areas as they presumably gained some advantage in foraging success near lit areas. From light tolerance studies, *Myotids* appear to be the species most intolerant of intensely lit areas (Stone et al. 2009; Lacoeuilhe et al. 2014) perhaps from the reduced capacity to evade predators by these more slowly flying bats (Stone et al. 2015).

**Offshore**

Artificial lighting will be required during the construction, O&M, and decommissioning of the offshore Projects. During construction and decommissioning, there will be a temporary increase in lighting from construction equipment and vessels with navigational, deck, and interior lights. During O&M, WTGs will require lighting that complies with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines. Vessel use and associated lighting will also occur, though at a lower frequency than during construction and decommissioning. Other temporary lighting (e.g., helicopter hoist status lights) may be used for safety when necessary. However, down-lighting and down-shielding lighting will be used where practicable, such as at offshore substations.

At WTG arrays, Bennett and Hale (2014) found that eastern red bat fatality rates are significantly reduced at WTGs with red flashing lights compared to WTGs with no lights, and mortality rates for all other species observed in the study did not correlate with lighting. This suggests that hoary bats are neither attracted nor repelled from red aviation lighting on WTGs, and eastern red bats are not attracted to aviation lights. Further, Arnett et al. (2008) showed that blinking red lights did not significantly influence the mortality rates of bats at onshore wind energy facilities. Red aviation lighting is less likely to attract invertebrate prey which may partly drive patterns of reduced attraction (Bennet and Hale 2014).

To minimize the offshore effects of lighting, Atlantic Shores is considering the use of an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval, which will substantially reduce the time the aviation obstruction lighting mounted on WTGs is illuminated. An ADLS automatically activates all aviation obstruction lighting (i.e., any FAA lighting on nacelles or towers) when aircraft approach the WTGs; at all other times, the lighting is off. The use of ADLS is expected to further reduce bat exposure to operational lighting. An assessment of the activation frequency of an ADLS indicates that it would be activated up to 20 hours and 25 minutes per year (see Appendix II-M2). Marine navigation lighting will include yellow flashing lights, which are not expected to serve as an attractant for insects, upon which bats may prey.

**Onshore**

The Onshore Project Area occurs primarily within and adjacent to urbanized and residential areas, thus additional light emitted by substations and/or converter stations is expected to be minimal. Atlantic Shores is not anticipating significant nighttime work, yet artificial lighting may be needed onshore during construction to light vehicle pathways and construction activity. Onshore construction lighting will be temporary and localized to the work area. During O&M, lighting may have an indirect effect on bats by disrupting commuting routes (Stone et al. 2009) and reducing overall foraging habitat (Cravens et al. 2019). Onshore lighting will be used on an as-needed basis and the lighting fixtures will be equipped with hoods for down-shielding to the maximum extent practicable to minimize effects to bats (see Section 4.9.2 of Volume I). Effects from lighting during decommissioning are expected to be similar to those during construction and will be temporary. During decommissioning, all artificial lighting will be removed. Atlantic Shores will minimize onshore work at night where practicable.

#### 4.4.2.3 Noise

This IPF section addresses sound generated during activities conducted both onshore and offshore in the Project Areas, including pile driving and secondary noise sources, and the potential effect on bats.

**Offshore**

Noise occurring offshore during any of the three Project phases is not expected to have any direct effects on bats offshore, and the likelihood of indirect effects such as avoidance behavior, caused by noise, is believed to be low as North American bat species are regularly observed navigating through and foraging within noisy urban areas (Schimpp and Kalcounis-Rueppell 2018).

Most studies showing negative effects of noise on bats demonstrate a noise-induced reduction in foraging efficiency for gleaning species only (Shaub et al. 2008, Bunkley and Barber 2015). All species with the potential to occur in the Lease Area are aerial insectivores and are not known to rely on passive listening for prey.

Bunkley et al. (2015) found that bats that emit low frequency (<35 kilohertz [kHz]) echolocation calls (e.g., silver-haired bats and hoary bats) were recorded less frequently at sites with compressor stations associated with natural gas extraction that produce broadband noise compared to quiet sites. Pile driving could produce similar levels of noise offshore resulting in avoidance behavior for low frequency emitting species, however there is no evidence to suggest that offshore pile driving would otherwise interfere with directional migratory flights, and noise associated with O&M and decommissioning is not expected to affect bat behavior.

**Onshore**

Because the Onshore Project Area is almost entirely co-located with existing developed areas, noise disturbance of bat habitat will be limited. There are potential temporary and localized direct and indirect effects to bats arising from onshore construction noise. During the non-hibernation period, noise from equipment during construction and decommissioning has the potential to cause avoidance behavior (Bunkley et al. 2015) or disrupt day-roosting bats, which may cause a direct effect through fleeing during daylight hours, increasing predation risk (Rydell et al. 1996). Noise effects will be temporary and localized and not expected to cause any long-term fitness disadvantages as frequent roost switching is common among bats (Whitaker 1998). Atlantic Shores will make reasonable efforts to minimize noise as feasible, including between August and October when the majority of onshore bat activity occurs during the fall migratory period. Onshore construction hours will adhere to local noise ordinances (see Section 8.0 In-Air Noise and Hydroacoustics and Appendix II-V Onshore Noise Report).

### 4.4.2.4 Land Disturbance: Onshore Construction

The siting of onshore facilities has avoided impacting bat habitat by siting them in existing developed areas. The installation and maintenance of cable landings, substations, and underground cables may have limited affects to bat habitat through temporary direct disturbance.

The greatest risk of direct effects to bats onshore is during the construction phase when there is potential for removal of trees used by bats for roosting (USFWS 2016). Some tree clearing could be necessary at the Asbury Ave Substation and/or Converter Station Sites (see Section 4.9 of Volume I) but will be avoided to the extent practicable. If required, this limited tree clearing will be the minimum required to install facility components. If tree clearing becomes necessary, presence/absence or species-specific habitat assessment field surveys may be conducted in consultation with state and federal agencies. Atlantic Shores will maintain their commitment to clearing trees only when bats are not active. Should bats be identified utilizing trees located on the substation and/or converter station sites for maternity roosting during the summer, trees will only be cleared in the winter. It is anticipated that if bats do return the following summer, they will utilize forested areas adjacent to the substations and/or converter stations. Tree clearing is not expected at the potential landfall sites or along the onshore interconnection cable routes, which are located along existing roadways and/or utility ROWs.

As it pertains to tree clearing and onshore activities, Atlantic Shores will adhere to updated guidance from USFWS regarding the reclassification of northern long-eared bats as Endangered under the ESA and any changes to the listing status of tricolored bats. Within the State of New Jersey, northern long-eared bat is also currently a candidate endangered species, so the NJDEP also advises that any tree removal be done outside of the "active season" for northern long-eared bat, which is defined as April 1 to September 30 if there are no known northern long-eared bat hibernacula within 10 mi (16 km) of a project (NJDEP, personal communication, March 2021). As stated above, in order to avoid impacts to all bat species and especially to northern long-eared bat, any tree removal will take place outside of the April 1 to September 30 time-period, and the Project will adhere to updated guidance from the USFWS regarding the reclassification of northern long-eared bats as Endangered under the ESA. Overall, onshore construction activities are expected to be short-term and localized and not affect population-level fitness.

O&M of the onshore components including the substations and/or converter stations, and onshore interconnection cable routes is not expected to affect bats. No tree clearing is anticipated during O&M. Necessary maintenance to new and existing infrastructure will largely occur through manholes, thereby avoiding and minimizing the need for tree clearing. Effects to bat species during decommissioning are expected to be similar to construction and decommissioning of the Project is not expected to result in additional habitat loss, except for the unlikely event that trees are removed for equipment to access a location.

#### 4.4.2.5 Summary of Proposed Environmental Protection Measures

Atlantic Shores will implement the following environmental protection measures to reduce effects to bats throughout the Project Areas. Atlantic Shores will also continue to work with NJDEP, NYDEC, BOEM, and USFWS to outline additional avoidance and minimization measures where appropriate.

**Offshore**

- Two years of pre-construction vessel-based acoustic surveys for bats have been implemented to build upon and fill knowledge gaps from previous survey efforts.
- Lighting during O&M will be limited to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats or their insect prey and therefore reducing the effects of light on potential collisions of bats at night.
- Red flashing FAA lights and yellow flashing marine navigation lights will be used on the WTGs instead of constant white light, which has been shown to reduce eastern red bat fatality rates, the most prevalent species observed offshore. Furthermore, ADLS is being considered to significantly reduce the number of hours FAA lighting will be illuminated.
- Down-lighting and down-shielded lighting will be used to the maximum extent practicable.

- A post-construction bat monitoring plan will be developed.

**Onshore**

- Onshore facilities have been sited to avoid bat habitat to the maximum extent practicable.
- Tree clearing will be minimized to the maximum extent practicable.
- If tree clearing is necessary at onshore substation and/or converter station sites, presence/absence or habitat assessment field surveys may be conducted in consultation with USFWS. To avoid potential conflicts, any tree removal activities will take place outside of the "active season" for northern long-eared bats, which is defined as April 1 to September 30. The Project will adhere to updated guidance from USFWS regarding the reclassification of northern long-eared bats as Endangered under the ESA and any changes to the listing status of tricolored bats.
- Onshore construction lighting will be temporary and localized to the work area.
- Lighting during O&M will be limited to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats or their insect prey and therefore reducing the effects of light on potential collisions of bats at night.
- Down-lighting and down-shielded lighting will be used to the maximum extent practicable.
- Reasonable efforts will be made to minimize onshore construction noise.
- Onshore work at night will be minimized to the extent practicable.

# 4.5 Benthic Resources

This section describes benthic resources and habitats present in the Offshore Project Area, which includes the Lease Area, Monmouth Export Cable Corridor (ECC), Northern ECC, and Northern ECC branches.[21] This section also assesses the impact producing factors (IPFs) associated with Project activities and the anticipated measures to avoid and minimize the potential effects to these resources. Benthic resources are important components of any marine ecosystem. Benthic habitats serve essential and diverse purposes within the marine ecosystem, influencing biological and behavioral processes and providing breeding, nursery, shelter, refuge, and foraging opportunities for a variety of benthic invertebrate and finfish species. Benthic invertebrate species are an important link in marine trophic interactions, typically acting as food sources for larger invertebrate or finfish predators. In addition to the ecological importance of benthic habitats and species, many species are considered recreationally or commercially important (see Section 7.4 Commercial Fisheries and For-Hire Recreational Fishing).

Atlantic Shores understands the importance of benthic resources to marine ecosystems and to the other ocean users relying on those ecosystems. Atlantic Shores has implemented benthic habitat assessment surveys, which were approved and accepted by Federal and State agencies, that build upon and fill data gaps from previously completed Federal and State funded initiatives to map and study benthic resources. The studies, both completed and ongoing, have provided data to characterize the seafloor and benthic habitats and to identify species occupying these habitats in the Offshore Project Area. These efforts have and will continue to inform Atlantic Shores' Project design and construction planning to avoid or minimize Project-related impacts.

## 4.5.1 Affected Environment

The description of benthic resource conditions within the Offshore Project Area is based on available literature, online data portals and mapping databases, and the results of Atlantic Shores' site-specific surveys. The site-specific surveys used to characterize benthic habitat and resources in the Offshore Project Area are presented in the Benthic Assessment Report (Appendix II-G1).

The affected environment for benthic resources spans the entirety of the Offshore Project Area, which is comprised of the Lease Area, Monmouth ECC, Northern ECC, and Northern ECC Branches.[22] The Offshore Project Area is located off the coast of Atlantic City, New Jersey within the Mid-Atlantic Bight. The shelf of the Mid-Atlantic Bight, a small portion of which will contain the offshore reaches of the Offshore Project Area, is characterized by valleys, channels, shoal massifs, scarps, and swales

[21] The Northern ECC extends north from the Lease Area to the New York State waters boundary, where it splits into branches that make landfall in Asbury Park, New Jersey, Staten Island, New York, and/or Brooklyn, New York. There are five landfall sites in total including: Asbury, Kingsley, Lemon Creek, Wolfe's Pond, and Fort Hamilton (see Figure 1.0-1).

[22] Atlantic Shores has updated the Project Design Envelope to include the following branches/landfall sites along the Northern ECC: Asbury Landfall Site, Kingsley Landfall Site, Lemon Creek Landfall Site, Wolfe's Pond Landfall Site, and Fort Hamilton Landfall Site. Several locations of benthic habitat sampling are no longer located within the Northern ECC Branches; however, are included in the benthic habitat analyses presented in this section as they are considered to be representative for the Project. For additional information regarding the layout of the Project, please refer to COP Volume I Project Information, Sections 1.0 Introduction and 4.7 Landfall Sites, as well as Figure 1.1-2 Project Overview.

(Stevenson et al. 2004; BOEM 2012). Though these topographic features exist within the Mid-Atlantic Bight, most of the Offshore Project Area is topographically flat, characterized by smaller features such as ripples, mega ripples, sand bedforms, and sand ridges (Steimle and Zetlin 2000; Stevenson et al. 2004; BOEM 2012).

One distinct oceanographic feature of the Mid-Atlantic Bight is the Cold Pool. The Cold Pool is an oceanographic phenomenon referring to a bottom-trapped, cold, nutrient-rich pool that extends from Cape Cod, Massachusetts to Cape Hatteras, North Carolina, located over the mid- and outer-shelf of the Mid-Atlantic Bight (Chen 2018; Ganim 2019). The formation of the Cold Pool is driven by seasonal patterns in solar heating and wind (Ganim 2019) and is not spatially uniform (Lentz 2017). It forms at the start of spring when wind mixing is reduced, and surface heat fluxes increase causing the water column to become stratified (Ganim 2019; Lentz 2017). Freshwater runoff in the spring can further intensify stratification (Castelao et al. 2010). The Cold Pool, located along the seafloor, is isolated from warming surface waters by the seasonal thermocline and creates habitat conditions that provide thermal refuge to colder water species in the Mid-Atlantic Bight ecosystem (Lentz 2017). Cold Pool waters are nutrient-enriched and when upwelled toward the surface, can drive phytoplankton growth and high concentrations of particulate organic matter in the water column (Voynova et al. 2013). The timing of the formation and breakdown of the Cold Pool, as well as its spatial extent, varies significantly each year but generally develops annually between spring and fall (Chen and Curchitser 2020). The Cold Pool dissipates in the fall due to enhanced vertical mixing from an increase in the frequency of strong wind events and the cooling of surface temperatures (Ganim 2019). The timing of Cold Pool formation and breakdown has been linked to biological processes of marine invertebrates (e.g., surfclam growth and ocean quahog spawning) (Narvaez et al. 2015; Toupoint et al. 2012).

#### 4.5.1.1 Benthic Habitat

**Desktop Studies**

Existing literature and data portals were reviewed to classify benthic habitat and determine the types of benthic habitat that may be present in the Offshore Project Area. There are approximately 13 habitat types in the Offshore Project Area according to a classification and mapping study based on bathymetry, sediment grain size, and seafloor topography data conducted by Greene et al (2010). The three most prevalent habitat types in the Lease Area, Monmouth ECC, Northern ECC, and Asbury and Kingsley branches include: (1) mid-position flats and depressions in shallow water 82 to 148 feet (ft) (25 to 45 meter [m]) on medium to coarse substrate[23]; (2) depressions and mid-position flats in shallow to moderate depth 0 to 148 ft (0 to 45 m) on coarse to fine sand; and (3) mid-position flats in shallow water 82 to 148 ft (25 to 45 m) on coarse to medium sand (Greene et al. 2010). Habitat types in the Northern ECC branches that extend to Staten Island and Brooklyn, New York differ from the larger Offshore Project Area. The three most prevalent habitat types in the Northern ECC branches include: (1) flats and side slopes in very shallow to shallow water 0 to 75 ft (0 to 23 m) on fine to coarse sand; (2) depressions and mid-position flats at moderate depths 75 to 144 ft (23 to 44 m) on very fine sand;

[23] Mid-position flat refers to a broad, flat plain that is at an elevation and relative slope similar to the surrounding area (Greene et al. 2010).

and (3) depressions in very shallow water 0 to 75 ft (0 to 23 m) mostly on medium to coarse sand but occasionally on silt (Greene et al. 2010). Sediment types in the dominant habitats classified by Greene et al. (2010) largely support sediment classification efforts by The Nature Conservancy as part of the Northwest Atlantic Marine Ecoregional Assessment (NAM ERA) mapping[24] which shows that the Offshore Project Area is dominated by medium, coarse, and fine sands as well as gravels (see Figure 4.5-1). Specifically, based on the NAM ERA mapping, the Lease Area is largely dominated by medium sand (0.01 to 0.02 in) (0.25 to 0.5 mm) and gravel/granule sediment (> 2 in), with a small portion of very coarse sand (1.0 to 2.0 in) in the northwestern corner; the Monmouth ECC largely consists of coarse and medium sand, with medium and fine sand present in the nearshore portion; and the Northern ECC largely consists of medium and coarse sand in the offshore extent, with smaller portions of very coarse sand and gravel (greater than 0.08 in) (greater than 2 mm) spread throughout. Along the nearshore reaches of the Northern ECC branches, NAM ERA mapping indicates that sediment consists of very fine sand (0.002 to 0.005 in) (0.06 to 0.125 mm), fine sand (0.005 to 0.01 in) (0.125 to 0.25 mm), and medium sand (The Nature Conservancy 2015), with some areas of coarse sand (0.039 to 0.079 in) (1.0 to 2.0 mm) near Brooklyn, New York.

In addition to soft sediment, hardened structures created by shipwrecks, obstructions, or artificial reefs contribute to the benthic habitat available for marine species. These features represent areas of hard substrate projecting above the seabed that attract benthic resources and fish species in areas where reef habitat is sparse like the Mid-Atlantic Bight (Ross et al. 2015). Multiple shipwrecks are located in and along the borders of the Offshore Project Area (see Section 6.3 Marine Archaeological Resources for more information). Additionally, one artificial reef is located at the northwestern tip of the Lease Area (Garden State North Reef), two are located along the outer boundary of the Monmouth ECC (Manasquan Inlet Reef and Axel Carlson Reef; depicted in Figure 7.4-16 of the COP). Two of these artificial reefs, the Garden State North Reef and the Axel Carlson Reef, are designated as placement areas by the U.S. Army Corps of Engineers (USACE 2017). The Garden State North Reef site is an artificial reef complex where ships, military vehicles, subway cars, concrete, and dredged rock have been disposed (NJDEP 2021). The Axel Carlson Reef site is an artificial reef complex where many boats, military tanks, construction materials, and rock have been disposed. Additional information on these sites can be found in Table 2.1-2 and Figure 3.2-1.

Living bottoms, such as corals (Phylum Cnidaria) and sponges (Phylum Porifera), could also provide habitat to benthic species. During site-specific benthic characterization surveys conducted between 2019 and 2022, corals (Phylum Cnidaria) were only observed in the Northern ECC. According to NOAA's Deep Sea Coral Research and Technology modeling (Kinlan et al. 2016), coral habitat suitability is classified as low within the Offshore Project Area. Results of the benthic characterization surveys largely support NOAA's modeling in that habitat suitability in the Lease Area and Monmouth ECC for non-gorgonian corals is classified as low, with some areas of the Monmouth ECC classified as medium suitability.

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[24] The NAM ERA uses grain-size data from the U.S. Geological Survey (USGS) and Woods Hole Coastal and Marine Science Center.

Habitat suitability in the Northern ECC for non-gorgonian coral species ranges from low to high (Kinlan et al. 2016). Sponges (Phylum Porifera) were observed in the Monmouth ECC and Northern ECC during towed video surveys (see Appendix II-G1). No sponges were observed in the Lease Area during towed video surveys.

**Site-Specific Surveys**

To validate seabed and habitat conditions described in published literature and available data portals, Atlantic Shores has initiated site-specific high-resolution geophysical (HRG), geotechnical, and benthic surveys to characterize benthic habitat in the Offshore Project Area. Site-specific surveys conducted by Atlantic Shores include benthic grab (see Appendix II-G1), SPI camera – plan view video (PV) (see Appendices II-G2 and II-G3), and towed video surveys (see Appendix II-G1) and to date, cover the Lease Area, Monmouth ECC, and Northern ECC and branches. These surveys were conducted in accordance with BOEM's 2019 guidelines for benthic habitat mapping and with NMFS *Updated Recommendations for Mapping Fish Habitat* (NMFS, 2021) to the extent possible in the survey years since it was published and were used to characterize seafloor sediment composition and biogenic features that make up the benthic habitat of the Offshore Project Area. The sediment survey data is characterized in accordance with the Coastal and Marine Ecological Classifications Standards (CMECS). CMECS is a hierarchical system with classification thresholds based on sediment grain size and the relative percent composition of mud, sand, and gravel-sized components (FGDC 2012). In the CMECS classification system, grain size and composition are used to describe benthic habitats and define complex and potentially valuable fish habitats. According to the National Marine Fisheries Service (NMFS), sediment containing at least 5% gravel content is considered complex habitat. Classifying to a standard allows for analysis of habitats and comparison both within and between regions, and the CMECS classification system was applied as recommended by NMFS in their guidelines for mapping Essential Fish Habitat (EFH) (NMFS 2021).

Sampling locations and CMECS classifications from surveys conducted from 2019 to 2022 are illustrated in Figure 4.5-2 and the percentage of each CMECS category in the Lease Area, Monmouth ECC, and Northern ECC is illustrated in Figure 4.5-3. A total of 60 samples were collected within the Lease Area. Of the 60 samples collected in the Lease Area, 25 samples (42% of samples) were classified as Gravelly Sand, 20 samples (33% of samples) were classified as Medium Sand, seven samples (12% of samples) were classified as Very Coarse/Coarse Sand, four samples (7% of samples) were classified as Sandy Gravel, three samples (5% of samples) were classified as Muddy Sand, and one sample (2% of samples) was classified as Muddy Sandy Gravel (see Appendix II-G1). Five of the samples collected within the Lease Area contained between 30% and less than 80% gravel content (i.e., Muddy Sandy Gravel and Sandy Gravel) and 25 samples contained between 5% and less than 30% gravel content (i.e., Gravelly Sand).

Within the Monmouth ECC, a total of 33 samples were collected. Results of the 33 samples collected in the Monmouth ECC include: 14 samples (42% of samples) classified as Gravelly Sand, six samples (18% of samples) classified as Medium Sand, four samples (12% of samples) classified as Sandy Gravel, four samples (12% of samples) classified as Very Coarse/Coarse Sand, three samples (9% of samples) classified as Gravelly Muddy Sand, one sample (3% of samples) classified as Fine/Very Fine Sand, and one sample (3% of samples) classified as Muddy Sandy Gravel. Of the samples collected in the Monmouth ECC, five contained gravel mixes with a gravel content between 30% and less than 80% (i.e., Muddy Sandy Gravel and Sandy Gravel) and 17 contained between 5% and less than 30% gravel content (i.e., Gravelly Sand and Gravelly Muddy Sand).

Within the Northern ECC, a total of 65 samples were collected. Results of the 65 samples collected in the Northern  ECC include: 17 samples (26% of samples) classified as Medium Sand, 10 samples (16% of samples) classified as Sandy Gravel, nine samples (14% of samples) classified as Gravelly Sand, eight samples (12% of samples) classified as Muddy Sand, six samples (9% of samples) classified as Fine/Very Fine Sand, five samples (8% of samples) classified as Muddy Sandy Gravel, four samples (6% of samples) classified as Sandy Mud, two samples (3% of samples) classified as Very/Coarse Sand, two samples (3% of samples) classified as Pebble/Granule, and two samples (3% of samples) classified as Gravelly Muddy Sandy.  Of the samples collected in in the Northern ECC, 15 contained gravel mixes with a gravel content between 30% and less than 80% (i.e., Sandy Gravel and Muddy Sandy Gravel) and 11 contained between 5% and less than 30% gravel content (i.e., Gravelly Sand and Gravelly Muddy Sand). Only two samples contained gravel content greater than 80% (i.e., Pebble/Granule).

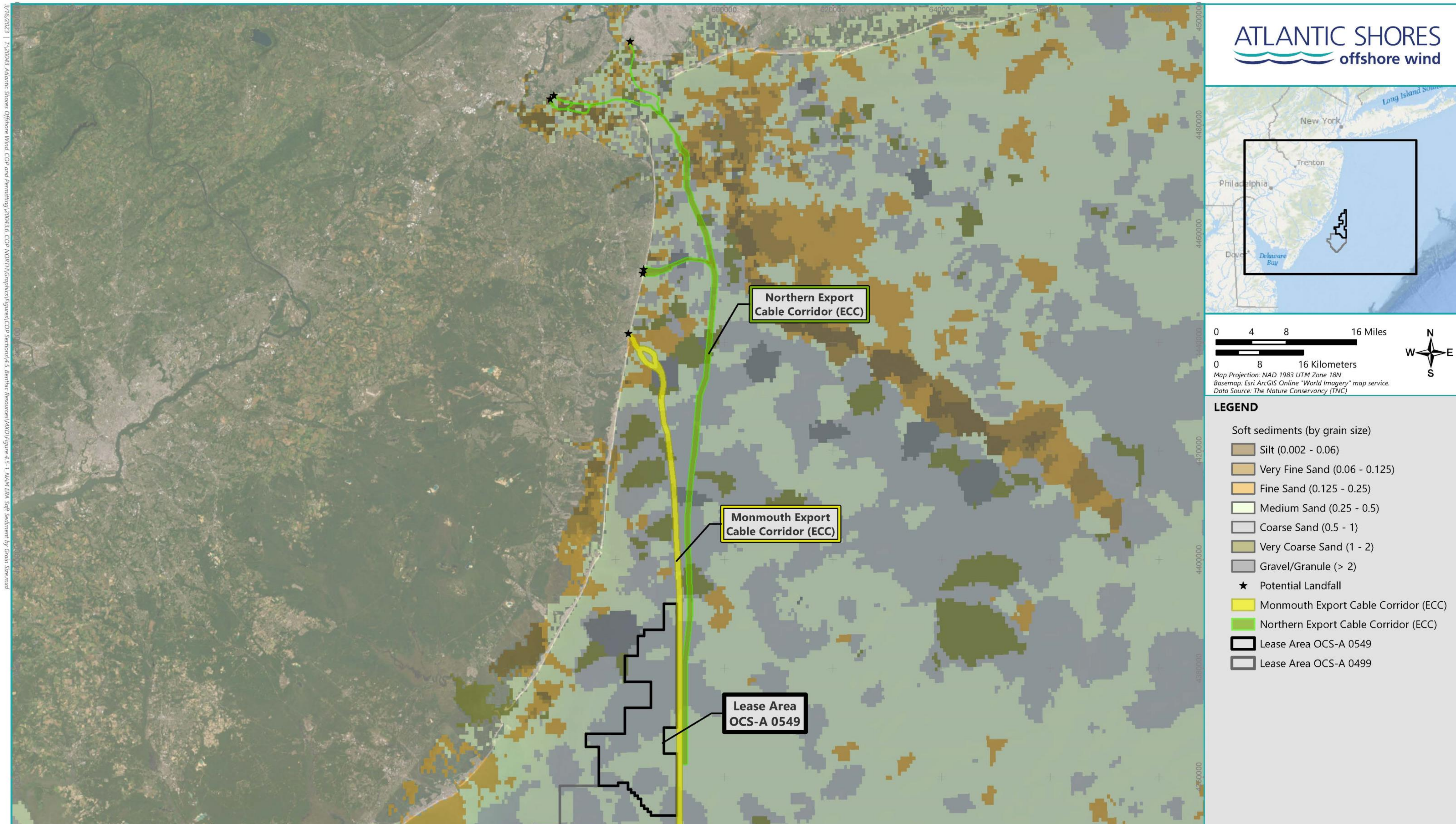
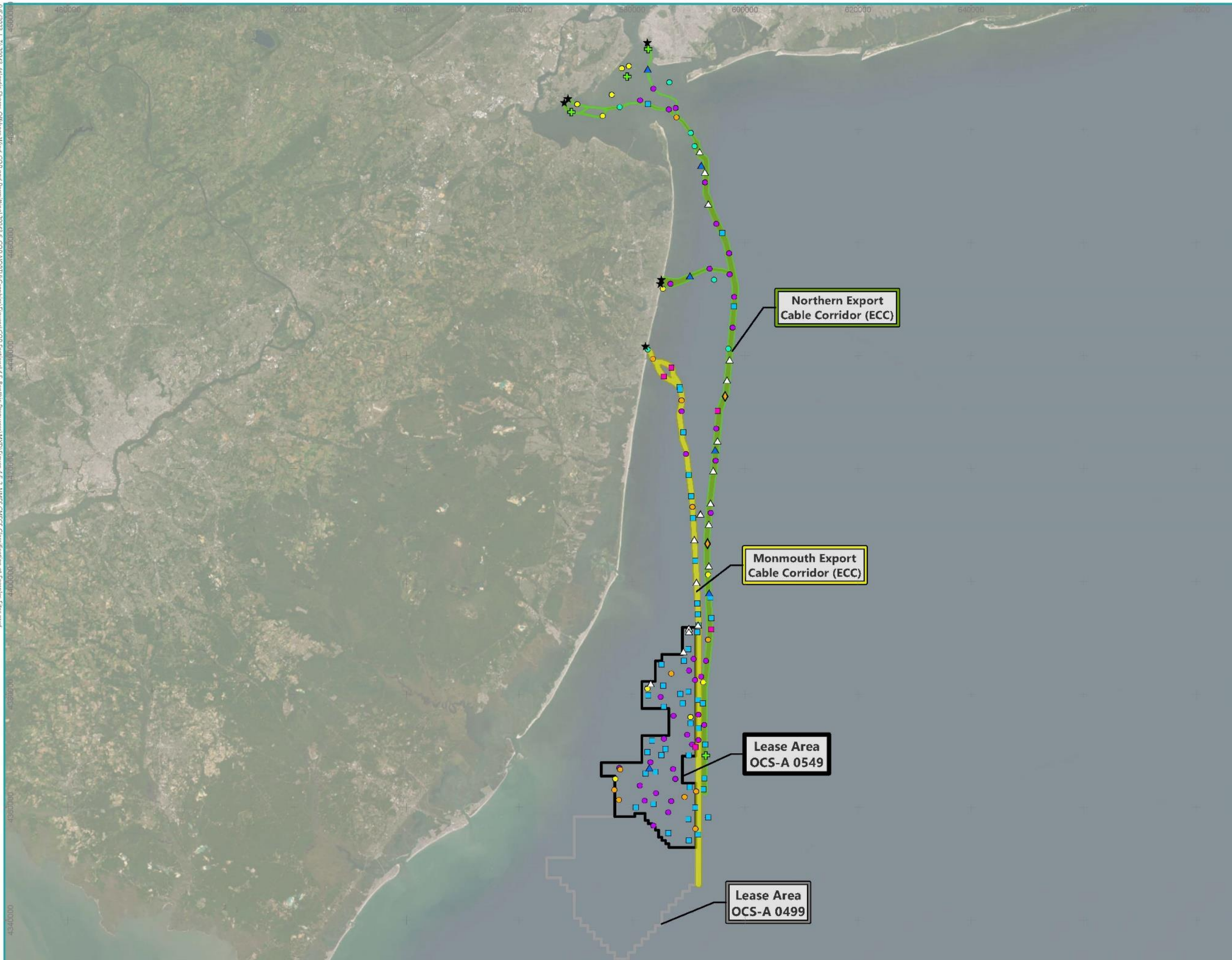


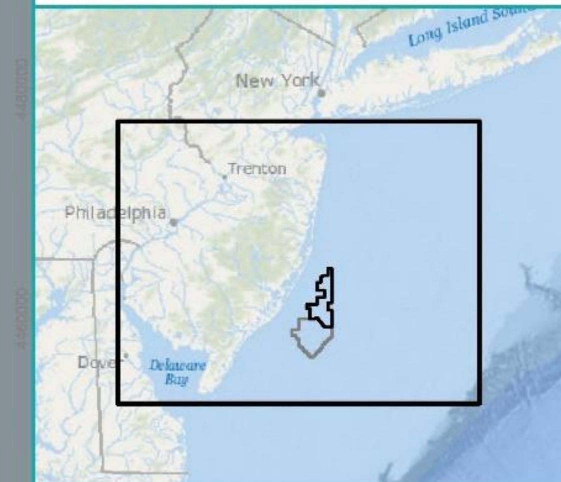

**Figure 4.5-1**

*NAM ERA Soft Sediment by Grain Size*

9/5/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\4.5 Benthic Resources\MXD\Figure 4.5 2 NMFS CMECS Classification at Samples Sites.mxd




ATLANTIC SHORES offshore wind




0 4 8 16 Miles

0 8 16 Kilometers

Map Projection: NAD 1983 UTM Zone 18N
Basemap: Esri ArcGIS Online "World Imagery" map service.
Data Source: Sediment Data provided by RPS

**LEGEND**

Grab Sample Site
- Sandy Mud

Gravels (≥80% gravel)
- Gravel (Pebble/Granule)

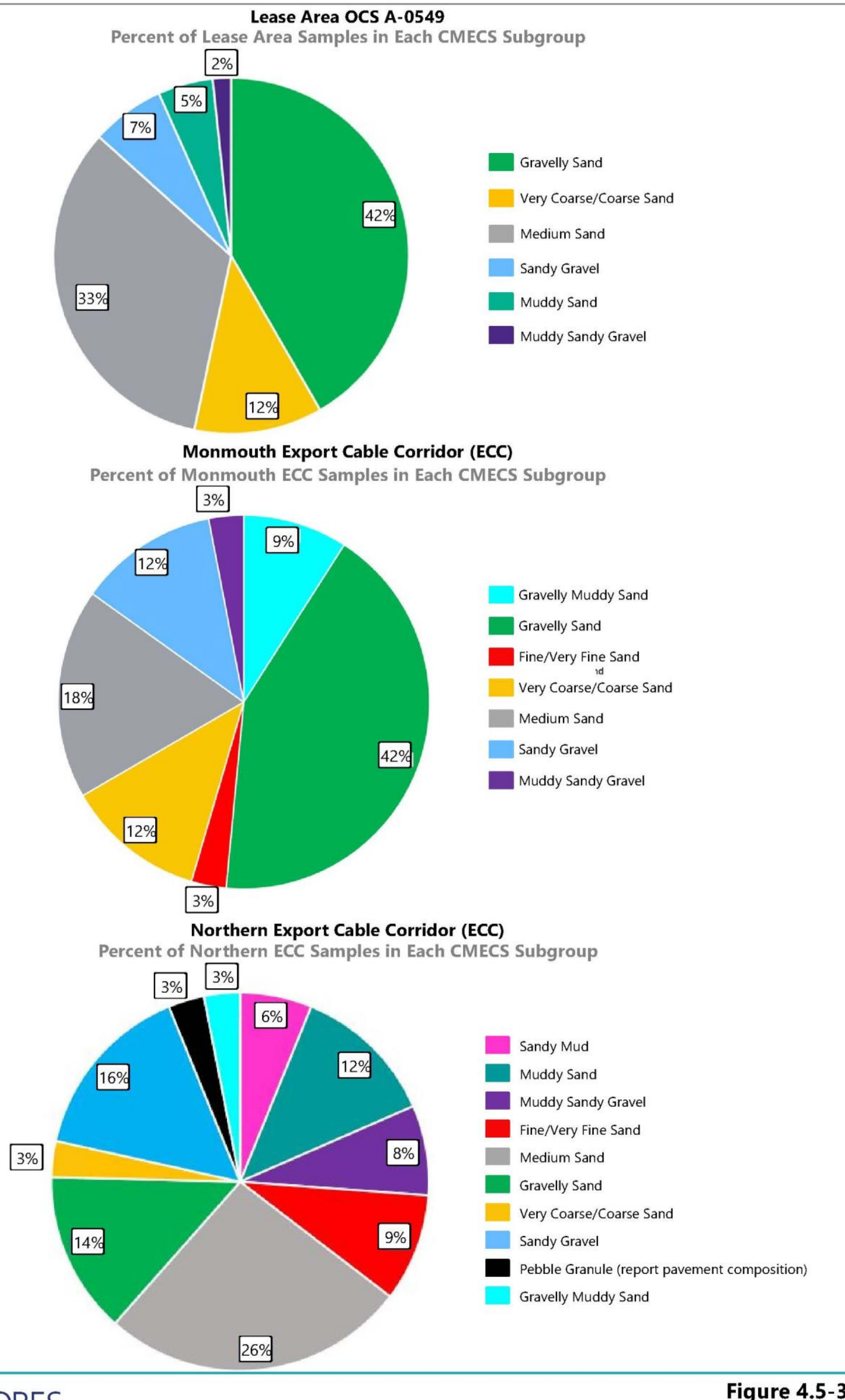
Gravel Mixes (30 to <80% gravel)
- Sandy Gravel
- Muddy Sandy Gravel

Gravelly (5 - <30% gavel)
- Gravelly Muddy Sand
- Gravelly Sand

Sands (<5% gravel)
- Fine/Very Fine Sand
- Medium Sand
- Muddy Sand
- Very Coarse/Coarse Sand
- Potential Landfall Site
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499

**Figure 4.5-2**

*NMFS CMECS classification at Grab Sample Sites*




ATLANTIC SHORES offshore wind

**Figure 4.5-3**

*Proportion of NMFS CMECS Sediments in Lease Area OCS-A 0549, Monmouth ECC and Northern ECC*

*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*

### 4.5.1.2 Benthic Community of the Offshore Project Area

The benthic organism community of the Offshore Project Area includes infauna and epibenthic organisms such as echinoderms, bivalves, gastropods, polychaetes, oligochaetes, amphipods, crustaceans, and cnidarians (Guida et al. 2017, SMAST 2016, Greene et al. 2010). The following subsections discuss data from existing literature, public data portals, and site-specific surveys to clearly characterize the benthic community in the affected environment.

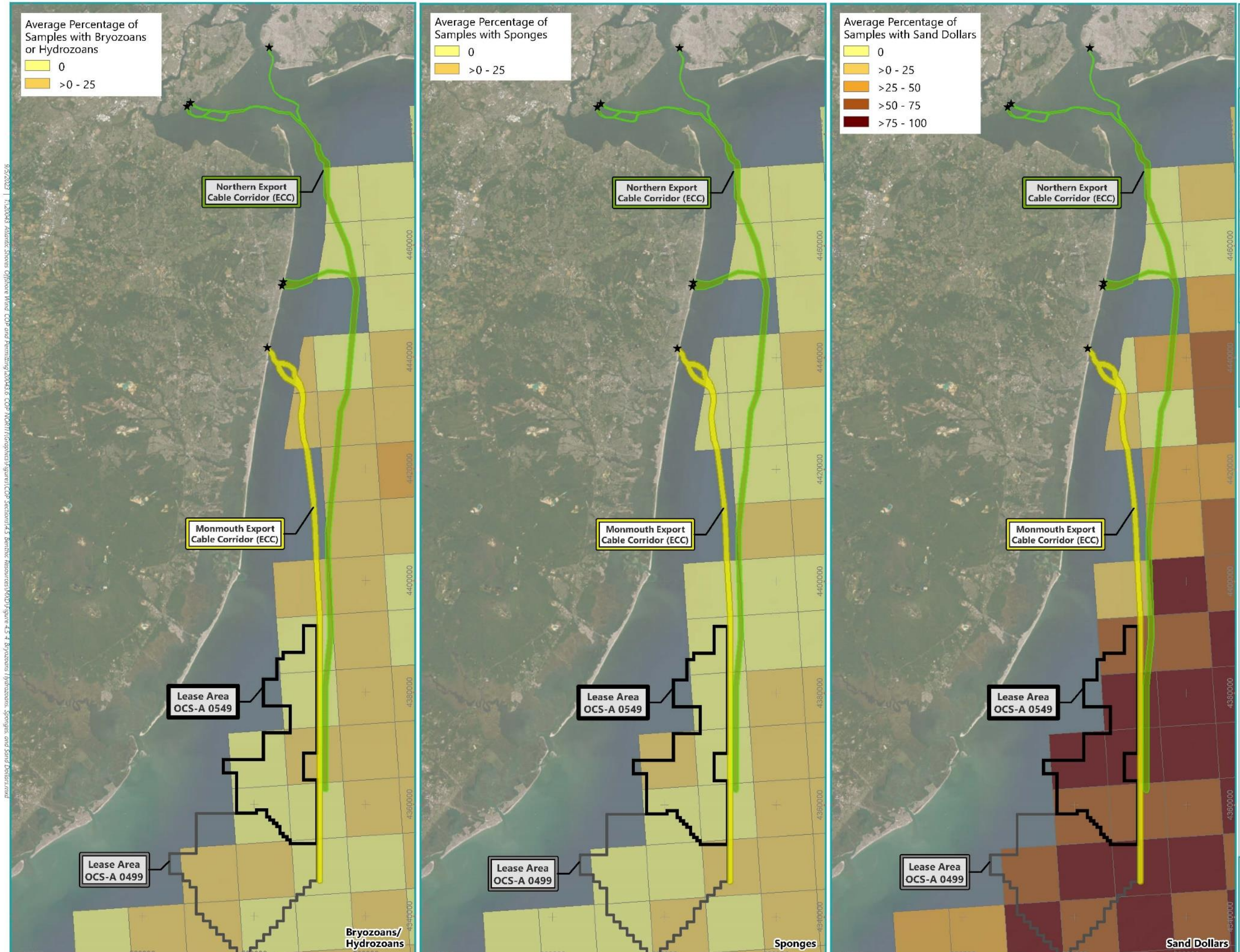
Existing literature and data portals were used as baseline sources to classify benthic community composition in the Offshore Project Area. Benthic community mapping conducted by Greene et al. (2010) and data assimilated into the Northeast Regional Ocean Council's (NROC) Northeast Ocean Data Portal (NROC 2009) connects physical habitat features (e.g., sediment, depth, and topographic features) with species composition. Three habitat types are most prevalent in the Lease Area, Monmouth ECC, Northern ECC, and Asbury and Kingsley Northern ECC Branches (mid-position flats and depressions in shallow water 82 to 148 ft [25 to 45 m] on medium to coarse substrate; depressions and mid-position flats, shallow to moderate depth 0 to 148 ft [0 to 45 m] on coarse to fine sand; and mid-position flats in shallow water 82 to 148 ft [25 to 45 m] on coarse to medium sand). Based on these habitat types, Greene et al. (2010) predicted the presence of the following phyla and representative organisms: annelids (e.g., polychaetes and oligochaetes), arthropods (e.g., amphipods and isopods), cnidarians (e.g., frilled anemone [*Metridium senile*]), echinoderms (e.g., common sea star [*Asterias forbesi*]), and mollusks (e.g., Astarte [*Astarte borealis*] and chestnut Astarte [*Astarte castanea*]). Three habitat types are most prevalent along the remaining Northern ECC Branches including flats and side slopes in very shallow to shallow water 0 to 75 ft [0 to 23 m] on fine to coarse sand; depressions and mid-position flats at moderate depths 75 to 144 ft [23 to 44 m] on very fine sand; and depressions in very shallow water 0 to 75 ft [0 to 23 m]). Based on these habitat types, Greene et al. (2010) predicted the presence of the following phyla and representative organisms: arthropods (e.g., amphipods, green crab [*Carcinus maenas*] and hermit crab [*Pagurus politus*]), mollusks (e.g., Bittium snail [*Bittium alternatum*], surfclam [*Spisula solidissima*]), annelids (e.g., polychaetes), and echinoderms (e.g., burrowing anemone [*Edwardsia elegans*]). Many of these benthic species or groups were collected during benthic grab samples and the State and Federal trawl/dredge surveys, which are discussed in further detail below.

Additional data derived from University of Dartmouth School of Marine Science and Technology (SMAST) 2003 to 2012 video surveys and mapped by NROC, show average presence and abundance[25] of species in the North Atlantic (see Figures 4.5-4 and 4.5-5). In the Lease Area, and portions of the Monmouth and Northern ECCs, these data showed low average presence of bryozoans (Phylum Bryozoa), hydrozoans (Phylum Cnidaria), and sponges, and moderate to high average presence of sand dollars (Phylum Echinodermata) (see Figure 4.5-4). Data obtained from NROC also determined low to moderate abundance for moon snails (Phylum Mollusca) and sea stars (Phylum Echinodermata) in the

[25] Average presence and abundance for identified species were calculated using University of Dartmouth SMAST video data and the New England Fishery Management Council Swept Area Seabed Impact (SASI) model. Average presence represents the average number of quadrats per SMAST survey station with a given species present within a larger SASI model grid. Average abundance represents the average number of species counted at the SMAST sampling stations within a larger SASI model grid (SMAST, 2016).

Offshore Project Area, with the exception of a small area of the Northern ECC which is expected to have high abundance of moon snails. Average abundance of hermit crabs (Phylum Arthropoda) is determined to be low throughout the Offshore Project Area (see Figure 4.5-5). The nearshore reaches of the ECCs along the New Jersey and New York Coast were not covered by these datasets.

To understand species composition in the Offshore Project Area, site-specific benthic grab surveys and towed video surveys (performed by Atlantic Shores between 2019 and 2022) were conducted throughout the Offshore Project Area. In addition to benthic grab surveys, data were obtained from the New Jersey Department of Environmental Protection (NJDEP) and Northeast Fisheries Science Center (NEFSC) State and Federal trawl and dredge surveys (NOAA Fisheries 2022; L. Barry, NJDEP 2020 personal communication) to contribute to benthic community characterization. Data were also obtained from the NYSDEC for results of their Nearshore Trawl Surveys occurring off the coast of New York; however, the location of those trawls did not overlap with the Offshore Project Area and therefore are not included. Results of these surveys and datasets provide site-specific evidence of infauna and epibenthic fauna presence in the Offshore Project Area. Based on the results of the surveys, many phyla are represented throughout the Offshore Project Area. Such phyla include Annelida, Arthropoda, Chordata, Cnidaria, Echinodermata, Mollusca, Nematoda, Nemertea, and Sipuncula. Table 4.5-1 shows the presence of different phyla in each portion of the Offshore Project Area and representative species.




ATLANTIC SHORES offshore wind


0 4 8 16 Miles

0 8 16 Kilometers

Map Projection: NAD 1983 UTM Zone 18N
Basemap: Esri ArcGIS Online "World Imagery" map service.
Data Source: Sample data provided by University of Massachusetts Dartmouth SMAST

**LEGEND**

- ★ Potential Landfall Site
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Atlantic Shores Lease Area OCS-A 0549
- Atlantic Shores Lease Area OCS-A 0499

**Figure 4.5-4**

*Average Presence of Bryozoans/Hydrozoans, Sponges, and Sand Dollars*

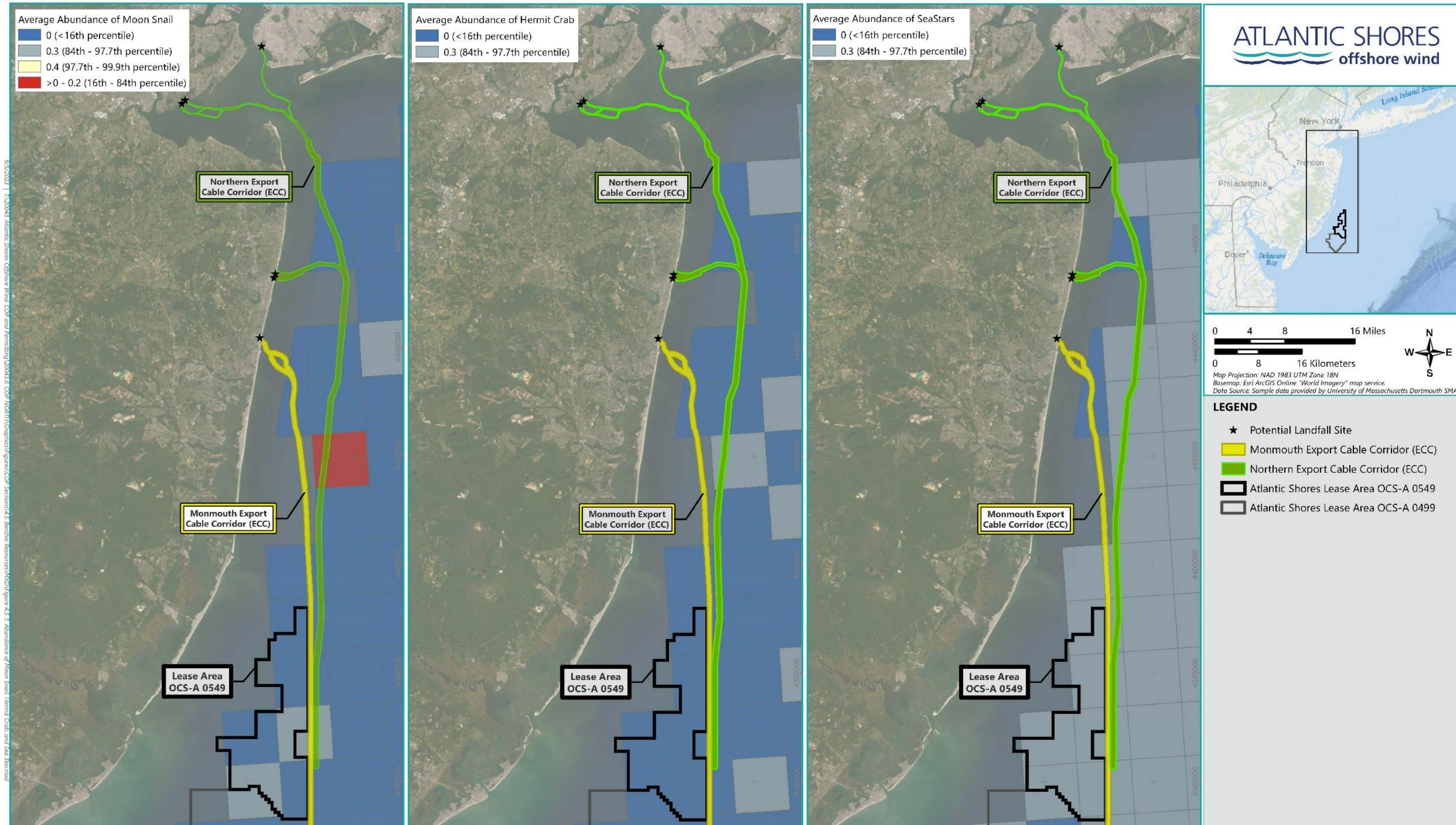



**Figure 4.5-5**

*Average Abundance of Moon Snail, Hermit Crab, and Sea Star*

### Table 4.5-1. Phyla Presence in the Atlantic Shores Offshore Project Area Based on Site-Specific Benthic Grabs, Towed Video, and Federal and State Trawl and Dredge Surveys

| Study | Phyla | Representative Groups or Species | Presence in Lease Area | Presence in Monmouth ECC | Presence in Northern ECC[3] |
|---|---|---|---|---|---|
| Atlantic Shores Benthic Grabs[1] | Annelida | Polychaetes, Oligochaetes | Y | Y | Y |
| | Arthropoda | Amphipods, Ostracods | Y | Y | Y |
| | Chordata[4] | Tunicates | Y | Y | N |
| | Cnidaria[4] | Hydroids Anemones | Y | Y | N |
| | Echinodermata | Sand Dollars, Sea Urchins, Sea Cucumber | Y | Y | Y |
| | Ectoprocta | Bryozoan | Y | N | N |
| | Foraminifera | Foram | Y | N | |
| | Mollusca | Atlantic Surf Clam, Nut Clam, Ocean Quahog | Y | Y | Y |
| | Nematoda | Nematode | Y | Y | N |
| | Nemertea | Ribbon Worm | Y | Y | Y |
| | Platyhelminthes | Flatworm | N | N | Y |
| | Sipuncula | Peanut Worm | Y | N | N |
| Atlantic Shores Towed Video Survey[1] | Cnidaria | Burrowing Anemones | Y | Y | Y |
| | Arthropoda | Crabs, Lobsters | Y | Y | Y |
| | Mollusca | Snail, Astarte, Atlantic Sea Scallop, Whelks | Y | Y | Y |
| | Echinodermata | Sea Stars, Sea Urchins | Y | Y | Y |
| | Arthropoda | Crabs, Lobster, Shrimp | Y | Y | Y |

| Study | Phyla | Representative Groups or Species | Presence in Lease Area | Presence in Monmouth ECC | Presence in Northern ECC[3] |
|---|---|---|---|---|---|
| NEFSC and NJDEP Trawl Surveys[2] | Echinodermata | Common Starfish, Sea Urchins, Sand Dollar | Y | Y | Y |
| | Mollusca | Sea Scallop, Northern Moonshell, Ocean Quahog, | Y | Y | Y |

[1] **Source**: 2022 Benthic Assessment Report (Appendix II-G1).

[2] **Source**: NEFSC Multi-Species Bottom Trawl (2008-2021); NJDEP Ocean Stock Assessment Program (OSAP) (2009-2020); NEFSC Clam and Scallop dredge survey (2008-2021).

[3] For the purposes of this table, the Northern ECC includes all branches as well as the main trunk of the ECC. Note that trawl surveys conducted by the NEFSC and NJDEP primarily cover the main "trunk" of the NECC and the Asbury and Kingsley branch. These trawl surveys did not occur in the nearshore reaches of the remaining three Northern ECC Branches that make landfall in New York.

[4] No solitary hard coral (e.g., star corals) or invasive tunicates were observed during benthic site characterization surveys in the Lease Area or the Monmouth ECC.

Site-specific benthic community composition metrics were calculated based on grab sample surveys conducted in the Offshore Project Area for Atlantic Shores between 2019 and 2022. The results of these surveys are included as Appendix II-G1 (Benthic Assessment Report). Based on the results of the benthic grabs, presented in Figure 4.5-6, organisms from phyla Nematoda and Arthropoda were most commonly collected and had the highest densities in grab samples in all three areas of the Offshore Project Area (i.e., Lease Area, Monmouth ECC, and Northern ECC). Additionally, the phyla with the greatest proportion of unique taxa were consistent across the Offshore Project Area. Those phyla included Annelida, Arthropoda, and Mollusca. (presented in Appendix II-G1).

Species richness, diversity, and evenness were analyzed across the grab samples for the three areas of the Offshore Project Area. These results are provided in Table 4.5-2 and Appendix II-G1. Overall species richness, diversity, and evenness were fairly consistent across the three areas of the Offshore Project Area. Average species diversity accounts for the number of unique taxa (i.e., species richness) and the abundance in each unique taxa (i.e., species evenness). Average species diversity increases as species richness and evenness increases. For additional information on benthic community sampling, see Appendix II-G1.

### Table 4.5-2. Average Species Richness, Diversity and Evenness from Benthic Grabs in the Offshore Project Area

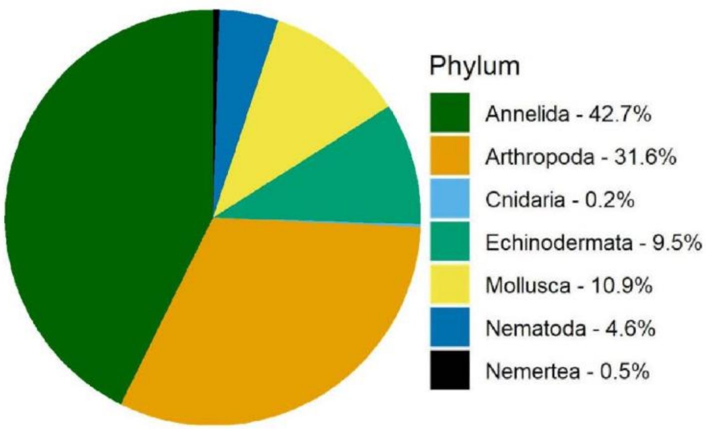
| Biodiversity Parameters[1] | Lease Area | | Monmouth ECC (2020-2022) | Northern ECC[2] (2022) |
|---|---|---|---|---|
| | 2019 | 2020 - 2022 | | |
| Average Species Richness | 3.63 | 3.76 | 3.85 | 3.74 |
| Average Species Diversity | 2.09 | 2.13 | 2.01 | 1.91 |
| Average Species Evenness | 0.74 | 0.76 | 0.69 | 0.63 |

[1] Biodiversity parameters were averaged across the samples taken in the Lease Area, Monmouth ECC, and Northern ECC. In 2019, five grab samples were taken in the Lease Area, each of which sampled an area of 0.05 square miles ($mi^2$) (0.13 square kilometer [$km^2$]). Between 2020 and 2022 136 grab samples were collected and analyzed to determine macroinvertebrate community composition, each of which sampled an area of 0.04 square miles ($mi^2$) (0.10 square kilometer [$km^2$]). Of the 136 samples, 49 were collected in the Lease Area, 29 samples in the Monmouth ECC and 58 in the Northern ECC.

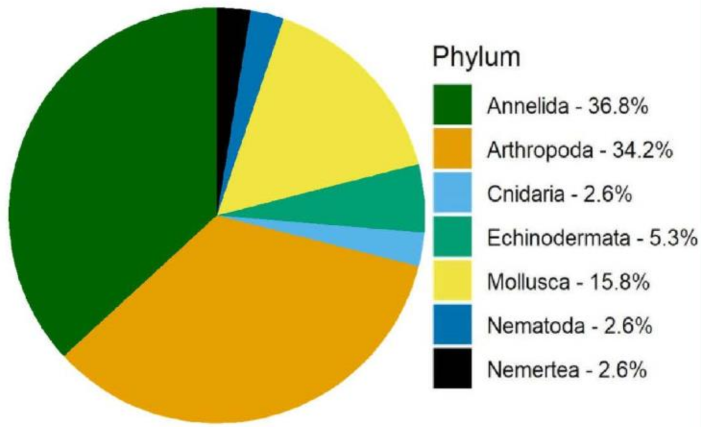
[2] Results for the Northern ECC include data from the main ECC trunk as well as the Northern ECC Branches.

## Lease Area 2019

### Proportional Abundance

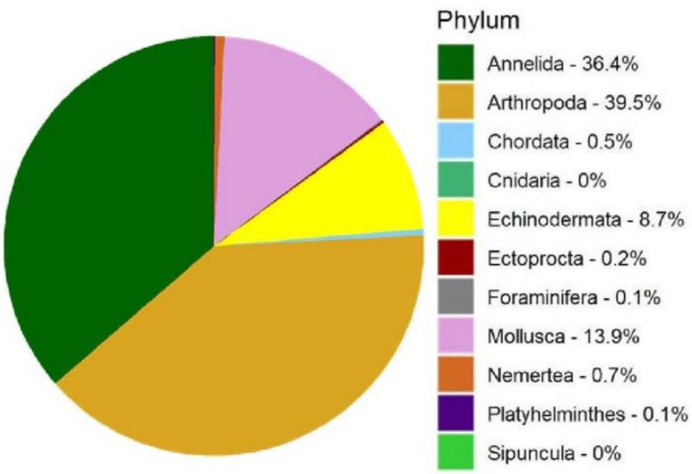



### Proportion of Unique Taxa

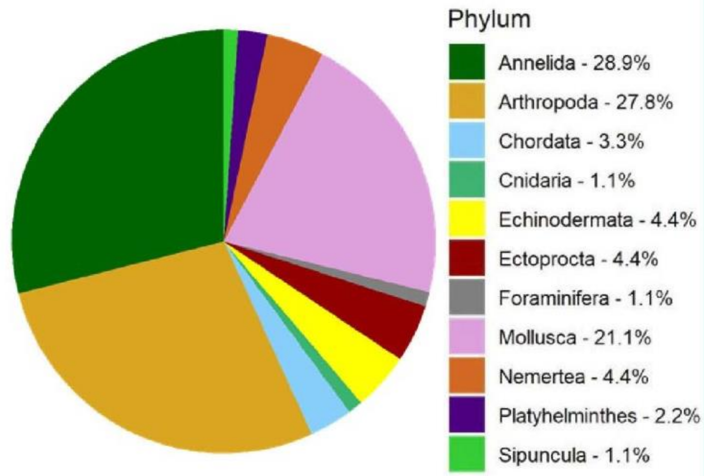



## Lease Area 2020 - 2022

### Proportional Abundance




### Proportion of Unique Taxa




ATLANTIC SHORES offshore wind

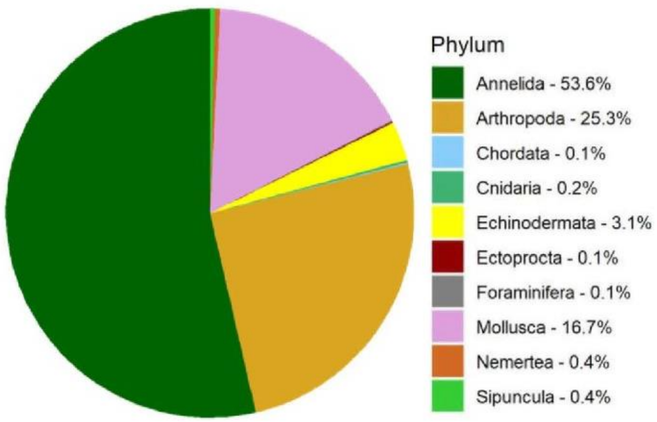
**Figure 4.5-6** • *Sheet 1 of 2*

*Proportional Abundance and Proportion of Unique Taxa based on Benthic Grabs Conducted in Lease Area OCS-A 0549*

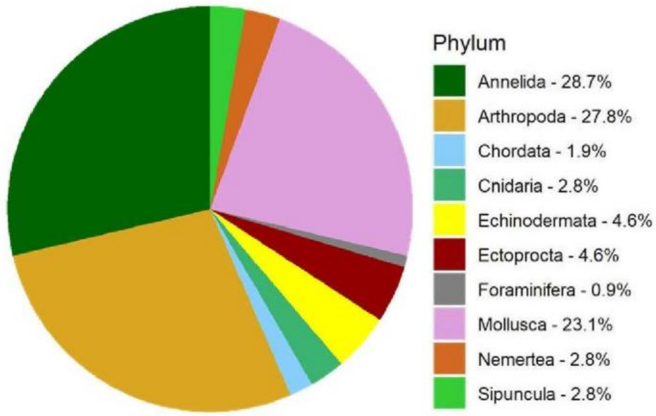
*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*

## Monmouth Export Cable Corridor (ECC)
## 2020-2022

Proportional Abundance

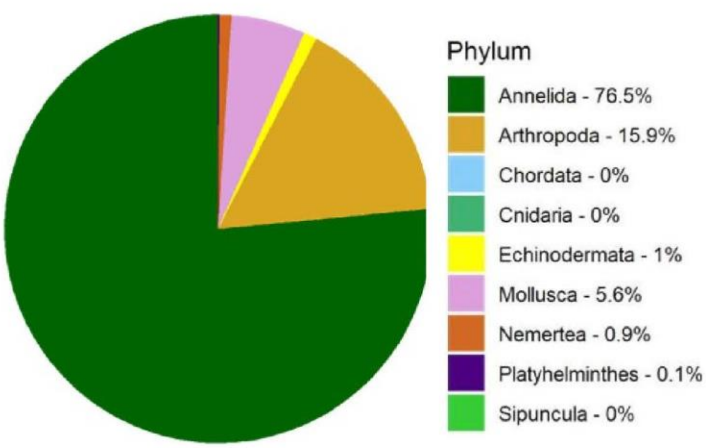



Proportion of Unique Taxa

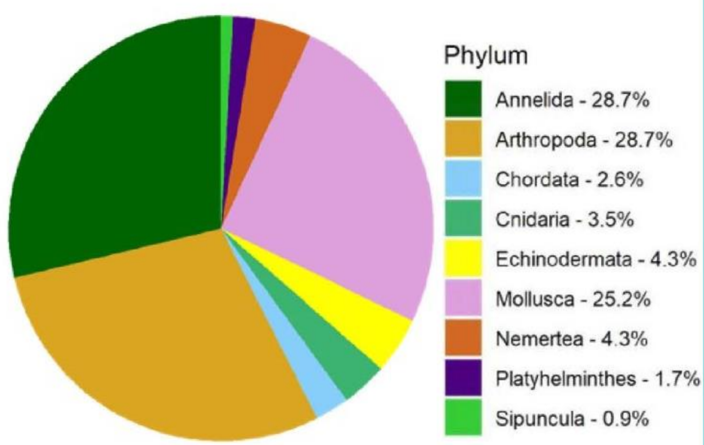



## Northern Export Cable Corridor (ECC)
## 2020 - 2022

Proportional Abundance




Proportion of Unique Taxa




ATLANTIC SHORES offshore wind

**Figure 4.5-6** • *Sheet 2 of 2*
*Proportional Abundance and Proportion of UniqueTaxa based on Benthic Grabs Conducted in the Monmouth ECC and NECC*

*Data Source: RPS Benthic Assessment Report (2020) (Appendix II-G2)*

In addition to benthic grab samples, towed video surveys (see Appendix II-G1) were conducted in the Lease Area, Monmouth ECC, and Northern ECC and branches in 2021 and 2022 in order to gather data on the epifaunal and demersal biological communities, and ground-truth past surveying efforts. The towed video surveys allow for observation and enumeration of benthic megafauna, thereby providing Atlantic Shores with a greater understanding of the benthic community in the Offshore Project Area, beyond what can be surveyed using benthic grabs. Similar to the benthic surveys, the following phyla were observed during towed video surveys: Arthropoda, Chordata, Cnidaria, Mollusca, and Echinodermata. The most dominant phyla in the Lease Area were Mollusca (64% of enumerated organisms) and Chordata (30.7% of enumerated organisms), while the most dominant phyla in the Monmouth ECC were Cnidaria (56.8% composition of enumerated organisms) and Chordata (21.1% of enumerated organisms). In the Northern ECC, the most dominant phyla were Cnidaria (33.6% composition of enumerated organisms) and Chordata (33.5% composition of enumerated organisms).

Invertebrates identified in the Lease Area belonged to the following six classes: Anthozoa, Asteroidea, Bivalvia, Echinoidea, Gastropoda, and Malacostraca. Of these classes, class Bilvalvia had the highest percent composition of enumerated invertebrates (88% composition of enumerated invertebrates), while class Asteroidea composed the lowest percent composition (0.1% composition of enumerated invertebrates). Within the Monmouth ECC, seven classes of invertebrates were identified: Anthozoa, Asteroidea, Bivalvia, Cephalopoda, Echinoidea, Gastropoda, and Malacostraca. Of these classes, Anthozoa had the highest percent composition of enumerated individuals (72% composition of enumerated invertebrates), while Cephalopoda had the lowest (0.04% composition of enumerated invertebrates). Within the Northern ECC, eight classes of invertebrates were identified: Anthozoa, Asteroidea, Bivalvia, Cephalopoda, Echinoidea, Gastropoda, Holothuroidea, and Malacostraca. Of these classes, Anthozoa has the highest percent composition of enumerated individuals (50.5% composition of enumerated invertebrates) while Holothuroidea has the lowest (0.2% composition of enumerated invertebrates).

The towed video surveys also analyzed the presence of colonial species which develop large mats or beds that contribute to the benthic environment (e.g., sponge, tube worms). Benthic invertebrates identified in all three areas of the Offshore Project Area that provide or contribute to the benthic habitat of the Offshore Project Area include surf clams, sea scallops, sand dollars, decorator worms and worm tubes. Blue mussels, slipper shells, sponge, and tunicates were identified in the Monmouth ECC and Northern ECC. Additionally, northern star coral was identified within the Northern ECC (see Appendix II-G1).

In order to gather additional evidence for the types of species found in the Offshore Project Area, particularly larger, more mobile species that were not collected in grab samples or captured in towed video surveys, data were obtained from NEFSC and NJDEP for the Offshore Project Area between 2009 and 2020/2021. Federal and State surveys conducted in the Offshore Project Area include the NEFSC Multi-Species Bottom Trawl, NEFSC Atlantic Surf Clam (*Spisula solidissima*) and Ocean Quahog (*Arctica islandica*) Dredge, and NJDEP Ocean Stock Assessment Program (OSAP) Trawl surveys.

The most commonly collected invertebrate species during the surveys included lady crab (*Ovalipes ocellatus*), Jonah crab (*Cancer borealis*) Atlantic Rock crab (*Cancer irroratus*), common spider crab (*Libinia emarginata*) and sea scallop (*Placopecten magelanicus*). Figure 4.5-7 illustrates the location of trawl surveys in the Offshore Project Area. Results of the surveys are included in Table 4.5-3.

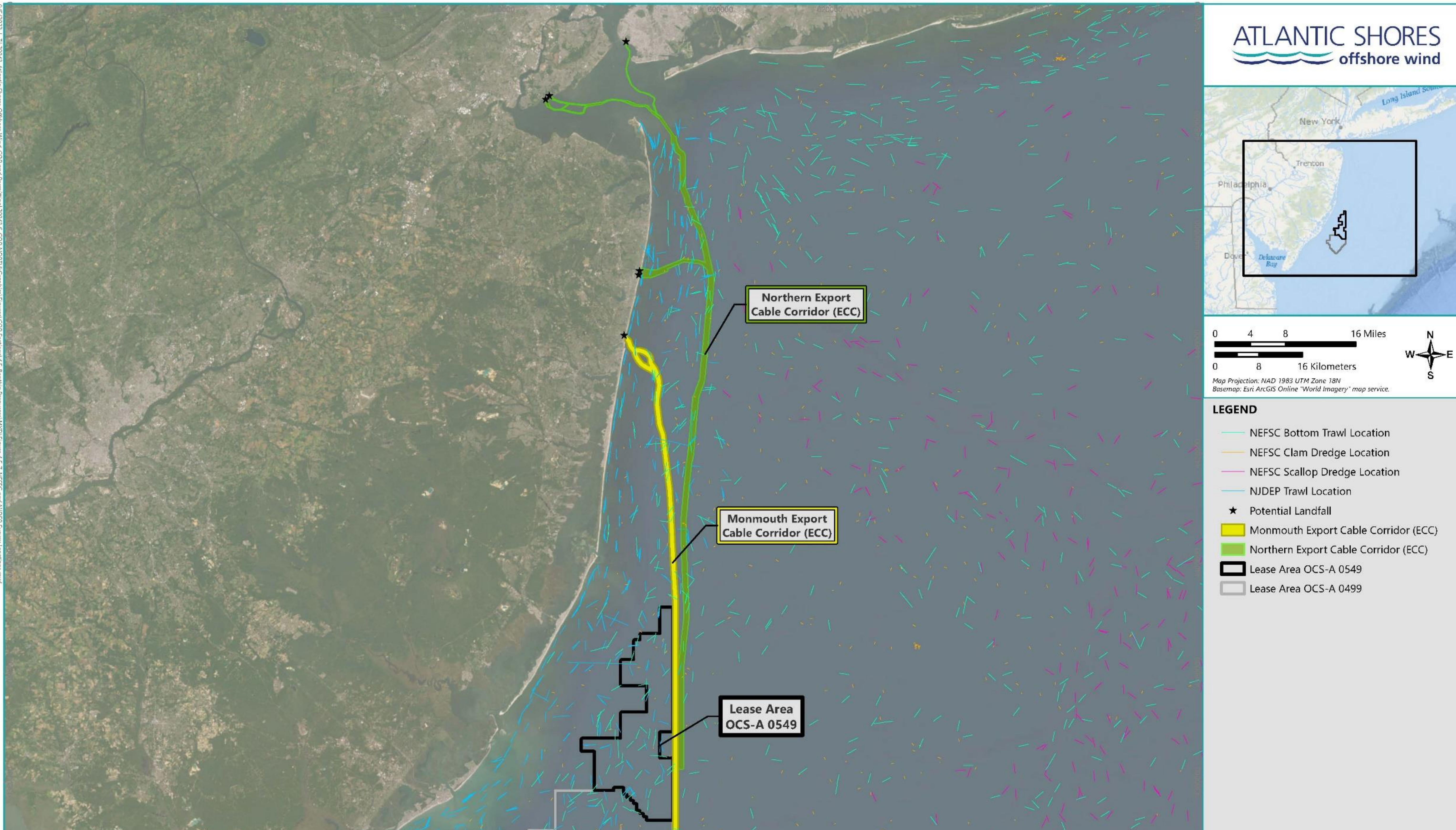



**Figure 4.5-7**

*NEFSC and NJDEP Survey Locations*

Some results from the Federal and State trawl surveys conducted in the Offshore Project Area support the information from the NROC-provided presence and abundance data. Specifically, the data mapped by NROC showed moderate to high presence of sand dollars in the Offshore Project Area (NROC, 2009). According to Table 4.5-3, sand dollars were collected in all three portions of the Offshore Project Area, which could indicate moderate to high presence. However, NROC-provided data of northern moon snail and sea star (i.e., starfish) abundance differs from trawl results. According to the NROC-provided data, northern moonsnail and sea stars (i.e., starfish) were predicted to have low abundance in the Offshore Project Area; however, northern moon snail and sea stars (i.e., starfish) were collected across all three portions of the Offshore Project Area. Therefore, though modeling and literature sources are useful, combining those sources with site-specific data is most beneficial when attempting to understand benthic communities in the Offshore Project Area.

### Table 4.5-3. Identified Benthic Species in Federal and State Trawl and Dredge Surveys

| Common Name | Scientific Name | Lease Area | Monmouth ECC | Northern ECC[1] |
|---|---|---|---|---|
| Atlantic Calico Scallop | *Argopecten gibbus* | | | ▲ |
| Atlantic Rock crab | *Cancer irroatus* | ▲○■ | ▲○■ | ▲○■ |
| American Lobster | *Homarus americanus* | ▲○ | ▲○ | ▲○ |
| Bathyal swimming crab | *Bathynectes longispina* | ▲ | | ▲ |
| Blotched swimming crab | *Portunus spinimanus* | ▲ | | |
| Blue Crab | *Callinectes sapidus* | ▲ | ▲○ | ▲○ |
| Boreal Astarte | *Asterias rubens* | ■ | ■ | ■ |
| Bristled Longbeak Shrimp | *Dichelopandalus leptocerus* | | | ▲ |
| Brown rock shrimp | *Sicyonia brevirostris* | ▲ | | ▲ |
| Channelled Whelk | *Busycotypus canaliculatus* | | | ■ |
| Chestnut Astarte | *Astarte castanea* | ○ | | |
| Coarsehand Lady Crab | *Ovalipes stephensoni* | ▲ | | ▲ |
| Common Spider Crab | *Libinia emarginata* | ▲○■ | ▲○ | ▲○ |
| Common Starfish | *Asterias rubens* | | | |
| False Quahog | *Pitar morrhuanus* | | | ■ |
| Galatheid Crab | *Galatheoidea spp* | | | ▲ |
| Gladiator Box Crab | *Acanthocarpus alexandri* | ▲ | | ▲ |
| Gulf Shrimp | *Penaeus spp* | ▲ | ○ | ▲○ |

| Common Name | Scientific Name | Lease Area | Monmouth ECC | Northern ECC[1] |
|---|---|---|---|---|
| Horseshoe Crab | *Limulus polyphemus* | ▲○■ | ○ | ▲○■ |
| Jonah Crab | *Cancer borealis* | ▲○■ | ○ | ▲○■ |
| Knobbed Whelk | *Busycon carica* | | | ■ |
| Lady Crab | *Ovalipes ocellatus* | ▲○■ | ○ | ▲○ |
| Mantis Shrimp | *Stomatopoda spp* | | | |
| Northern Moon Snail | *Polinices heros* | ○■ | ○■ | ○■ |
| Northern Shrimp | *Pandalus borealis* | ▲ | | |
| Norwegian Shrimp | *Nephrops norvegicus* | ▲ | | |
| Ocean Quahog | *Arctica islandica* | ■ | ■ | ▲■ |
| Pastel Swimming Crab | *Portunus armatus* | ○ | ○ | |
| Pink Glass Shrimp | *Pasiphaea multidentata* | ▲ | | ▲ |
| Red Deep Sea Crab | *Chaceon quinquedens* | ▲ | | ▲ |
| Royal Red Shrimp | *Pleoticus robustus* | ▲ | | ▲ |
| Royal Sea Star | *Astropecten articulatus* | ■ | | ■ |
| Ridge Slipper Lobster | *Scyllarides nodifer* | ▲ | | ▲ |
| Sea Scallop | *Placopecten magelanicus* | ▲■ | ▲○■ | ▲○ |
| Seasnail | *Liparis atlanticus* | | ○ | |
| Sevenspine Bay Shrimp | *Crangon septemspinosa* | ▲ | | ▲ |
| Shark's Eye/Lobed Moonshell | *Polinices duplicatus* | | ○ | ○ |
| Smooth Astarte | *Astarte castanea* | ■ | ■ | ■ |
| Southern Moonsnail | *Mercenaria campechiensis* | | ■ | |
| Southern Quahog | *Mercenaria campechiensis* | | | ■ |
| Surf Clam | *Spisula solidissima* | ▲○■ | ○ | ○ |
| Waved Whelk | *Buccinum undatum* | ■ | | |
| Unclassified Calico Crab | *Hepatus epheliticus* | ▲ | | |
| Unclassified Cancer Crab | *Cancridae spp* | | ○ | |
| Unclassified box crab | *Calappidae spp* | ▲ | | ▲ |

| Common Name | Scientific Name | Lease Area | Monmouth ECC | Northern ECC[1] |
|---|---|---|---|---|
| Unclassified Hermit Crab | *Paguroidea* | ■ | | |
| Unclassified Mantis Shrimp | *Stomopoda spp.* | ▲ | | ▲ |
| Unclassified Porcelain Crab | *Porcellanidae spp* | ▲ | | |
| Unclassified Razor Shell | *Solenidae spp.* | ■ | ■ | ■ |
| Unclassified Sand Dollar | *Echinoidae sp* | ○ | ○ | ○ |
| Unclassified Sea Urchin | *Echinoidae spp* | ○ | ○ | ○ |
| Unclassified Starfish | *Asteriidae sp.* | ○■ | ○■ | ○■ |
| Unclassified Swimming Crab | *Portunidae spp.* | ▲ | | ▲ |
| Unclassified Caridean Shrimp | *Caridea spp.* | ▲ | | ▲○ |
| Unclassified Cephalopod | *Cephalopoda spp.* | ▲ | | |
| Unclassified Prawn | *Penaeus spp* | ▲ | | ▲ |

Notes:
▲- NEFSC Multi-Species Bottom Trawl; ■ – NEFSC Atlantic Surfclam and Ocean Quahog Dredge Surveys;
○ – NJDEP OSAP Trawl Survey
[1] Within the Northern ECC, trawl surveys conducted by the NEFSC and NJDEP primarily occurred in the main "trunk" of the Northern ECC and the Asbury and Kingsley branch. These trawl surveys did not occur in the three remaining Northern ECC branches, which make landfall in New York.

**Commercial, Recreational, and Ecologically Important Shellfish Species**

Benthic community composition is of particular importance with respect to benthic invertebrate species of recreational or commercial fishing interest. Table 4.5-4 identifies species of commercial, recreational, or ecological importance based on NOAA landings data, as well as specific NOAA trust resources of ecological importance. NOAA trust resources included in Table 4.5-4 are based on a list provided by NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) during a virtual meeting held on May 20, 2020 (NOAA 2020, personal communication). Also included in Table 4.5-4 are the habitat requirements for those species and the potential occurrence in the Offshore Project Area based on data collected during NEFSC and NJDEP OSAP trawls.

Based on State and Federal trawl surveys and grab sample surveys conducted on behalf of Atlantic Shores, all species listed in Table 4.5-4 could occur in the Offshore Project Area.

Though the Federal and State trawl surveys are useful tools for understanding the types of species present in the Offshore Project Area, limitations of the data exist. For example, analyses like species density cannot be easily conducted due to variability in sampling methodology (e.g., tow length variability, lack of consistent site sampling between years or seasons). However, combining the trawl results with benthic habitat sampling can add confidence in the types of species that may be present in the Offshore Project Area and affected by Project activities.

## Table 4.5-4. Benthic Invertebrate Species of Commercial, Recreational, or Ecological Importance

| Species | Commercial/ Recreational Importance[1] | NOAA Trust Resource[2] | EFH | Habitat Requirements | Potential Occurrence in Offshore Project Area[3] |
|---|---|---|---|---|---|
| Atlantic Surfclam (*Spisula solidissima*) | C | | X | Typically found in well-sorted, medium sand, but may also occur in fine or silty-fine sand (Cargnelli et al. 1999). | Potential occurrence of juveniles and adults throughout the Offshore Project Area. |
| Horseshoe Crab (*Limulus polyphemus*) | | X | | Utilizes inshore sandy substrates during spring spawning, then migrates to deeper estuarine and continental shelf habitats during fall (ASMFC 2015). | Potential occurrence throughout the Offshore Project Area. |
| Atlantic Sea Scallop (*Placopecten magellanicus*) | C | | X | On sandy or gravel ocean floor at depths of 100 to 300 ft (30.4 to 91.4 m) (NOAA 2020). | Potential occurrence in the offshore reaches of the Lease Area, and Monmouth and Northern ECCs. |
| American Lobster (*Homarus Americanus*) | C | | | Rocky substrates, often utilizing shelters such as boulders and kelp (NOAA 2020). | Potential occurrence in the Offshore Project Area around artificial reefs, shipwrecks, and other hard structures/ substrates. |
| Jonah Crab (*Cancer borealis*) | C | | | Historically caught on hard and soft sediment habitats (e.g., rocks, clay, sand, mud), however limited information is available on habitat use (ASMFC 2018; Fisheries and Oceans Canada 2020). | Potential occurrence in the Offshore Project Area. |
| Ocean Quahog (*Arctica islandica*) | C | | X | Burrow into a variety of substrates but are often associated with fine sand (MAFMC 2020). | Potential occurrence in the Offshore Project Area where fine, sandy sediment is present. |
| Blue Crab (*Callinectes sapidus*) | C | X | | Underwater grasses and oyster reefs, ranging from shallow brackish water to deeper, saltier water (NOAA 2020) | Potential occurrence in the nearshore areas of the Monmouth ECC, Northern ECC Branches; however, there are no documented underwater grasses in the Offshore Project Area. |

| Species | Commercial/ Recreational Importance[1] | NOAA Trust Resource[2] | EFH | Habitat Requirements | Potential Occurrence in Offshore Project Area[3] |
|---|---|---|---|---|---|
| Blue Mussel (*Mytilus edulis*) | | X | | Intertidal shallow waters attached to rocks, pilings, shells, or other solid objects (URI 2020) | Potential occurrence in the Offshore Project Area, particularly in nearshore regions of the Monmouth ECC, Northern ECC Branches, or around artificial reefs, shipwrecks and other hard structures/ substrates. |
| Channeled Whelk (*Busycotypus canaliculatus*) | C | | | Found in subtidal waters, less than 98 ft (30 m) deep, on sandy silt, shell hash or mud substrates (Nelson et al. 2018). | Occurrence most likely in the Offshore Project Area where sandy sediments are prevalent. |
| Eastern Oyster (*Crassostrea virginica*) | | X | | Brackish and salty waters between 8 to 35 ft (2.4 to 10.7 m) deep, often concentrated in beds and forming dense reefs (Chesapeake Bay Program 2020). | Potential occurrence in the nearshore reaches of the Monmouth ECC, Northern ECC Branches. Occurrence of eastern oyster is not expected in the Lease Area due to depth thresholds. |
| Knobbed Whelk (*Busycon carica*) | C | | | Shallow subtidal mud or sand flats during the spring and fall, and deeper waters offshore during winter (Barnegat Bay Partnership 2020) | Potential occurrence in the nearshore portions of the Monmouth ECC, Northern ECC Branches in the spring and fall, and in the offshore reaches of the Lease Area and ECCs in the winter. |
| Soft-Shell Clam (*Mya arenaria*) | | X | | Sandy or muddy substrate in bays and estuaries (URI 2020). | Potential occurrence in the Northern ECC Branches in Raritan and Lower New York Bays. |

[1] C- commercially important species; R – recreationally important species. Species with commercial landings values of $4,000 or greater in 2021 for the State of New Jersey as reported by NOAA Fisheries were considered a species of commercial importance. Species with confidential commercial landing values were not marked as a species of commercial importance in this table. None of the species in the table above were recorded in recreational landings in New Jersey.

[2] NOAA GARFO provided a list of Other NOAA Trust Resources to be evaluated in the EFH Assessment in a virtual meeting held on May 20, 2020.

[3] Presence in the Offshore Project Area is based on NEFSC and NJDEP OSAP trawl results and known habitat requirements.

### 4.5.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect benthic resources and habitat during Project construction, operations and maintenance (O&M), or decommissioning are presented in Table 4.5-5.

**Table 4.5-5. Impact Producing Factors for Benthic Resources**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Installation and maintenance of new structures and cables | ● | ● | ● |
| Anchoring and jack-up vessels | ● | ● | ● |
| Noise | ● | ● | ● |
| Electromagnetic fields | | ● | |
| Presence of structures and cables | | ● | ● |
| OSS Operation | | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for impacts to benthic resources is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I), assuming the use of all piled foundations for the assessment of pile driving noise. Potential impacts from accidental offshore spills, discharges, and releases are not included in this section. Such impacts are considered to have a low likelihood of occurrence and are discussed in more detail in Section 9.2.3. Section 3.2 Water Quality provides further detail on measures to minimize the potential for drilling fluid release and frac-outs during horizontal directional drilling (HDD) installation at the landfall sites, including the development of an HDD Contingency Plan.

#### 4.5.2.1 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new foundation structures and offshore cables includes installation of associated scour and cable protection. These activities may affect benthic resources and habitat through direct seafloor disturbance and temporary increases in suspended sediment and deposition. This section focuses on the temporary direct and indirect disturbances that will primarily occur during the construction phase. Section 4.5.2.5 addresses permanent seafloor disturbance from the footprints of foundations, scour protection, and offshore cable protection that will result in habitat conversion of primarily sandy substrate to hard substrate. The O&M phase is expected to have significantly lower seafloor disturbance than Project construction. During O&M, Project components will be carefully monitored as described in Section 5.0 of Volume I. If portions of buried offshore cables require maintenance, the sediment cover may need to be removed for inspection and possible replacement of a portion of the cable. These activities would temporarily disturb the seafloor but would be short-term and extremely localized. The decommissioning phase is expected to have similar, but less expected seafloor disturbance than Project construction.

**Direct Seafloor Disturbance**

Benthic habitat will be temporarily disturbed during construction; however, as evidenced by the assessments and analyses conducted by Atlantic Shores to date, the area of disturbance is small relative to the total area of available surrounding habitat (Table 4.5-6) and benthic resources are expected to recover in the short-term.

Seafloor-disturbing activities during construction of the wind turbine generator (WTG) and offshore substation (OSS) foundations include jack-up vessel positioning and anchoring (see Section 4.5.2.2), seabed preparation, foundation placement, and scour protection installation. Seabed preparation may be required for gravity-based foundations or in areas with large sand bedforms. Seafloor-disturbing activities during installation of the offshore cables include anchoring, pre-installation activities (e.g., sand bedform removal, boulder relocation, and pre-lay grapnel run), offshore cable installation, cable protection installation, where needed, and excavation of the offshore HDD pit. Detailed methodologies for conducting these activities are described in Section 4.0 of Volume I.

The maximum area of seabed disturbance in the Lease Area and ECCs from construction of the Project is summarized in Table 4.5-6. The maximum total area of temporary seafloor disturbance (not including the area of the seafloor that will be permanently occupied by structures or cables) in the Lease Area is 4.0 square miles ($mi^2$) (10.36 square kilometers [$km^2$]), which represents only approximately 3.2% of the 126.76 $mi^2$ (328.3 $km^2$) Lease Area. The total temporary seafloor disturbance in the Monmouth ECC is 2.21 $mi^2$ (5.73 $km^2$) and the total temporary seafloor disturbance in the Northern ECC is 3.0 $mi^2$ (7.76 $km^2$), for a total temporary disturbance of 5.21 $mi^2$ (13.5 $km^2$) for both ECCs combined (Table 4.5-6). This estimated area of disturbance represents approximately 5.5% of the entire ECC area. The area of temporary disturbance in the Lease Area and ECCs is small relative to the total area of available surrounding undisturbed habitat in the Lease Area and ECCs. Temporary direct seabed disturbance from the Project will be limited to these smaller areas.

## Table 4.5-6. Maximum Total Seabed Disturbance

| Offshore Project Area Component | Maximum Area of Seafloor Disturbance | | |
|---|---|---|---|
| | **Permanent Disturbance** | **Additional Temporary Disturbance** | **Total** |
| Maximum Total Seabed Disturbance in the Lease Area[1, 2, 3,] | 1.38 $mi^2$ (3.58 $km^2$; 883 ac) | 4.00 $mi^2$ (10.36 $km^2$; 1,920 ac) | 5.38 $mi^2$ (13.93 $km^2$; 3,443 ac) |
| Maximum Total Seabed Disturbance in the ECCs[4] | 0.75 $mi^2$ (1.94 $km^2$; 480 ac) | 5.21 $mi^2$ (13.5 $km^2$; 3,334 ac) | 5.96 $mi^2$ (15.44 $km^2$; 3,814 ac) |
| Monmouth ECC | 0.35 $mi^2$ (0.90 $km^2$; 224 ac) | 2.21 $mi^2$ (5.73 $km^2$; 1,411 ac) | 2.56 $mi^2$ (6.63 $km^2$; 1,638 ac) |
| Northern ECC[5] | 0.40 $mi^2$ (1.04 $km^{2;}$ 288 ac) | 3.00 $mi^2$ (7.76 $km^2$; 1,920 ac) | 3.40 $mi^2$ (8.80 $km^2$; 2,195 ac) |

Notes:
Basis of Calculations are described in detail in Section 4.11 of Volume I.

[1] Impacts calculations in the Lease Area include impacts from seabed preparation activities, which may include dredging operations. A total area of 111,987.6 square feet (10,404.0 square meters) per foundation, assuming the use of a suction bucket jacket foundation, may be required for seabed preparation activities. Assuming the use of 157 wind turbine foundations, the total area of seabed preparation that would be required totals approximately 17.5 million square feet (1.6 million square meters). The total volume of material anticipated for seabed preparation is approximately 1.1 million cubic yards (861,634 cubic meters).
[2] Total impact calculations within the Lease Area include seabed preparation activities, which may include dredging operations, around the OSS foundations. A total area of 369,676 square feet (34,344 square meters) around each OSS foundation, assuming the use of three large OSS with a suction bucket jacket foundation,  may be subject to seabed preparation. Assuming the use of three large OSS foundations, a total area of 1.1 million square feet (103,032 square meters) may be required for seabed preparation activities. The total volume of material anticipated for seabed preparation is approximately 135,000 cubic yards (103,214 cubic meters).
[3] Total impact calculations in the Lease Area account for dredging activities along the inter-array and interlink cables. Along the inter-array and inter-link cables, dredging activities would total approximately 0.67 square miles (1.73 square kilometers) and 0.18 square miles (0.46 square kilometers), respectively. These activities will result in a total of approximately 2.2 million (1.7 million cubic meters) cubic yards and 588,600 cubic yards (450,000 cubic meters) of dredged material from inter-array and inter-link cable installation, respectively.
[4] Impact values within the ECC includes impacts from dredging activities. Along the Monmouth and Northern ECC, dredging activities would total approximately 0.96 square miles (2.48 square kilometers) and 1.19 square miles (3.08 square kilometers), respectively. These activities will result in a total of approximately 3.2 million cubic yards (2.4 million cubic meters) and 4.0 million cubic yards (3.0 million cubic meters) of dredged material for the Monmouth and Northern ECC, respectively.
[5] Disturbance values for the Northern ECC include four export cables extending to the Asbury branch and three extending to the New York Landfall sites.

Benthic grabs and sediment data from The Nature Conservancy indicate the majority of the Offshore Project Area consists of fine, medium, and gravelly/coarse sand. Predominant seafloor features that could occur in the Offshore Project Area include sand ripples, mega ripples, sand waves, and sand ridges (see Section 2.1 Geology). Additionally, the Offshore Project Area is dynamic in nature, exhibiting wide-spread bottom disturbance from existing marine uses (e.g., fishing and vessel activity) and mobile sediment. The species and habitat in the Offshore Project Area, including EFH, are adapted to disturbance and are expected to recover in the short-term. Therefore, impacts to benthic invertebrates and their habitat during installation and maintenance of structures and cables are expected to be temporary and localized.

Although immobile benthic invertebrate species in the direct footprint of foundation and associated scour protection or offshore cable installation may be subject to injury or mortality, the benthic community is expected to recover and benthic infauna and epifauna are expected to recolonize the area after physical disturbance from construction and maintenance activities cease in a given location (Brooks et al. 2006; Guarinello et al. 2017; Guida et al. 2017). A review of studies of recovery and recolonization along the U.S. East Coast by Brooks et al. (2004) reported that recovery of benthic assemblages to background levels following dredging disturbance can range from 3 months to 2.5 years with recovery time dependent on site-specific taxa, type of sediment disturbance, and environmental conditions. Fine grain sediments typically recover to pre-disturbance conditions more quickly, in a matter of months, than sand and gravel sediments which may take 2-3 years to recover (Wilber and Clarke 2007). The Bureau of Ocean Energy Management (BOEM) (2021a) reported that benthic assemblages subjected to physical disturbance in soft sediment communities typically recover in 6 to 18 months through dispersal from adjacent areas, assuming the affected area is not disturbed during the recolonization period. Guida et al. (2017) also supports benthic community recolonization, indicating that benthic infauna and epifauna that are adapted to sandy bottom habitats similar to the habitat in the Offshore Project Area, tend to recover quickly from disturbances and are considered resilient. Brooks et al. (2004) reported that polychaetas typically are the first to recolonize disturbed areas with crustaceans (amphipods) also reported to recolonize within weeks following disturbance activities. Based on documented cases of habitat recolonization and recovery after significant disturbances involving benthic communities like those found in the Offshore Project Area, and the expectation that the surrounding available habitat will not be disturbed, seafloor-disturbing Project activities are not expected to cause long-term population-level effects to the resident benthic organisms and communities. Similar to the conclusion in BOEM (2021a), although mortality of some benthic invertebrates is anticipated, impacts are not expected to be significant at the population level and would not measurably alter the environmental baseline.

According to BOEM (2021a), benthic invertebrate species associated with hard-substrate/complex habitat may take longer to recover from individual mortality events compared to species associated with soft-bottom habitats. The frequency, severity, and spatial extent of the disturbance are important factors in how benthic recovery may occur. In areas that are not adapted to severe disturbances at frequent intervals, marine organisms may have less ability to withstand disturbance (Watling and Norse 1998); however, the Project represents a one-time disturbance that is limited in its spatial extent. Freese et al. (1999) conducted a single trawl pass in an area of hard-bottom habitat in Alaska that had recently experienced no or minimal trawling activity. Immediate changes to habitat and the benthic community consisted of boulder displacement and removal and damage of large epifaunal invertebrates, sponges, and anthozoans; however, there were not significant impacts to mobile invertebrate densities, and individuals were not obviously damaged (Freese et al. 1999). Site-specific HRG and benthic assessments conducted to date (see Appendix II-G1) in cooperation with NOAA, BOEM, and NJDEP, have indicated the presence of complex habitat, as defined by NMFS. Atlantic Shores is committed to minimizing the impacts to complex habitat to the maximum extent practicable by using tools and installation methods that minimize the potential disturbance. For example, in nearshore areas, HDD techniques will be employed to avoid seabed disturbance impacts to benthic habitat at the landfall sites. Any impacts caused by the construction, O&M, or decommissioning will be similar in nature to other human-induced activities occurring in the Offshore Project Area.

**Suspended Sediment and Deposition**

Various sediment-disturbing Project activities conducted during construction, O&M, and decommissioning have the potential to suspend sediments into the water column resulting in the transport and deposition of these sediments on the seafloor. As described in Section 2.1 Geology, sediments disturbed during Project activities are not expected to contain hazardous contaminants. Therefore, during all phases of the Project, the benthic community will primarily be affected by the short-term, localized, and temporary physical suspension of sediments and resulting deposition.

The primary construction activities that will result in elevated suspended sediment concentrations and deposition include seabed foundation preparation, sand bedform removal, inter-array and offshore export cable installation, and excavation at the offshore HDD pit. In order to determine the extent of suspended sediment and deposition produced by construction activities, a Sediment Transport Modeling study was conducted (see Appendix II-J2). This study examined the extent and duration of elevated total suspended solids (TSS) concentrations and sediment deposition as a result of seabed preparation for WTG and OSS foundation installation, sand wave clearance in the Lease Area and along the ECCs, inter-array and offshore export cable installation, and HDD activities at the Monmouth and Northern ECC Landfall Sites.[26] Results of the study represent a maximum case scenario by modeling facility components and activities that would result in the greatest impact including, but not limited to, the use of a TSHD for seabed preparation activities, use of a suction bucket jacket for all foundations (both WTG and OSS), and the presence of three large OSS structures. A summary of these findings is provided in the following subsections.

*Suspended Sediment Concentration Predictions*

Model simulation results of above-ambient TSS concentrations stemming from seabed preparation for WTG and OSS foundation installation; sand wave clearance; cable installation for the inter-array cable, Monmouth ECC, and Northern ECC; and HDD activities remained relatively close to the area where the activities would take place, were constrained to the bottom of the water column, and were relatively short-lived. Table 4.5-7 summarizes the extent and duration of suspended sediment concentrations resulting from seabed preparation for WTG and OSS foundation installation, sand wave clearance, cable installation, and HDD activities. Two TSS concentration thresholds are provided in Table 4.5-7, 10 milligram per liter (mg/L) and 100 mg/L. A threshold of ≥10 mg/L is cited in literature as within the range of ambient TSS concentration conditions of the Mid-Atlantic Bight (Balthis et al. 2009). A threshold of ≥100 mg/L has been cited in literature as a level at which larval fish and mobile benthic organisms exhibit signs of sensitivity (Auld and Schubel 1978, Turner and Miller 1991, Wilber and Clarke 2001, Anderson and Mackas 1986).

Simulations of seabed preparation for WTG and OSS foundation installation and sand wave clearance using a trailing suction hopper dredge and several possible inter-array cable or offshore export cable installation methods using either jet trenching installation parameters (for inter-array cable and export cable installation) or mechanical trenching installation parameters (for inter-array cable installation only) predicted above-ambient TSS of ≥10 mg/L stayed relatively close to the representative foundation locations and route centerline. This is due to sediments being introduced to the water column close to the seabed. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 0.7 mile (1.1 kilometers) from the representative WTG foundation site, up to approximately 1.6 miles (2.6 kilometers) from representative OSS foundation sites, and 2.4 miles (3.9 kilometers), 2.0 miles (3.2 kilometers), and 2.8 miles (4.5 kilometers) from the sand wave clearing route for the inter-array cables, Monmouth ECC, and Northern ECC, respectively. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 1.7 miles (2.7 kilometers), 1.6 miles (2.6 kilometers), and 1.5 miles (2.4 kilometers) for inter-array, Monmouth ECC, and Northern ECC cable installation, respectively (Table 4.5-7). For the landfall approach scenarios, use of an excavator was assumed, and sediment was introduced at the surface.

[26] For modeling purposes, the Sediment Transport Report selected one route along the Northern ECC. The route selected uses the South Beach Branch due to the length of the route and the complex hydrodynamic conditions that exist along the route. This branch is no longer under consideration for this Project, but provides a conservative and representative assessment of the conditions in the areas of the New York Landfalls.

This resulted in a maximum distance for the predicted above-ambient TSS concentrations ≥10 mg/L of approximately 2.1 miles (3.3 kilometers) and 1.1 miles (1.9 kilometers) for the Monmouth and Northern ECC HDD pits, respectively (Table 4.5-7).

For the model scenario of seabed preparation for the representative WTG foundation location, above-ambient TSS concentrations were predicted to substantially dissipate within 4 hours, with full dissipation occurring in less than 5 hours. Modeling scenarios for seabed preparation for OSS foundations predicted above-ambient TSS concentrations to substantially dissipate within 7 to 10 hours, with full dissipation occurring between approximately 9 to 12 hours. Sand wave clearing model scenarios for the inter-array cable, Monmouth ECC, and Northern ECC predicted above-ambient TSS concentrations to substantially dissipate within 4 to 6 hours, with full dissipation in less than 15 hours. For the inter-array cable installation model scenario, above-ambient TSS concentrations substantially dissipated within 4 to 6 hours and fully dissipated in 9 or less hours. For the Monmouth and Northern ECC installation model scenarios, above-ambient TSS concentrations substantially dissipated within 2 to 6 hours but required between 12 and 18 hours to fully dissipate, likely due to the relatively longer route (i.e., larger volume of suspended sediment), route orientation in relation to currents, and more frequent occurrence of fine sediment. For the landfall approach scenarios, the tails of the plumes, with concentrations of ≥10 mg/L, were transported away from the source and were short-lived, while concentrations around the HDD pits dissipated within approximately 6 to 12 hours for the Monmouth HDD pit and approximately 6 to 10 hours for the Northern HDD pit. The larger areas of TSS concentrations above thresholds and the longer time for the plume to diminish to ambient conditions for the Monmouth HDD pit may be attributed to sediments being released in deeper water, the higher fraction of fine sediments taking longer to settle, and slightly stronger currents transporting the sediments parallel with the shore.

### Table 4.5-7. Suspended Sediment Modeling Results from Seabed Preparation for Foundations, Cable Installation, and HDD Activities

| Scenario | Maximum Duration of TSS >10 mg/L (hrs) | Maximum Extent of TSS ≥10 mg/L | Maximum Duration of TSS >100 mg/L (hrs) | Maximum Extent of TSS ≥100 mg/L |
|---|---|---|---|---|
| Seafloor Preparation for Foundations | | | | |
| Representative WTG Seabed Foundation Preparation [1] | 4.9 | 0.7 mi (1.11 km) | 4.4 | 0.7mi (1.05 km) |
| Large OSS Seabed Foundation Preparation – 1 [1, 2] | 11.9 | 1.5 mi (2.4 km) | 7.6 | 1.4 mi (2.3 km) |
| Large OSS Seabed Foundation Preparation – 2 [1, 2] | 12.1 | 1.5 mi (2.4 km) | 9.1 | 1.4 mi (2.3 km) |

| Scenario | Maximum Duration of TSS >10 mg/L (hrs) | Maximum Extent of TSS ≥10 mg/L | Maximum Duration of TSS >100 mg/L (hrs) | Maximum Extent of TSS ≥100 mg/L |
|---|---|---|---|---|
| Large OSS Seabed Foundation Preparation – 3 [1, 2] | 8.9 | 1.6 mi (2.6 km) | 7.2 | 1.4 mi (2.2 km) |
| Sand Wave Clearance | | | | |
| Representative IAC – Sand Wave Clearance | 14.3 | 2.4 mi (3.9 km) | 8.3 | 2.0 mi (3.2 km) |
| Representative Sand Wave Clearance, Monmouth ECC | 12.5 | 2.0 mi (3.2 km) | 7.0 | 1.3 mi (2.1 km) |
| Representative Northern ECC– Sand Wave Clearance | 8.7 | 2.8 mi (4.5 km) | 7.0 | 0.8 mi (1.3 km) |
| Offshore Cable Installation | | | | |
| Representative Inter-array Cable - Jet Trencher | 8.0 | 1.4 mi (2.2 km) | 2.5 | 0.5 mi (0.8 km) |
| Representative Inter-array Cable - Mechanical Trencher | 8.7 | 1.7 mi (2.7 km) | 3.8 | 0.4 mi (0.6 km) |
| Representative Monmouth Export Cable - Jet Trencher | 12.8 | 1.6 mi (2.6 km) | 6.0 | 0.9 mi (1.5 km) |
| Representative Northern Export Cable- Jet Trencher | 17.7 | 1.5 mi (2.4 km) | 3.0 | 0.3 mi (0.4 km) |
| HDD Activities at Landfall Site | | | | |
| Monmouth Landfall Representative HDD Pit Excavator | 12.3 | 2.1 mi (3.3 km) | 11 | 0.3 mi (0.4 km) |
| Northern Landfall Representative HDD Pit Excavator | 10.3 | 1.1 mi (1.9 km) | 10.2 | 0.1 (0.18 km) |

[1] A suction bucket jacket foundation, which represents the maximum disturbance of all foundation types under consideration, was used to model impacts from seafloor preparation for WTG and OSS installation.
[2] The modeling assumed three large OSS structures for the Project.

These model predictions agree with modeling results conducted for similar projects in similar sediment conditions (BOEM, 2021a; Elliot et al., 2017; West Point Partners, LLC 2013; ASA, 2008). Actual suspended sediment concentrations and sediment transport during installation may be even lower given that environmental monitoring surveys conducted during installation of the Block Island Wind Farm submarine cable found that suspended sediment levels measured during jet plow installation were up to 100 times lower than those predicted by the modeling (Elliot et al., 2017).

Benthic invertebrates can experience negative effects from elevated suspended sediment concentrations, but typically the extent of effects is species-specific and observed at high concentrations. Effects from increased suspended sediment concentrations can include abrasion, temporary interference with feeding and respiration, reduced growth rates, and in some cases, mortality (Johnson 2018; Wilber and Clarke 2001; Kjelland et al. 2015). However, Wilber and Clarke (2001) also report that elevated suspended sediments at concentrations less than 100 milligrams per liter (mg/L) can enhance larval growth rates of northern quahog and suspended sediment concentrations as high as 500 mg/L increase eastern oyster larval growth rates. A typical adult bivalve response to elevated suspended sediment reported by Wilber and Clarke (2001) is a reduction in net pumping rate and rejecting excess filtered material. Johnson (2018) reports that adult bivalves are relatively tolerant of total suspended solids (TSS) but could still exhibit reduced growth and survival rates; however, very high TSS concentrations would be required to induce mortality. Wilber and Clarke (2001) reported that adult bivalves exposed to TSS levels below 100,000 mg/L for shorter than 5 days did not experience mortality.

Results from the Sediment Transport Modeling report showed that suspended sediment concentrations greater than 100 mg/L are only anticipated to last up to approximately 5 hours for seabed preparation activities for the representative WTG foundation, approximately 9 hours for seabed preparation activities for representative OSS foundation locations, approximately 8 hours for sand wave clearing activities, approximately 11 hours for HDD activities, and approximately 6 hours for cable installation, both of which are significantly less than the multiple-day studies compiled by Wilber and Clarke (2001). Additionally, concentrations greater than 100 mg/L are expected to be localized, extending up to a maximum distance of 0.7 mile (1.1 km) from the representative WTG foundation location, 1.4 miles (2.3 kilometers) from representative OSS foundation locations, 2.0 miles (3.2 kilometers) from sand wave clearing routes, 0.9 mile (1.5 kilometers) from cable centerlines, and 0.3 mile (0.4 kilometer) from HDD activities. Therefore, while effects could occur to sessile and less mobile individuals and early life stages of EFH species in the immediate vicinity of the seabed preparation, cable installation, and HDD activities, these effects are expected to be short-term and not result in high levels of mortality.

*Sediment Deposition Predictions*

Installation and maintenance of structures and cables will also result in the transport of sediment that will subsequently deposit over time as sediment particles settle through the water column to the seabed. Sediment deposition levels were modeled, as part of the Sediment Transport Modeling study, for seabed preparation activities for WTG and OSS foundations, sand wave clearing activities, the offshore installation of inter-array cables, the Monmouth ECC, Northern ECC, and HDD activities at the Monmouth and Northern ECC Landfall Sites (see Appendix II-J2).

Table 4.5-8 summarizes the areal extent and maximum distance of sediment deposition due to seabed preparation activities, cable installation, and HDD activities. Two depositional thresholds are provided in the table below, 0.04 inch (1 millimeter) and 0.4 inch (10 millimeters). A threshold of 0.04 inch (1 millimeter) is cited in literature as the level at which burial and mortality occurs in demersal eggs (Berry et al., 2011). A threshold of 0.4 inch (10 millimeters) is cited in literature as the level at which sessile benthic invertebrates exhibit signs of sensitivity (Essink, 1999).

### Table 4.5-8. Deposition Modeling Results from Seabed Preparation for Foundations, Cable Installation, and HDD Activities

| Scenario | Area of Deposition 0.04 in (≥1 mm )[1] | Maximum Extent of Deposition ≥0.04 in (1 mm)[1] | Area of Deposition ≥0.4 in (10 mm)[2] | Maximum Extent of Deposition ≥0.4 in (10 mm)[2] |
|---|---|---|---|---|
| Seafloor Preparation for Foundations | | | | |
| Representative WTG Seabed Foundation Preparation[3] | 0.2 $mi^2$ (0.6 $km^2$) | 2,821 ft (860 m) | 0.04 $mi^2$ (0.1 $km^2$) | 1,214 ft (370 m) |
| Large OSS Seabed Foundation Preparation – 1[3, 4] | 1.0 $mi^2$ (2.6 $km^2$) | 6,890 ft (2,100 m) | 0.2 $mi^2$ (0.4 $km^2$) | 2,493 ft (760 m) |
| Large OSS Seabed Foundation Preparation – 2[3, 4] | 1.0 $mi^2$ (2.7 $km^2$) | 7,152 ft (2,180 m) | 0.2 $mi^2$ (0.5 $km^2$) | 3,182 ft (970 m) |
| Large OSS Seabed Foundation Preparation – 3[3, 4] | 1.1 $mi^2$ (2.8 $km^2$) | 6,660 ft (2,030 m) | 0.2 $mi^2$ (0.5 $km^2$) | 2,690 ft (820 m) |
| Sand Wave Clearance | | | | |
| Representative IAC – Sand Wave Clearance | 1.4 $mi^2$ (3.5 $km^2$) | 4,002 ft (1,220 m) | 0.3 $mi^2$ (0.8 $km^2$) | 492 ft (150 m) |
| Representative Sand Wave Clearance, Monmouth ECC | 2.0 $mi^2$ (5.2 $km^2$) | 2,821 ft (860 m) | 0.9 $mi^2$ (2.3 $km^2$) | 558 ft (170 m) |
| Representative Northern ECC– Sand Wave Clearance | 2.0 $mi^2$ (5.2 $km^2$) | 1,903 ft (580 m) | 1.1 $mi^2$ (2.9 $km^2$) | 656 ft (200 m) |
| Offshore Cable Installation | | | | |
| Inter-array Cable - Jet Trencher | 0.01 $mi^2$ (<0.01 $km^2$) | 164 ft (50 m) | N/A | N/A |
| Inter-array Cable - Mechanical Trencher | N/A[5] | N/A[5] | N/A[5] | N/A[5] |

| Scenario | Area of Deposition 0.04 in (≥1 mm )[1] | Maximum Extent of Deposition ≥0.04 in (1 mm)[1] | Area of Deposition ≥0.4 in (10 mm)[2] | Maximum Extent of Deposition ≥0.4 in (10 mm)[2] |
|---|---|---|---|---|
| Monmouth Export Cable - Jet Trencher | 3.21 $mi^2$ (8.32 $km^2$) | 656 ft (200 m) | 0.01 $mi^2$ (0.02 $km^2$) | 98 ft (30 m) |
| Northern Export Cable- Jet Trencher | 1.71 $mi^2$ (4.45 $km^2$) | 295 ft (90 m) | N/A[6] | N/A[6] |
| HDD Activities at Landfall Site | | | | |
| Monmouth Landfall Representative HDD Pit Excavator | 0.03 $mi^2$ (0.09 $km^2$) | 1,572 ft (479 m) | <0.01 $mi^2$ (0.01 $km^2$) | 335 ft (102 m) |
| Northern Landfall Representative HDD Pit Excavator | <0.01 $mi^2$ (0.01 $km^2$) | 479 ft (146 m) | <0.01 $mi^2$ (<0.01 $km^2$) | 230 ft (70 m) |

[1] A depositional threshold of 0.04 inch (1 millimeter) was used in the Sediment Transport Modeling report as it is the burial and mortality threshold for demersal eggs (Berry et al 2011).
[2] Sensitivity in sessile benthic organisms has been observed 0.4 inch (10 millimeter) (Essink, 1999).
[3] A suction bucket jacket foundation, which represents the maximum disturbance of all foundation types under consideration, was used to model impacts from seafloor preparation for WTG and OSS installation.
[4] The modeling assumed three large OSS structures for the Project.
[5] Installation of inter-array cables resulted in deposition less than 0.04 inch (1 millimeter) for both mechanical trenching.
[6] Installation of the Northern ECC resulted in a deposition less than 0.4 inch (10 millimeter).

This Project-induced sediment deposition has the potential to bury sessile benthic invertebrates, such as Atlantic surfclam and ocean quahog, that are within the zone of deposition. Thresholds for lethal burial depths are species-dependent, with sessile organisms being most sensitive (Essink, 1999). According to Essink (1999), sessile organisms such as oysters and mussels can survive in sediment deposition of 0.4 to 0.8 inches (10 to 20 millimeters), while other macrozoobenthos can survive in deposition of 8.0 to 11.8 inches (200 to 300 millimeters). One study, conducted by Colden and Lipcius (2015), showed deposition-caused mortality occurring in eastern oysters only when over 90% of the individual was covered in sediment. Results from the Sediment Transport Modeling report show that deposition greater than 0.04 inch (1 millimeter) will occupy a maximum area of 0.2 square miles (0.6 square kilometers) around the representative WTG foundation location, 1.1 square miles (2.8 square kilometers) around the representative OSS foundation locations, 3.21 square miles (8.32 square kilometers) for cable installation, and 0.03 square miles (0.09 square kilometer)  HDD activities. Based on the modeling results, the area of deposition of ≥ 0.04 inch (1 millimeter) will be minimal compared to the surrounding available habitat and limited to the cable corridor.

With respect to sedimentation and deposition, it is important to note that benthic invertebrates that occupy the seafloor of the Mid-Atlantic Bight are generally adapted to periodic seafloor disturbance and deposition events. Therefore, Project-induced sediment deposition is not anticipated to result in population-level effects to the benthic community, including EFH-designated species. Although sessile organisms could experience localized increases in physical abrasion, burial, or limited mortality, mobile species are expected to temporarily vacate the area during these activities and return shortly after sediment conditions return to ambient conditions, a phenomenon that has commonly been observed following dredging activities and other physical disturbance of seafloor conditions (Brooks et al. 2004; BOEM 2021a, Guida et.al 2017).

The degree of suspended sediment and deposition will be significantly lower during O&M activities than during Project construction. Some sediment suspension and deposition may occur from maintenance of structures and cables if repairs are required, but impacts are expected to be short-term and temporary, due to the predominately sandy seafloor and shallow sediments in the Offshore Project Area. Decommissioning of structures and cables is expected to have similar limited impacts to those described for construction. During all Project phases, dynamically positioned vessels and jet plow embedment will be used to the maximum extent practicable to reduce sediment disturbance during cable laying processes.

#### 4.5.2.2 Anchoring and Jack-Up Vessels

Temporary anchoring and use of jack-up vessels within the Offshore Project Area may occur during construction and decommissioning and to a lesser extent during O&M with variations in duration and extent according to the specific work activity. All vessel anchoring and jacking-up associated with Project activities will occur within surveyed areas of the Lease Area or ECCs. These activities may affect benthic resources through direct seafloor disturbance and temporary increases in suspended sediment and deposition and effects are expected to be similar to those described in Section 4.5.2.1.

Positioning of anchors and jack-up vessels is expected to result in temporary impacts in the immediate area where anchors, chains, or jack-up legs meet the seafloor. Potential effects to benthic habitat and resources during anchoring and jack-up vessel positioning include temporary surficial disturbances of the seafloor and increases in suspended sediments and deposition, which could cause mortality to benthic invertebrates or cause temporary habitat disruption in limited areas. The severity of impacts for each event would depend on the specific location and habitat type, with greater effects expected when seafloor-disturbing activities interact with sensitive habitats, early life stages (e.g., egg and larvae), and sessile species such as Atlantic surfclam and ocean quahog. Immobile and early life stages of benthic invertebrate species in the direct path of anchor or jack-up vessel disturbance may be subject to injury or mortality; however, as described in Section 4.5.2.1, the benthic community is expected to recover and benthic infauna and epifauna are expected to recolonize the area after physical disturbance ceases.

The maximum seabed disturbance in the Lease Area and ECCs resulting from jack-up or anchored vessel use is included in the temporary seafloor disturbance calculations presented in Table 4.5-6. Disturbance caused by anchoring and jack-up vessels will occur in small areas relative to the total available surrounding habitat in the Lease Area and ECCs as described in Section 4.5.2.1. Impacts would be temporary and localized, and any isolated mortality of benthic organisms is not expected to have population-level impacts since benthic macroinvertebrates are anticipated to recolonize the area after physical disturbance ceases as described in Section 4.5.2.1. HDR (2019a) as cited in BOEM (2021a) reported that post-construction monitoring at the Block Island Wind Farm showed seabed scars from anchoring disturbance recovered to baseline conditions within 18 months to 2 years. Anchoring in sensitive habitat areas such as hard bottom habitats could have longer-term effects to the benthic community. As previously stated, Atlantic Shores is committed to minimizing the impacts to complex habitat to the maximum extent practicable by using tools and installation methods that minimize the potential disturbance. For example, Atlantic Shores proposes to use midline buoys on anchored construction vessels to minimize seabed disturbance and will develop an anchoring plan for areas where anchoring is required to avoid impacts to sensitive habitats to the maximum extent practicable, including hard bottom and structurally complex habitats, as identified in site-specific HRG and benthic assessments.

Vessels are not expected to anchor or use jack-up positioning during O&M activities unless the WTGs, OSSs, or offshore cables require major maintenance (e.g., component replacement or cable repair). Impacts associated with potential vessel positioning with anchors or jack-up legs during operation are expected to be similar, but less than those described for the construction phase. Impacts from anchoring and jack-up vessels during decommissioning are expected to be similar to those described for construction.

### 4.5.2.3 Noise

This section addresses underwater sound that may be generated during activities conducted in the Offshore Project Area, including impulsive pile driving and other noise sources (e.g., HRG surveys, vessels, cable installation, vibratory pile driving, operational WTGs, operational offshore cables, and decommissioning) and assesses the potential effect noise generated from these activities may have on benthic resources.

Noise, defined as unwanted sound, is detected by benthic species as oscillations in the water column and seafloor, with oscillations transmitted through the seafloor likely to be the primary exposure pathway for benthic organisms (Roberts and Elliott 2017). Noise generated during Project construction, O&M, and decommissioning has the potential to result in physiological stress and behavioral changes in benthic resources where and when the stimulus is present, with pile driving representing the greatest potential for effect. As described in the following subsections, underwater noise will likely be limited to the spatial and temporal extent of the vibrational stimuli and is expected to pose low risk to benthic invertebrates.

#### 4.5.2.3.1 Impact Pile Driving Noise

Impact pile driving may occur if piled foundation types (monopile and jackets) are chosen as the foundation type or if the use of an HDD conductor barrel for the Project is proposed. Impact pile driving creates stress waves that travel down the length of the pile and couple with the surrounding medium, radiating acoustic energy into the water and sediment. Noise levels produced by pile driving depend upon several interdependent factors such as pile size, hammer strike energy, and seabed characteristics. Impact pile driving primarily produces low-frequency sound with predominant acoustic energy <1 kilohertz (kHz) (Robinson et al. 2007, Tougaard et al. 2009), though sound production can extend to much higher frequencies (MacGillivray 2018), perhaps >100 kHz (Tougaard et al. 2009).

Pile driving also generates multiple types of vibrational waves in the sediment and at the seabed interface that can be detected by benthic species (Roberts and Elliott 2017). The characteristics of impact pile driving noises from the installation of foundations or HDD conductor barrels are described in more detail in Appendix II-L.

Bivalves are known to respond to vibrational stimuli by closing their siphons and, in more active mollusks, moving away from the source (Mosher 1972, Ellers 1995). There are limited studies on the effects of pile driving on shellfish and crustaceans. One study investigated the clearance rate (the rate that filter-feeders remove suspended particles from water) of blue mussels (*Mytilus edulis*) and found significantly increased rates in study animals exposed to *in situ* pile driving versus ambient noise. The study concluded that the higher clearance rates were due to increased metabolic activity because of stress during pile driving (Spiga et al. 2016). Another study assessed physiological and behavioral responses of European green crabs (*Carcinus maenus*) to pile driving noise playback exposure and found no measurable physiological effects, but did find behavioral changes, including increased time spent immobile and decreased likelihood to feed (Corbett 2019).

Based upon these studies, the effects of intermittent and impulsive pile driving noise on benthic invertebrates will be limited to the spatial and temporal extent of the vibrational stimuli. As such, the risks of noise-related effects from pile driving on benthic invertebrates are expected to be low.

##### 4.5.2.3.2 Other Noise Sources

There are several other potential anthropogenic sound sources associated with offshore Project construction, O&M, and decommissioning. These sources were not quantitatively modeled because the potential acoustic effects of these noise sources are expected to be much less than impulsive pile driving. A qualitative assessment of other noise sources generated by Project activities, including HRG surveys, vessels, cable installation, vibratory pile driving (if needed), operational WTGs, operational offshore cables, and decommissioning is summarized in this section.

As detailed in Sections 4.5.3 and 4.5.9 of Volume I, HRG surveys may be conducted to support pre-construction site clearance activities as well as post construction facilities surveys. The HRG survey equipment used for this type of survey work would be the same or similar to the equipment deployed during Atlantic Shores' 2019–2022 site characterization surveys including multibeam echosounders, side scan sonars, sub-bottom profilers, and high-resolution seismic equipment. Of this equipment, sub-bottom profilers and high-resolution seismic equipment emit acoustic signals vertically downwards into the water column, some of which will penetrate the seabed. Studies of stronger HRG survey equipment (not being deployed by Atlantic Shores, e.g., seismic airguns), have shown little evidence to suggest that the sound signals produced would have any substantial effect on invertebrate behavior (Hawkins et al. 2015). Given the results of these studies, the mobile and intermittent nature of HRG surveys, and the short-term and infrequent nature of surveying small areas of the seafloor relative to the overall area, noise from HRG surveys will not pose a risk to benthic invertebrates.

Vessel noise includes non-impulsive sounds that arise from a vessel's engines, propellers, and thrusters. Sound levels emitted from vessels depend on the vessel's operational state (e.g., idling, in-transit, etc.)

and are strongly weather dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 decibel (dB) re 1 micropascal (μPa) for numerous vessels with varying propulsion power. Noise from Project vessels is likely to be similar in frequency characteristics and sound levels to existing commercial traffic in the region. To date, there is no convincing evidence for any significant effects induced by non-impulsive noise in benthic invertebrates (Hawkins at al. 2015). Moreover, given the rapid attenuation of underwater vibrations with increasing distance from a sound source (Morley et al. 2014), it is unlikely that these stimuli will cause more than short-term behavioral effects (e.g., flight or retraction) or physiological (e.g., stress) responses. Overall, effects to benthic invertebrates from vessel noise are expected to be short-term and localized and are not anticipated to pose a risk to benthic invertebrates.

Noise generated from cable installation activities (e.g., from sand bedform removal [if needed], jet trenching, plowing/jet plowing, mechanical trenching, etc.) are expected to be minimal, with most activities generating noise impacts similar to those described for vessel noise. A detailed modeling and measurement study conducted for construction activities associated with cable installations concluded that underwater sound generated by cable laying vessels was similar to that of other vessels already operating in the area and no significant acoustic impacts were identified (JASCO 2006). Therefore, noise associated with cable laying activities are not expected to pose a risk to benthic invertebrates.

Non-impulsive, vibratory pile driving could be an additional source of noise generated during construction. Vibratory pile driving may be used for a short period at the beginning of pile driving or to install the entire pile, depending on sediment conditions (see Section 4.2.1 of Volume I), to install sheet piling for the construction of a cofferdam, or to install a casing pipe to support HDD activities. Compared to noise generated from impulsive pile driving, which was determined to cause minimal effects to benthic invertebrates, non-impulsive pile installation is expected to result in even lower effects due to lower peak pressure levels and short duration. Comparisons of vibratory pile installation versus impulsive hammer pile installation indicate that vibratory pile installation typically produces lower amplitude sounds in the marine environment than impact hammer installation (Rausche and Beim 2012). Received peak sound pressure level (PK) and sound exposure levels (SEL) near impact hammer pile installation can exceed 200 dB, while studies of vibratory pile driving measured source levels ranging from 177 to 195 dB PK and 174.8 to 190.6 dB SEL (Hart Crowser and Illingworth and Rodkin 2009; Houghton et al. 2010). Therefore, exposure to non-impulsive vibratory hammer installation noise is unlikely to result in substantial impacts to benthic invertebrates because of its lower peak pressure levels and its relatively short duration.

During Project operation, WTGs will generate non-impulsive sound in the nacelle that will be transmitted down the WTG tower to the foundation and then radiated into the water. Underwater sound levels generated by an operational WTG are related to the WTG's power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Under normal conditions, the sound level that results from WTG operation is of low intensity (Madsen et al. 2006), with energy concentrated at low frequencies (below a few kHz) (Tougaard et al. 2008). Pangerc et al. (2016) recorded SPL measurements at approximately 164 ft (50 m) from two individual 3.6 megawatt (MW) monopile wind turbines over a 21-day operating period. The sound pressure level increased with wind speed up to an average value of 128 dB re 1 µPa at a wind speed of about 22.4 miles per hour (mph) (10 meters per second [m/s]), and then showed a general decrease. Additional studies conducted during operation of the Block Island Wind Farm measured sound levels below 120 dB SPL at wind speeds less than 29 mph (13 m/s) (HDR 2019b). These sound levels are expected to be similar to those reported for cable laying/trenching. Therefore, the effects of WTG noise on benthic invertebrates, while long-term, are not expected to be substantial and will not cause population-level effects.

High-voltage alternating current (HVAC) offshore cables are expected to produce non-impulsive low-frequency tonal vibration sound in the water. Such low-frequency tonal vibrations are expected to be undetectable by benthic organisms. Direct current (DC) cables do not produce a similar tonal sound because the current is not alternating. Low level tonal sound from an existing 138-kilovolt (kV) transmission line was measured in Trincomali Channel, offshore Vancouver Island, British Columbia during a quiet period of recording. The SPL at approximately 328 ft (100 m) from the cable was below 80 dB. Assuming cylindrical spreading of sound, the source level of the submarine cable was approximately 100 dB SPL (JASCO 2006). Anticipated SPL arising from the vibration of AC cables during operation are significantly lower than SPL that may occur during cable installation (Meißner et al. 2006) and may be undetectable in the ambient soundscape of the Lease Area. Based on these studies, no effects on benthic invertebrates are expected during cable operation.

Sounds associated with decommissioning are reasonably assumed to be similar to, or less than, those produced during either the construction or O&M phases of the Project. The methods used to decommission and remove the Project's foundations will depend on the type of foundation (see Section 6.2.3 of Volume I); therefore, the level and duration of sounds emitted during decommissioning will depend on the type (e.g., gravity versus piled foundation), size, and location of the foundation. Piled foundations, if used, will be cut below the mudline, likely using underwater acetylene cutting torches, mechanical cutting, and/or a high-pressure water jet. Mechanical cutting tools and high-pressure water jetting will generate non-impulsive broadband sound (Topham and McMillan 2017). Regardless of the foundation type used, removal and transport of Project components (e.g., foundations, WTGs, OSSs, etc.), will require the use of vessels, which will also generate non-impulsive sound. Potential effects to benthic invertebrates from sound generated during decommissioning activities are expected to be similar or less than those encountered during the construction or O&M phases of the Project.

The risk of noise-related effects to benthic invertebrates and associated behavioral responses from other sound sources such as HRG surveys, vessels, cable installation, vibratory pile driving, operational WTGs, operational offshore cables, and decommissioning is expected to be very low.

#### 4.5.2.4 Electromagnetic Fields

This section addresses electromagnetic fields (EMF) generated during operation of the Project and the localized effects on benthic resources. EMFs are invisible areas of electric and magnetic energy that occur both naturally and anthropogenically in the marine environment. Atlantic Shores conducted an EMF study to predict EMF levels from operation of the Project's submarine electrical system which includes a combination of high-voltage direct current (HVDC) and HVAC cables and OSSs (see Appendix II-I). The modeling results show that EMF levels are predicted to decrease exponentially with increasing distance from the cables and are therefore expected to cause minimal risk to benthic invertebrates.

It is hypothesized that electric field detection by invertebrates is conducted through the use of chemical and mechanical sensory neurons (Normandeau et al. 2011). However, due to cable configuration and shielding, electric fields will not be released into the marine environment from Project cable operation, and therefore were not modeled in Appendix II-I and are not further discussed in this section.

Magnetic fields will however be generated by the offshore cable system, which includes HVAC and HVDC export cables, HVAC interlink cables, and HVAC inter-array cables. Multiple theories have been proposed for invertebrate detection of magnetic fields. The most supported theory proposes the use of a magnetite-based system which involves the presence of magnetic crystals (magnetite) that can detect differences in magnetic fields (CSA Ocean Sciences, Inc. and Exponent 2019, Normandeau et al. 2011). Magnetosensitivity has been observed in three invertebrate phyla: Mollusca (e.g., snails and bivalves), Echinodermata (e.g., sea urchins), and Arthropoda (e.g., lobsters) (Normandeau et al. 2011). It is hypothesized that species of these phyla that are magneto-sensitive utilize the earth's natural magnetic field for orientation, navigation, and homing (Normandeau et al. 2011). Of the marine invertebrate species studied with regards to responses to magnetic fields, the American lobster is the only species which may occur in the Offshore Project Area.

Magnetic fields generated from HVAC and HVDC export cables, HVAC inter-link cables, and HVAC inter-array cables used for the Project will be minimized by cable burial (between approximately 5 to 6.6 ft [1.5 to 2 m]) and armoring (see Section 4.5.1 of Volume I). Table 4.5-9 summarizes the modeled peak magnetic field production anticipated for Project export and inter-array cables under maximum power generation scenarios for cable crossing and normal conditions.[27]

Though well-established magnetic field thresholds for benthic invertebrates are lacking, research suggests that marine species may be more likely to detect magnetic fields from DC cables than AC cables (Normandeau et al. 2011). In fact, studies have provided evidence that marine invertebrates may not be able to detect or respond to magnetic fields produced by AC cables that have a frequency of 60 hertz (Hz), especially at intensities below 50 milligauss (mG) (Normandeau et al. 2011). Modeling of Atlantic Shores' HVAC export cables and inter-array cables which will operate at 60 Hz, predicted magnetic fields ranging from 60.07 to 244.42 mG at the cable centerline. However, the field is predicted to drop to approximately 50 mG between 5.4 and 8.4 ft (1.6 to 2.6 m) in horizontal distance from the export cables and between 1.7 and 2.8 ft (0.52 to 0.85 m) in horizontal distance from the inter-array cables.

[27] These predicted EMF levels assume cable shielding and burial. The model results are extremely conservative since the modeling assumed full load operation 100% of the time. The Project will more reasonably operate at approximately 50% annual capacity factor with correspondingly reduced current.

Since the HVAC export and inter-array cables will operate at 60 Hz, and the magnetic fields are predicted to drop to approximately 50 mG at a maximum horizontal distance of 8.4 ft (2.6 m), it can reasonably be assumed that magnetic fields produced by Project HVAC offshore cables will result in minimal impacts to benthic invertebrate species in the Offshore Project Area.

### Table 4.5-9. Peak Magnetic Fields Modeled under Maximum Power Generation for the Atlantic Shores Export and Inter-Array Cables

| Cable Type | Peak Magnetic Field (mG) for Maximum Modeled Case |
|---|---|
| HVAC[1] | |
| Export Cable | 107.82 |
| Export Cable (at cable crossing) | 244.42 |
| Inter-array Cable | 60.07 |
| HVDC | |
| Export Cable | 152.68 |
| Export Cable (at cable crossing) | 349.22 |

[1]HVAC inter-link cables are part of the larger OSS electrical system, and were not analyzed as isolated, individual cables. However, due to the configuration of the inter-link cables, they are expected to operate in a similar fashion as either HVAC export cables or the HVAC inter-array cables.

As previously stated, marine invertebrates that rely on magnetic fields for orientation, navigation, and homing behaviors may be more sensitive to magnetic fields produced by DC cables than AC cables Though precise magnetic field sensitivity thresholds for marine invertebrates do not exist, studies have been conducted to identify behavioral effects from DC sources. These studies have found impacts to be minor. Hutchison et al. (2018) conducted a field study which used enclosures situated over an existing DC cable to examine American lobster response in the presence of a maximum magnetic field of 653 mG DC. Results of the field study showed that though subtle changes in behavior (e.g., exploration activity) and differences in spatial distribution (e.g., use of enclosure space, proximity to seabed) were observed, the magnetic field did not present a barrier to movement.

Laboratory studies have also been conducted on marine invertebrates to determine potential effects of magnetic fields produced by a DC source on invertebrate behavior and movement. One study conducted by Harsanyi et al. (2022) examined the impacts of high levels of DC magnetic fields on the early life history stages of European lobster (*Homarus gammarus*) and edible crab (*Cancer pagurus*). This laboratory study simulated magnetic fields of 28,000 mG and results showed the potential for larval deformities and reduced egg volume. Studies conducted by Woodruff et al. (2012 and 2013) examined responses of Dungeness crab and American lobster in the presence of high DC magnetic fields and observed no statistically significant difference in behavior (e.g., feeding) or spatial use (e.g., distribution in tanks). Woodruff et al. (2012) also examined behavioral changes such as antennular flicking and feeding in Dungeness crabs when exposed to 30,000 mG DC. Results of the study showed no statistically significant differences between controlled (i.e., no DC field exposure) and experimental trials (i.e., 30,000 mG DC exposure).

Woodruff et al. (2013) continued their study in 2012 and examined spatial distribution (e.g., location in tanks with respect to EMF source) and activity levels (e.g., time spent buried or active) of Dungeness crabs when exposed to 10,000 mG DC and found no statistical significance with respect to magnetic field strength. Woodruff et al. (2013) also studied changes in spatial use and behavior in American lobster when exposed to a maximum EMF level of 11,000 mG DC. Unlike the results of the Hutchison et al. (2018) field study, results from Woodruff et al. (2013) laboratory studies showed no correlation between EMF levels and spatial use (e.g., location in tank, time spent under shelter or buried) and behavior in American lobsters (e.g., activity levels). The magnetic DC fields used in the Hutchison et al. (2018), Harsanyi et al. (2022), and Woodruff et al (2012 and 2013) studies are significantly greater (most by orders of magnitude) than the modeled magnetic field levels expected to be generated by HVDC export cables for the Project. Although some effects to the spatial distribution of American lobster were observed in the field studies conducted by Hutchison et al. (2018), the presence of the cable did not represent a barrier to crossing, meaning effects to orientation, navigation, and homing would be unlikely. Therefore, it is reasonable to assume that EMF generated from HVDC export cables from the Project will not result in substantial impacts to benthic invertebrates.

Given the localized spatial extent of expected EMF emissions from the Project, the reported lack of invertebrate impacts in available literature (BOEM 2020, Hutchison et al. 2018, Woodruff et al. 2012, 2013), and proposed mitigation measures, EMFs associated with Project operation are not expected to pose a risk to benthic invertebrates.

#### 4.5.2.5 Presence of Structures and Cables

This section addresses the potential effect that the presence of structures and cables in the Offshore Project Area may have on benthic resources. The seafloor of the Offshore Project Area is predominately comprised of flat, sandy habitat occupied by benthic species such as crabs, clams, polychaetes, oligochaetes, and nematodes. Introduction of new foundations, scour protection, offshore cables, and offshore cable protection introduces habitat complexity and diversity in a largely homogenous environment. Within the Offshore Project Area, the presence of foundations, cable protection, and scour protection may result in habitat conversion/creation, increased food availability, facilitation of invasive species settlement, and hydrodynamic disturbances.

The presence of foundations and scour protection will result in localized habitat conversion of any sandy, soft bottom habitat to a coarser, complex habitat. The maximum total area of permanent seafloor disturbance in the Lease Area, using the foundation type with the maximum footprint, is 1.37 $mi^2$ (3.58 $km^2$) (Table 4.5-6), which represents approximately 1.1% of the 126 $mi^2$ (326 $km^2$) Lease Area. The maximum total permanent seafloor disturbance in the Monmouth and Northern ECCs from the placement of cable protection is 0.35 $mi^2$ (0.90 $km^2$) and 0.40 $mi^2$ (1.04 $km^2$), respectively (Table 4.5-6). The combined permanent seafloor disturbance for the Atlantic and Monmouth ECCs represents 0.8% of the total ECC area. This permanent habitat conversion of predominantly sandy and sandy gravel benthic habitat to hard structure habitat will be localized and restricted to the foundation, cable protection, and scour protection footprints (ICF, 2020).

Even though the presence of foundations, cable, and scour protection will eliminate a small percentage of flat sandy habitat in the Offshore Project Area, the Project is expected to produce ecological benefits by creating new, hard substrate habitat for benthic species, thereby potentially increasing species abundance of invertebrate species that prefer hard substrates such as mussels, crabs, sea anemone, encrusting worms and barnacles (English et al. 2017, Lüedeke 2015). In two different wind farms, the Block Island Wind Farm off Rhode Island and the Horns Rev Wind Farm in the North Sea, abundance of benthic invertebrates within soft-bottom communities largely remained the same between pre- and post-construction (ICF 2020). At the Block Island Wind Farm, abundance of small invertebrates (e.g., nematodes and polychaetes) in existing soft-bottom benthic communities increased after construction around some WTGs.

Colonization of foundations and scour protection will predominately include fouling benthic species (e.g., mussels) that were not present, or at least not abundant, prior to development (English et al. 2017). Post-construction monitoring at the Alpha Ventus Offshore Wind Farm, located in the North Sea, observed a 100-fold increase in the abundance of fouling species (e.g., mussels) on foundations when compared to the biomass observed in the former soft sediment, as well as increases brown crab abundance (*Cancer pagurus*) (English et al. 2017). Surveys at the Horns Rev and Nysted offshore windfarms, located off the coast of Denmark, measured a 50 to 150% increase in biomass, primarily of common mussel species (ICF 2020). In the U.S., monitoring at the Block Island Wind Farm during the first two years following construction found increased abundance of benthic invertebrate species when comparing the WTG locations to control areas surrounding the facility; however, no statistically significant difference was observed between the facility and control areas with regards to species composition (HDR 2019a).

The presence of structures and scour protection may also result in increased food availability for filter feeders (Raox et al. 2017; HDR 2019a). It is hypothesized that the foundations and scour protection will facilitate the colonization of various benthic species, as well as attract predators such as finfish and crustaceans, a phenomenon known as the "reef effect". This colonization and predator attraction could result in a greater influx of organic matter, a prime food source for benthic filter feeders and detritovores, from uneaten food particles, dead organisms, and other waste products (Raox et al. 2017). At the Block Island Wind Farm, the seafloor in the immediate vicinity of the WTGs were colonized by a dense blanket of mussels, where high levels of organic material were found (HDR 2019a). Increased food availability for benthic filter feeders and detritivores could lead to biomass increases of those species.

In addition to providing increased food availability for benthic species, the presence of structures and foundations could result in increased predation on benthic organisms. Hard structures such as WTG, OSS, and met tower foundations and scour protection could offer more diverse and abundant feeding opportunities for finfish or predatory macroinvertebrates in an area that is largely comprised of flat, sandy habitat with small topographic features (e.g., ripples) (ICF 2020). Attraction of finfish and predatory invertebrates could lead to increased predation rates on benthic species (Raox et al. 2017). At windfarms in the North and Baltic Sea, higher finfish diversity and abundance was observed in the vicinity of WTG foundations compared to surrounding areas (Leonhard et al. 2011; Wilhelmsson et al.

2006). Studies conducted around oil platforms in the U.S. have observed higher predation rates around the platforms compared to surrounding environments (Page et al. 2007). Similar effects could occur around foundations and scour protection in the Offshore Project Area.

The presence of foundations and scour and cable protection could result in the spread of non-indigenous invertebrate species (English et al. 2017). Examples of non-indigenous invertebrate species known to inhabit marine ecosystems off the coast of New Jersey and New York include European green crab and Asian shore crab (*Hemigrapsus sanguineus*) (USGS 2021; USDA 2021). A study which examined the development and progression of fouling communities at numerous wind farms off the Belgian coast showed that foundations created new habitat for non-indigenous species previously absent from the area (e.g., Pacific oyster (*Crassostrea gigas*) and Japanese shore crab (*Hemigrapsus sanguineus*)) and offered habitat expansion to two existing non-indigenous species, a species of barnacle and species of limpet (Kerckhof et al. 2011). In the U.S., exotic invertebrate species have been observed around oil and gas platforms. One study which examined species composition around offshore oil and gas platforms off the coast of California found three exotic invertebrate species, the Japanese skeleton shrimp (*Caprella mutica*), red rust bryozoan (*Watersipora subtorquata*), and an anemone species (*Diadumene spp*) (Page et al. 2006). Colonization of non-indigenous species can lead to decreases in native biomass due to competition of resources and can alter trophic links and ecological processes (Page et al. 2006; Sellheim et al. 2010). However, the surrounding area is comprised primarily of soft sediment so it can reasonably be assumed that if the foundations and scour protection resulted in invasive species attraction or growth, it is unlikely to result in population-level impacts to native invertebrates which would be dominated by species inhabiting soft sediments (BOEM, 2021a).

The presence of WTGs and other foundation structures in the Lease Area may affect currents and water movement within the Lease Area. Specifically, as water moves along a current and approaches a turbine or foundation, it changes and accelerates around a structure, creating turbulence (ICF 2020). This phenomenon is known as the wake effect (ICF 2020). The magnitude of wake effect depends on the diameter of foundation structures, volume of impervious surface in the water column and seafloor, and current speed (ICF 2020, English et al. 2017). Wake effect from monopile foundations has been observed approximately 600 ft (200 m) down current of the structures (English et al. 2017). During peak tidal movements, turbulent wakes have been observed as far as 1,312 ft (400 m) from the monopile (English et al. 2017). These localized wake effects could influence larval settlement and primary productivity. In some cases, changes in current and water movement could result in positive effects for certain species. Changes to currents and water movement have potential to result in increased food availability for filter feeders (e.g., Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surfclam, ocean quahog) as well as influence larvae settlement, a phenomenon which has been observed with gravity-base structures (English et al. 2017, ICF 2020).

Monitoring the physical dynamics in the Mid-Atlantic Bight and Cold Pool is important to understanding how placement of wind turbines may affect ocean mixing. Changes to Cold Pool timing have been linked to disturbances in biological processes of marine invertebrates. Mortality events in surfclams and alterations of ocean quahog spawning timing has been observed during earlier seasonal breakdown of the Cold Pool (Narvaez et al. 2015, Toupoint et al. 2012).

Modeling studies, considering varying sizes of wind projects and technology, have indicated that wind turbines may cause atmospheric disturbances to near-surface winds that influence ocean mixing (Afsharian and Taylor 2019). The extent of changes to ocean mixing at local and regional, or mesoscale, scales is not well known and can vary widely in magnitude as local mixing is dependent on atmospheric forcing, daily heating and cooling, wind, and changes in temperature and humidity associated with mesoscale weather and other processes (Paskyabi 2015). Measuring and predicting any possible effects to ocean mixing is highly dependent on the characteristics of the wind project (e.g., spacing between turbines, size of turbines) and the local and regional atmospheric and oceanographic conditions (Moum and Smyth 2019), including conditions of benthic invertebrates in the local and regional areas.

Conditions and observations at local and regional scales are necessary to understand if effects to mixing may occur from the Project and if so, whether effects may influence the Cold Pool dynamics. Drawing early conclusions from European or modeling studies have inherent differences, as the Mid-Atlantic Bight has weaker tidal currents and more intense stratification than the North Sea and is different from other western boundary currents or mesoscale circulation features in European waters. It has been suggested that slower ocean velocities in the southern Mid-Atlantic Bight would result in significantly less mixing than has been found in Europe (Carpenter et al. 2016). European studies are more representative of Mid-Atlantic Bight conditions during weaker stratification. Therefore, it is not likely that structure-induced mixing would be sufficient to overcome intense summer stratification to influence the Cold Pool and cause broader ocean mixing (Miles et al. 2020). As a result, substantial impacts to the Cold Pool and ocean mixing from the presence of Project WTGs is not expected. However, considering the seasonal, annual, and longer scale changes in the Cold Pool and Mid-Atlantic Bight, Atlantic Shores is supportive of contributing to regional collaborative science to study and monitor the Cold Pool and its influence on benthic invertebrates.

In 2019, Atlantic Shores, in collaboration with Rutgers University and MARACOOS, deployed a metocean buoy to contribute to the study of the Mid-Atlantic Cold Pool. This buoy contains sensors at the atmospheric-boundary layer and ocean floor that allow for continuous measurements of the Cold Pool, as well as support regional oceanographic and atmospheric modeling efforts. The data collected by this buoy is publicly accessible and can be accessed through MARACOOS' data portal at https://ioos.noaa.gov/regions/maracoos. Once operational, the Project will also represent a living laboratory as it provides abundant opportunities for direct ocean and ecological observations, such as the anticipated beneficial effects of introducing structure to a homogenous sandy sea floor.

As stated, the presence of foundations and cable and scour protection could create a range of effects to benthic resources during the O&M phase of the Project. Most of these effects will be permanent throughout the life of the Project and mostly beneficial. Foundations and cable and scour protection are expected to produce ecologically beneficial effects that could outweigh the risk of introducing hard structure to a small area of the vast flat, sandy habitat found in the Mid-Atlantic Bight. Once the Project is decommissioned, the local environmental and ecological features of the area are expected to revert to pre-construction conditions. Potential effects from decommissioning include the loss of Project-related hard structures, which are expected to be colonized at the time of decommissioning.

Benthic resources that attach to foundations will be displaced during decommissioning as the foundations and scour protection are removed.

#### 4.5.2.6 Offshore Substation Operation

As discussed in Section 4.4.2 of Volume I, if the Project uses an HVDC OSS, seawater may be used in a once-through cooling system to provide cooling to the HVDC OSS which is subsequently discharged back into the environment with an elevated temperature and residual chlorine concentration. This section assesses the potential effects to benthic resources from the operational discharge of an HVDC OSS. Effects of seawater withdrawal required for cooling the HVDC OSS are evaluated in Section 4.6 Finfish.

As described in more detail in Section 3.2 Water Quality, Atlantic Shores performed effluent discharge modeling for an HVDC OSS to predict the magnitude and extent of the effluent plumes above background values (see Appendix II-W). All simulated cases met the water quality standards for both the excess temperature threshold of 5.4°F (3°C) temperature excess and the residual chorine threshold of 0.5 mg/L of residual chlorine concentration at the regulatory distance threshold of 328 feet (100 meters) from the discharge point. In fact, the thermal discharge water quality standard was generally met within 32.8 feet (10 meters) or less of the discharge point, but two simulated cases reached up to 105 feet (32 meters) from the discharge point before dropping below the thresholds. The residual chorine water quality standard was generally met within 3.3 feet (1 meter) or less from the discharge point, but two simulated cases reached up to 17.7 and 19 feet (5.4 and 5.8 meters) from the discharge point before dropping below the thresholds.

These model predictions indicate that impacts from the OSS discharge to benthic organisms are expected to be minimal given the highly localized extent of the thermal and residual chorine discharge plume. Impacts to benthos will also be minimized given the dynamic nature of the plume and the dilution that occurs within a maximum distance of 328 feet (100 meters) for all modeled scenarios.

#### 4.5.2.7 Summary of Proposed Environmental Protection Measures

The majority of the potential effects to benthic resources are expected to be temporary and localized as described in the previous sections. Many of the permanent effects from the presence of structures, including cable and scour protection, are expected to be ecologically beneficial. Atlantic Shores has extensively studied the benthic habitat in the Offshore Project Area and has already taken precautionary steps and commitments to avoid, mitigate, and monitor Project effects on benthic communities and habitat during construction, O&M, and decommissioning. Additional avoidance and mitigation measures and tools will be evaluated further as the Project progresses through development and permitting and in cooperation and coordination with Federal and State jurisdictional agencies and other stakeholders. The following provides a summary of proposed environmental protection measures that Atlantic Shores will implement to reduce impacts to benthic resources within the Offshore Project Area:

- Comprehensive benthic habitat surveys (seafloor sampling, imaging, and mapping) have been and continue to be conducted in consultation with BOEM and NOAA to support the identification of sensitive and complex habitats and the development of strategies for minimizing impacts to identified areas to the maximum extent practicable.
- HDD will be used to avoid seabed disturbance impacts to benthic habitat at the landfall sites. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. All drilling fluids will either be collected and recycled upon HDD completion or used as clean fill where appropriate.
- Inter-array, inter-link, and export cables will be buried to a target depth of 5 to 6.6 ft (1.5 to 2 m) which will allow the benthic community to recover and recolonize, avoid direct interaction with benthic invertebrates, and minimize impacts from EMF.
- Dynamically positioned vessels and jet plow embedment will be used to the maximum extent practicable to reduce sediment disturbance during cable laying processes.
- Vessels will operate in compliance with regulatory requirements related to the prevention and control of discharges and accidental spills.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (see Appendix I-C).
- Anchor midline buoys will be used on anchored construction vessels, where feasible, to minimize seabed disturbance.
- An anchoring plan will be employed for areas where anchoring is required to avoid impacts to sensitive habitats, to the maximum extent practicable, including hard bottom and structurally complex habitats, identified through the interpretation of site-specific HRG and benthic assessments.
- Coordination and consultation will occur throughout the filing of the NPDES permitting associated with an HVDC OSS to ensure impacts are minimized and reduced to the greatest extent practicable.
- A benthic habitat monitoring plan will be implemented to measure and assess the disturbance and recovery of marine benthic habitats and communities as a result of Project construction and operation.

# 4.6 Finfish, Invertebrates, and Essential Fish Habitat

This section describes finfish and pelagic invertebrate resources and associated habitat, including Essential Fish Habitat (EFH), present in the Offshore Project Area, which includes the Lease Area, Monmouth Export Cable Corridor (ECC), Northern ECC, and Northern ECC Branches.[28] This section also assesses the impact producing factors (IPFs) associated with Project activities and the anticipated measures to avoid and minimize the potential effects to these resources. Finfish and pelagic invertebrates are essential components of a marine ecosystem, providing important trophic resources for both larger predator and smaller prey species. The benthic habitat that supports many demersal and benthic-oriented species is described in more detail in Section 4.5 Benthic Resources. In addition to ecological importance, many finfish and invertebrate species are considered commercially and recreationally important (see Section 7.4 Commercial Fisheries and For-Hire Recreational Fishing). In order to maintain a healthy habitat for these species of recreational and commercial importance, EFH was established through the Magnuson-Stevens Fishery Conservation and Management Act to conserve and protect habitats that provide spawning, breeding, feeding, and growth opportunities to designated species. The EFH assessment is included as Appendix II-J1.

Atlantic Shores understands the importance of finfish and pelagic invertebrates and their associated EFH from an ecological, recreational, and commercial perspective and is committed to understanding these resources in the Offshore Project Area. Atlantic Shores has implemented benthic habitat assessment surveys, approved, and accepted by Federal and State agencies, that build upon and fill data gaps from previously completed Federal and State-funded research efforts. These studies have provided data to characterize the seafloor and benthic habitats, including EFH, and to identify species occupying these habitats in the Offshore Project Area. In addition, Atlantic Shores will implement a fisheries monitoring plan to monitor baseline environmental conditions relevant to fisheries and how these conditions may change throughout Project construction and operation. Proposed fisheries surveys detailed in the Fisheries Monitoring Plan (see Appendix II-K) include a demersal fish trawl survey, fish pot survey, and clam dredge survey. These efforts have and will continue to inform Atlantic Shores Project design and construction planning to avoid or minimize Project-related impacts with the goal of maintaining a healthy, functioning marine ecosystem.

## 4.6.1 Affected Environment

The description of finfish, pelagic invertebrates, and EFH is based on available literature, online data portals, mapping databases, and survey results from Federal and State agencies. Specific information on species composition, distribution, and abundance within the Offshore Project Area was obtained from the Northeast Ocean Data Portal, Northeast Fisheries Science Center (NEFSC) multispecies trawl

[28] The Northern ECC extends north from the Lease Area to the New York State waters boundary, where it splits into branches that make landfall in Asbury Park, New Jersey, Staten Island, New York, and/or Brooklyn, New York. There are five landfall sites options in total: Asbury, Kingsley, Lemon Creek, Wolf's Pond, and Fort Hamilton (see Figure 1.0-1).

surveys,[29] New Jersey Department of Environmental Protection (NJDEP) Ocean Stock Assessment Program (OSAP) trawl surveys[2], BOEM Habitat Mapping and Assessment of the Northeast Wind Energy Areas (Guida et al. 2017),[30] and NJDEP Ocean/Wind Power Ecological Baseline Studies (Geo-Marine 2010).[31] Additional data sources that were reviewed, but ultimately not included in this analysis include NYSERDA's Large Bony Fish and Fish Shoals study and Virginia's Institute for Marine Science's (VIMS) Northeast Area Monitoring and Assessment Program (NEAMAP) studies. These studies did not overlap with the Offshore Project Area, and therefore, are not discussed in this analysis.

The Offshore Project Area is located in the Mid-Atlantic Bight, a region known for diverse species assemblages, with fish and shellfish species of commercial and recreational importance (BOEM 2012). The diversity of the Mid-Atlantic Bight has been attributed to overlapping species ranges from the New England and South Atlantic regions (BOEM 2012). Fish community composition within the Mid-Atlantic Bight fluctuates seasonally and consists largely of tropical-subtropical and temperate species (BOEM 2012; Geo-Marine 2010). Approximately 336 marine fish species can be found along the coastline of New Jersey, many of which are likely to occur in the Offshore Project Area, and demonstrate seasonal migration patterns, moving offshore in the winter, and nearshore during the spring and summer (Geo-Marine 2010).

The seasonality of food sources in the Mid-Atlantic Bight could be an influencing factor for fish migration patterns (Sherman et al. 1983). Two important sources of nutrients for many finfish species are phytoplankton and zooplankton. Phytoplankton are small, photosynthetic microalgae. Distribution and abundance of phytoplankton is strongly dependent on water temperature, light, nutrient concentrations, pH, and salinity (Geo-Marine 2010). The phytoplankton community off the coast of New Jersey is dominated by diatoms (Geo-Marine 2010). Within the Mid-Atlantic Bight, phytoplankton abundance is strongly influenced by the seasonal stratification of the shelf. The highest abundance of phytoplankton is seen in coastal waters where stratification is weak or absent (Geo-Marine 2010). Offshore, phytoplankton are most abundant in the fall and winter when seasonal stratification diminishes (Geo-Marine 2010).

Zooplankton refers to small animals suspended in the water column that either drift with currents or have weak swimming abilities (NMFS 2021). The zooplankton community found along the shelf of the Mid-Atlantic Bight and the inshore estuarine environment (e.g., Raritan Bay) includes, but is not limited to, copepods (e.g., Calanus finmarchicus), mysids, euphausiids, amphipods, cnidaria, ctenophores, and larval fish species (e.g., Atlantic herring) (Sage and Herman 1972; Kane 2005; NMFS 2021). Copepods

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[29] Site-specific trawl data from 2008 to 2021 were obtained directly from NOAA Fisheries and NJDEP for trawl surveys that overlapped with the Offshore Project Area (Lease Area, Monmouth ECC, Northern ECC, including the branches which extend to New York and the Asbury Branch which extends to New Jersey).

[30] Guida et al. (2017) evaluated NEFSC seasonal trawl data from 2003 to 2016 in the entire NJ WEA which includes areas outside of the Lease Area.

[31] Geo-Marine (2010) evaluated NJOSAP ocean trawl data from 2003 to 2008 in sampling strata that extended from Barnegat Bay (about 5 miles [mi] (8 kilometers [km]) south of the Monmouth Landfall Site) to Hereford Inlet (about 48 mi [477 km] south of the Monmouth ECC), extending from the coastline out to the 98-foot (ft) (30-meter [m]) depth contour.

are a key food source for larval and adult pelagic fish that reside or migrate through the Mid-Atlantic Bight (Kane 2005). Studies along the shelf of the Mid-Atlantic Bight have shown evidence of seasonal variability in zooplankton abundance, with the greatest abundance occurring in the spring and summer, and the lowest abundance occurring in the winter (NMFS 2021). Seasonal differences in zooplankton abundance have been linked to migration patterns of some migratory species (e.g., Atlantic mackerel, Atlantic menhaden) (Sherman et al. 1983).

One unique feature of the Mid-Atlantic Bight is known as the Cold Pool. The Cold Pool is an oceanographic phenomenon referring to a bottom-trapped, cold, nutrient-rich pool that extends from Cape Cod, Massachusetts to Cape Hatteras, North Carolina, located over the mid- and outer-shelf of the Mid-Atlantic Bight (Chen 2018; Ganim 2019). The formation of the Cold Pool is driven by seasonal patterns in solar heating and wind (Ganim 2019) and is not spatially uniform (Lentz 2017). It forms at the start of spring when wind mixing is reduced, and surface heat fluxes increase causing the water column to become stratified (Ganim 2019; Lentz 2017). Freshwater runoff in the spring can further intensify stratification (Castelao et al. 2010). The Cold Pool, located along the seafloor, is isolated from warming surface waters by the seasonal thermocline and creates habitat conditions that provide thermal refuge to colder water species in the Mid-Atlantic Bight ecosystem (Lentz 2017). Recruitment and settlement of several cold-water species, such as yellow-tail flounder (*Pleuronectes ferruginea*) and red hake (*Urophycis chuss*), has been linked to the presence of the Cold Pool (Chen 2018; Lentz 2017; Sullivan et al. 2005; Miller et al. 2016). This feature also provides temporary habitat for some northern species, like haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*), which thrive in colder temperatures (Steves et al. 1999; Kohut and Brodie 2019). Cold pool waters are also nutrient-enriched and when upwelled toward the surface, can drive phytoplankton growth and high concentrations of particulate organic matter in the water column (Voynova et al. 2013).

The timing of the formation and breakdown of the Cold Pool, as well as its spatial extent, varies significantly each year but generally develops annually between spring and fall (Chen and Curchitser 2020). The Cold Pool dissipates in the fall due to enhanced vertical mixing from an increase in the frequency of strong wind events and the cooling of surface temperatures (Ganim 2019). The breakdown of the stratified Cold Pool is known to influence the timing of migration for species such as winter flounder (*Pseudopleuronectes americanus*), summer flounder (*Paralichthys dentatus*), black sea bass (*Centropristis striata*), and Atlantic butterfish (*Peprilus triacanthus*) (Kohut and Brodie 2019).

The Offshore Project Area, which includes the nearshore areas of the ECCs leading to the landfall site options, contains tidal, nearshore, and offshore habitat, with water depths ranging from approximately 66 to 98 feet (ft) (20 to 30 meters [m]) in the Lease Area. The seabed in the Offshore Project Area and vicinity is predominantly comprised of fine, medium, and gravelly/coarse sand, with morphological features such as sand ripples, mega ripples, sand waves, and sand ridges, all of which are typical of the Mid-Atlantic Bight (see Section 2.1 Geology). Hardened structures created by shipwrecks, obstructions, or artificial reefs also contribute to the benthic and demersal habitats available for marine species. These features represent areas of hard substrate projecting above the seabed that attract benthic resources and fish species in areas where reef habitat is sparse like the Mid-Atlantic Bight (Ross et al. 2015). Multiple shipwrecks are located in and along the borders of the Offshore Project Area.

Additionally, one artificial reef is located at the northwestern tip of the Lease Area (i.e., Garden State North Reef), and two are located along the outer boundary of the Monmouth ECC (Manasquan Inlet Reef and Axel Carlson Reef; depicted in Figure 7.4-16). Two of these artificial reefs, the Garden State North Reef and the Axel Carlson Reef, are classified as placement areas as designated by the U.S. Army Corps of Engineers (USACE 2017). The Garden State North Reef site is an artificial reef complex where ships, military vehicles, subway cars, concrete, and dredged rock have been disposed (NJDEP 2021). The Axel Carlson Reef site is an artificial reef complex where many boats, military tanks, construction materials, and rock have been disposed. Additional information on these sites can be found in Table 2.1-2 and Figure 3.2-1 for additional information.

Based on seasonal trawl surveys, presented in more detail in Sections 4.6.1.1, 4.6.1.2, and 4.6.1.4, the most common fish and pelagic invertebrate species captured in the Offshore Project Area include: Atlantic butterfish, Atlantic croaker (*Micropogonias undulatus*), Atlantic herring (*Clupea harengus*), northern sand lance (*Ammodytes dubius*), alewife (*Alosa pseudoharengus*), American sandlance (*Ammodytes americanus*), bay anchovy (*Anchoa mitchilli*), longfin inshore squid (*Doryteuthis pealeii*), little skate (*Leucoraja erinacea*), northern searobin (*Prionotus carolinus*), spiny dogfish (*Squalus acanthias*), scup (*Stenotomus chrysops*), spot (*Leiostomus xanthurus*), spotted hake (*Urophycis regia*), silver hake (*Merluccius bilinearis*), round herring (*Etrumeus teres*), weakfish (*Cynoscion regalis*), Atlantic silverside (*Menidia menidia*), and windowpane (*Scophthalmus aquosus*).

Many fish species that have the potential to occur in the Offshore Project Area are migratory, traveling between offshore and nearshore habitats seasonally to spawn (Geo-Marine 2010; Guida et al. 2017). Species composition within the Offshore Project Area includes a variety of demersal and pelagic finfish and invertebrates.[32] A list of major demersal and pelagic finfish and pelagic invertebrate species potentially present within and surrounding the Offshore Project Area is presented in Table 4.6-1. This table focuses on species that are reported as either abundant in the literature or trawl surveys, commercially or recreationally important, forage species that serve as prey, EFH-designated species, or protected species. Habitat association (demersal, benthic, pelagic) is also provided for each species. Additional information about demersal and pelagic fish, highly migratory species, pelagic invertebrates, threatened and endangered species, and EFH-designated species is provided in Sections 4.6.1.1 through 4.6.1.6.

[32] Demersal species are those living close to the seafloor, while benthic species are those associated with or occurring on the seafloor (NOAA 2021b; NOAA, 2020d). Pelagic species are those that inhabit the water column (NOAA 2020e).

## Table 4.6-1. Finfish and Pelagic Invertebrate Species Potentially Present in the Atlantic Shores Offshore Project Area

| Species | Commercial/ Recreational Importance[1] | Forage Species | EFH[2] | Protected Species Status[3] | Habitat Association |
|---|---|---|---|---|---|
| Albacore Tuna (*Thunnus Alalunga*) | C, R | | X | | Juvenile - Pelagic |
| Alewife (Alosa Pseudoharengus) [4] | R | X | | | Pelagic |
| American Eel (*Anguilla Rostrata*) [4] | C, R | | | | Demersal |
| American Shad (*Alosa Sapidissima*) [4] | C, R | | | | Pelagic |
| American Sand Lance (*Ammodytes americanus*) | | X | | | Demersal |
| Atlantic Bonito (*Sarda Sarda*) | C, R | | | | Pelagic |
| Atlantic Butterfish (*Peprilus Triacanthus*) | C | X | X | | Pelagic |
| Atlantic Chub Mackerel (*Scomber Colias*) | C, R | | | | Pelagic |
| Atlantic Cod (*Gadus Morhua*) | R | X | X | | Eggs And Larvae – Pelagic<br>Adult – Benthic |
| Atlantic Croaker (*Micropogonias undulatus*) | R | | | | Demersal |
| Atlantic Herring (*Clupea harengus*) | | X | X | | Juvenile and Adult – Pelagic |
| Atlantic Mackerel (*Scomber scombrus*) | C, R | X | X | | Pelagic |
| Atlantic Menhaden (*Brevoortia tyrannus*) [4] | C, R | X | | | Pelagic |
| Atlantic Salmon (*Salmo salar*) [5] | | | | E | Pelagic |
| Atlantic Silverside (*Menidia menidia*) | | X | | | Pelagic |
| Atlantic Sturgeon (*Acipenser oxyrinchus*) | | | | E, E(S) | Demersal |
| Atlantic Wahoo (Acanthocybium solandri) | R | | | | Pelagic |
| Bay Anchovy (Anchoa mitchilli) | | X | | | Pelagic |
| Big Eye Tuna (*Thunnus obesus*) | C, R | | | | Pelagic |
| Black Drum (*Pogonia cromis*) | C, R | | | | Demersal |
| Black Sea Bass (*Centropristis striata*) | C, R | X | X | | Larvae– Pelagic |

| Species | Commercial/ Recreational Importance[1] | Forage Species | EFH[2] | Protected Species Status[3] | Habitat Association |
|---|---|---|---|---|---|
| | | | | | Juvenile and Adult–Demersal |
| Blacktip Shark (*Carcharhinus limbatus*) | R | | | | Pelagic |
| Blueback Herring (*Alosa aestivalis*) [4] | R | X | | | Pelagic |
| Bluefin Tuna (*Thunnus thynnus*) | C, R | | X | | Juvenile and Adult - Pelagic |
| Bluefish (*Pomatomus saltatrix*) | C, R | X | X | | Pelagic |
| Blueline tilefish (*Caulolatilus microps*) | C, R | | | | Benthic |
| Blue Shark (*Prionace glauca*) | R | | X | | Juvenile and Adult - Pelagic |
| Clearnose Skate (*Raja eglanteria*) | R | | X | | Juvenile and Adult - Benthic |
| Common Thresher Shark (*Alopias vulpinus*) | C, R | | X | | Pelagic |
| Conger eel (*Conger oceanicus*) | C | | | | Benthic |
| Cownose Ray (*Rhinoptera bonasus*) | R | | | | Demersal |
| Cunner (*Tautogolabrus adspersus*) | R | | | | Demersal |
| Dolphinfish (*Coryphaena hippurus*) | C, R | | | | Pelagic |
| Dusky Shark (*Carcharhinus obscurus*) | | | X | | Neonate, Juvenile, Adult - Pelagic |
| Golden Tilefish (*Lopholatilus chamaeleonticeps)* | C, R | | | | Benthic |
| Goosefish (*Lophius americanus*) | C, R | | | | Demersal |
| Gray Triggerfish (*Balistes capriscus*) | R | | | | Demersal |
| Haddock (*Melanogrammus aeglefinus*) | R | X | X | | Juvenile – Benthic |
| Hickory Shad (*Alosa mediocris*) | R | | | | Pelagic |
| Little Skate (*Leucoraja erinacea*) | C | | X | | Juvenile and Adult - Benthic |
| Little Tunny (*Euthynnus alletteratus*) | R | | | | Pelagic |

| Species | Commercial/ Recreational Importance[1] | Forage Species | EFH[2] | Protected Species Status[3] | Habitat Association |
|---|---|---|---|---|---|
| Longfin Inshore Squid (*Doryteuthis pealeii*) | C | | X | | Eggs – Benthic<br>Juvenile and Adult - Pelagic |
| Monkfish (*Lophius americanus*) | R | X | X | | Eggs and Larvae – Pelagic<br>Adult– Benthic |
| Northern Kingfish (*Menticirrhus saxatilis*) | R | | | | Demersal |
| Northern Puffer (*Sphoeroides maculatus*) | R | | | | Demersal |
| Northern Shortfin Squid (*Illex illecebrosus*) | C | | X | | Juvenile - Pelagic |
| Northern Sand Lance (*Ammodytes americanus*) | | X | | | Demersal |
| Northern Searobin (*Prionotus carolinus*) | R | | | | Demersal |
| Ocean Pout (*Macrozoarces americanus*) | | X | X | | Eggs and Adult - Benthic |
| Ocean sunfish (*Mola mola*) | R | | | | Pelagic |
| Pollock (*Pollachius virens*) | R | | X | | Larvae – Pelagic |
| Porbeagle shark (*Lamna nasus*) | R | | | | Pelagic |
| Red Hake (*Urophycis chuss*) | C, R | X | X | | Eggs and Larvae – Pelagic<br>Juvenile and Adult– Benthic |
| Round Herring (*Etrumeus teres*) | | X | | | Pelagic |
| Sand Tiger Shark (*Carcharias taurus*) | | | X | | Neonate and Juvenile– Demersal |
| Sandbar Shark (*Carcharhinus plumbeus*) | | | X | | Neonate, Juvenile, and Adult - Demersal |
| Scup (*Stenotomus chrysops*) | C, R | X | X | | Juvenile and Adult– Demersal |
| Sheepshead (*Archosargus probatocephalus*) | R | | | | Demersal |
| Shortfin Mako Shark (*Isurus oxyrinchus*) | C, R | | X | | Pelagic |

| Species | Commercial/ Recreational Importance[1] | Forage Species | EFH[2] | Protected Species Status[3] | Habitat Association |
|---|---|---|---|---|---|
| Shortnose sturgeon (*Acipenser brevirostrum*) [5] | | | | E, E(S) | Demersal |
| Silver Hake (*Merluccius bilinearis*) | C | | X | | Eggs and Larvae – Pelagic<br>Adult – Pelagic and Benthic |
| Silver Perch (*Bairdiella chrysoura*) | | | | | Demersal |
| Skipjack Tuna (*Katsuwonus pelamis*) | R | | X | | Juvenile and Adult - Pelagic |
| Smoothhound Shark Complex (Smooth Dogfish) (*Mustelus canis*) | R | | X | | Demersal |
| Southern Kingfish (*Menticirrhus americanus*) | R | | | | Demersal |
| Spanish Mackerel (*Scomberomorus maculatus*) | R | | | | Pelagic |
| Spiny Dogfish (*Squalus acanthias*) | C, R | | X | | Pelagic and epibenthic |
| Spot (*Leiostomus xanthurus*) | C, R | X | | | Demersal |
| Spotted Hake (*Urophycis regia*) | | | | | Demersal |
| Striped Bass (*Morone saxatilis*) [4] | R | | | | Demersal |
| Striped Mullet (*Mugil cephalus*) | R | X | | | Demersal/Pelagic |
| Striped Searobin (*Prionotus evolans*) | R | | | | Demersal |
| Summer Flounder (*Paralichthys dentatus*) | C, R | X | X | | Eggs and Larvae – Pelagic<br>Juvenile and Adult – Demersal |
| Swordfish (*Xiphias gladius*) | C, R | | | | Pelagic |
| Tautog (*Tautoga onitis*) [4] | C, R | | | | Demersal |
| Tiger Shark (*Galeocerdo cuvieri*) | R | | X | | Juvenile and Adult - Pelagic |
| Weakfish (*Cynoscion regalis*) [4] | C, R | X | | | Pelagic |

| Species | Commercial/ Recreational Importance[1] | Forage Species | EFH[2] | Protected Species Status[3] | Habitat Association |
|---|---|---|---|---|---|
| White Hake (*Urophycis tenuis*) | R | | X | | Adult - Benthic |
| White Mullet (*Mugil curema*) | R | X | | | Pelagic |
| White Perch (*Morone americana*) | R | | | | Demersal |
| White Shark (*Carcharodon carcharias*) | | | X | | Neonate, Juvenile, and Adult - Pelagic |
| Windowpane Flounder (*Scophthalmus aquosus*) | R | X | X | | Eggs and Larvae – Pelagic<br>Juvenile and Adult - Benthic |
| Winter Flounder (*Pseudopleuronectes americanus*) | R | X | X | | Eggs, Juvenile, and Adult – Benthic<br>Larvae - Initially planktonic, then demersal |
| Winter Skate (*Leucoraja ocellate*) | C, R | | X | | Juvenile and Adult – Benthic |
| Witch Flounder (*Glyptocephalus cynoglossus*) | | X | X | | Eggs and Larvae – Pelagic<br>Adult - Benthic |
| Yellowfin Tuna (*Thunnus albacares*) | C, R | | X | | Juvenile - Pelagic |
| Yellowtail Flounder (*Limanda ferruginea*) | | X | X | | Eggs and Larvae – Pelagic<br>Juvenile and Adult- Benthic |

Notes:
[1] C- commercially important species; R – recreationally important species. Species with commercial landings values of $4,000 or greater in 2019 for the State of New Jersey as reported by National Oceanic and Atmospheric Administration (NOAA) Fisheries were considered a species of commercial importance. Species with confidential commercial landing values were not marked as a species of commercial importance in this table. Species were deemed recreationally important if average recreational landings from 2015 to 2019 for New Jersey were greater than 10,000 pounds (4,536 kilograms [kg]). Although many highly migratory species landings are not tracked given the prevalence of catch and release, these species were considered recreationally important. These species were identified through EFH data for the Offshore Project Area and available literature for New Jersey and the Mid-Atlantic Bight.
[2] Habitat association for EFH species only includes life stages with designated EFH in the Offshore Project Area.
[3] E-Federally endangered species; T-Federally threatened species; E(S) – New Jersey State endangered species
[4] Other NOAA Trust Resource species requested to be described by NOAA GARFO.

[5] Unlikely to occur within the Offshore Project Area

Sources:

Atlantic State Marine Fisheries Commission (ASMFC). Fisheries Management 2020. Arlington (VA): ASMFC; [accessed 2020 November 13]. http://www.asmfc.org/fisheries-management/program-overview.

Bureau of Ocean Energy Management (BOEM). 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment. BOEM 2012-003.

Geo-Marine. 2010. Ocean/Wind Power Ecological Baseline Studies, Volume IV: Fish and Fisheries Studies. Plano, Texas: Geo-Marine, Inc.

National Oceanic Atmospheric Administration (NOAA). 2020a. Habitat Conservation, Habitat Protection: EFH View Tool. Silver Springs (MD): National Marine Fisheries Service; [updated 2020 November 20; accessed 2022 March]. https://www.habitat.noaa.gov/protection/efh/efhmapper/.

National Oceanic Atmospheric Administration (NOAA). 2020c. Species Directory. Silver Springs (MD): NOAA; [accessed 2020 November 13]. https://www.fisheries.noaa.gov/species-directory.

National Oceanic Atmospheric Administration (NOAA). 2020d. Commercial and Recreational Landings Query. Silver Springs (MD): NOAA Fisheries Office of Science and Technology; [accessed 2020 November 16]. https://foss.nmfs.noaa.gov/apexfoss/f?p=215:200.

#### 4.6.1.1 Demersal Fish

Demersal fish live or feed on, or close to, the seafloor. Seabed formations and substrate types can be influencing factors in demersal finfish distribution. Sediment within the Offshore Project Area largely consists of fine, medium, and gravelly sand, as well as sandy gravel (see Section 4.5 Benthic Resources and Appendix II-G1). Topographically, the Offshore Project Area is largely level and consistent, offering little topographic relief along the seabed; however, some areas contain sand bedforms of varying size (see Section 2.1 Geology). One study conducted by Slacum et al. (2010) examined species assemblage on sand shoals versus surrounding flat bottom habitat and found that species abundance, diversity, and richness were greater in flat bottom habitats than sandy shoals (The Nature Conservancy 2015). In addition to seafloor bathymetry, there are shipwrecks within the Offshore Project Area, as well as three artificial reefs (Garden State North Reef, Axel Carlson Reef, Atlantic City Reef) along the Lease Area and Monmouth ECC that could potentially create shelter, as well as foraging habitat for demersal fish and their prey (e.g., black sea bass, tautog (*Tautoga onitis)*) (Steimle and Figley 1996; NCDEQ 2021; SAFMC 2021). These reefs are depicted in Section 7.7, Figure 7.7.2. Atlantic Shores will work with NJDEP regarding the avoidance and minimization of effects to any artificial reef from Project activities. Another important ecological feature off the coast of New Jersey is the Carl Shuster Horseshoe Crab Reserve, which is located approximately 16 miles (mi) (26 kilometers[km]) south of the Offshore Project Area. Given the distance between the Offshore Project Area and the Carl Shuster Horseshoe Crab Reserve, Project activities are not expected to directly impact the reserve. Other factors influencing species distribution include temperature, presence of prey species, and shelter (Sogard et al. 1992; Steimle and Figley 1996; Stein et al. 2004a; Kohut and Brodie 2019).

Figure 4.6-1 represents the seasonal biomass of demersal fish species in the vicinity of the Offshore Project Area aggregated from 2010 to 2017. Data were obtained from the Northeast Ocean Data Portal which used NEFSC Multi-Species Bottom annual spring and fall trawl (NEFSC trawl) results to calculate and model seasonal biomass of demersal finfish (NROC 2009). NEFSC trawl surveys were conducted from the Gulf of Maine to Cape Hatteras, North Carolina. These data illustrate that demersal biomass off the coast of New Jersey fluctuates seasonally, with higher levels of biomass in the fall than in the spring.

In addition to changes in biomass, seasons influence species distribution, particularly those species that undergo seasonal migrations as shown in independent trawl survey data. Data were obtained directly from National Oceanic and Atmospheric Administration (NOAA) Fisheries and NJDEP from the NEFSC Multispecies Bottom Trawl and NJDEP OSAP Trawl surveys for the Offshore Project Area between 2008 and 2021 (NOAA Fisheries 2022; L. Barry, NJDEP 2020 personal communication)[33]. The Federal and State trawl site locations within the Offshore Project Area are illustrated in Figure 4.6-2.

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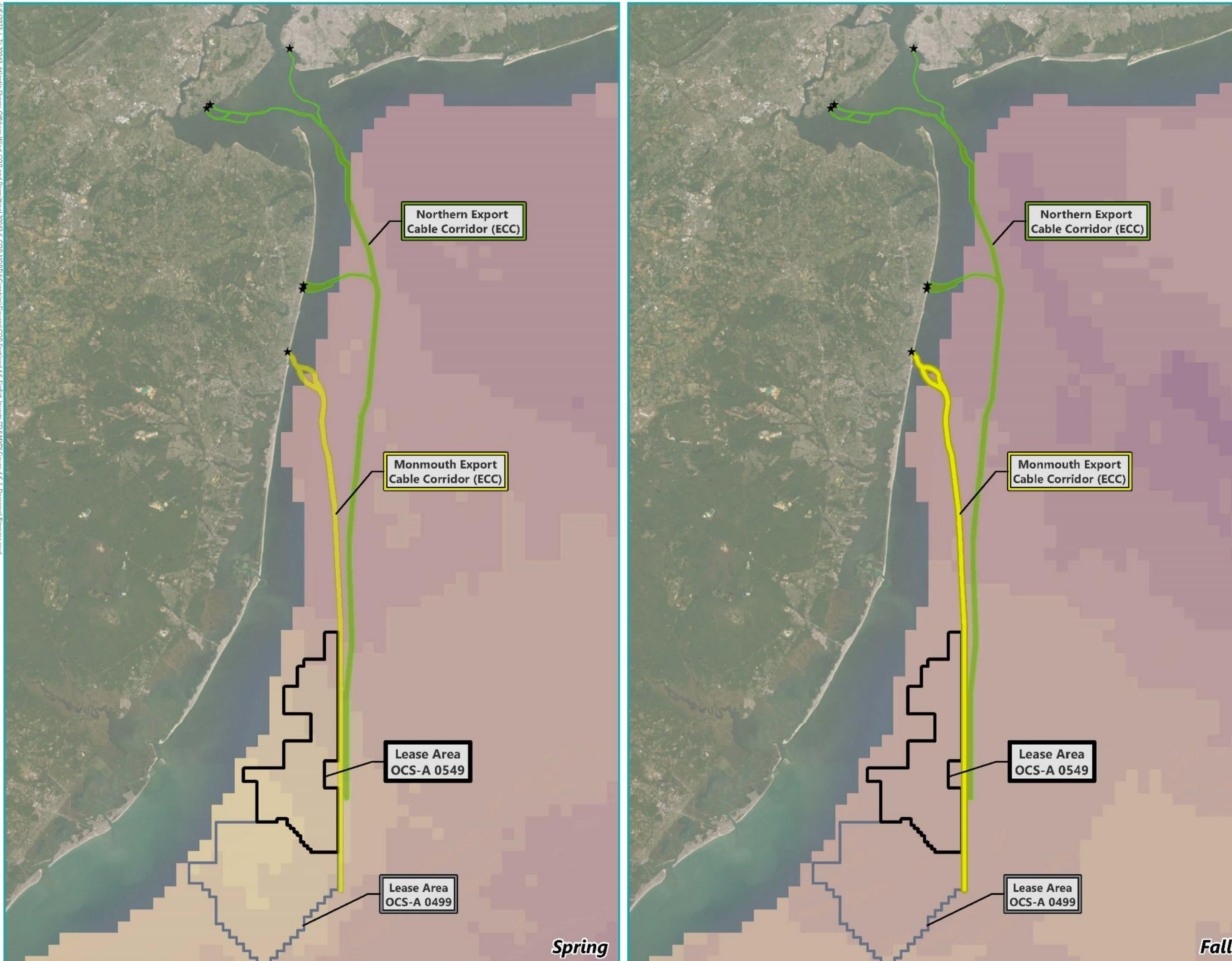
[33] Given the nearshore geographic distribution of the Virginia Institute of Marine Science's Northeast Area Monitoring and Assessment Program surveys, only a small number of trawl locations overlap with the Offshore Project Area. Therefore data from those surveys are not provided in Tables 4.6-2 and 4.6-3, as the NEFSC and NJDEP OSAP trawl surveys provide greater coverage and understanding of the species composition within the Offshore Project Area.

Of the NEFSC survey locations, 37 are located within the Lease Area, 18 in the Monmouth ECC, and 23 in the Northern ECC (see Figure 4.6-2).

Of the NJDEP OSAP trawl sites, 35 are located in the Lease Area, 17 in the Monmouth ECC, and 41 in the Northern ECC (see Figure 4.6-2). Table 4.6-2 represents the top five numerically dominant demersal species collected in the Offshore Project Area during State and Federal trawl surveys in each season. The most numerically dominant species typically differed between survey seasons, which could be attributed to seasonal migrations.



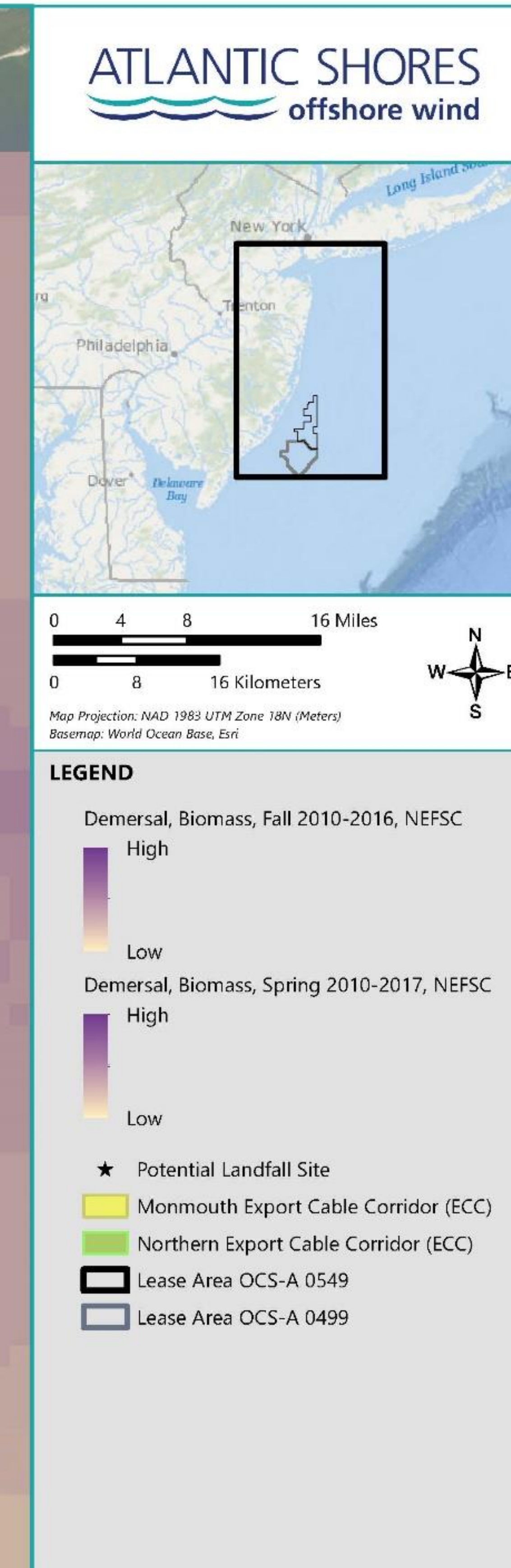




**Figure 4.6-1**

*Demersal Finfish Biomass*

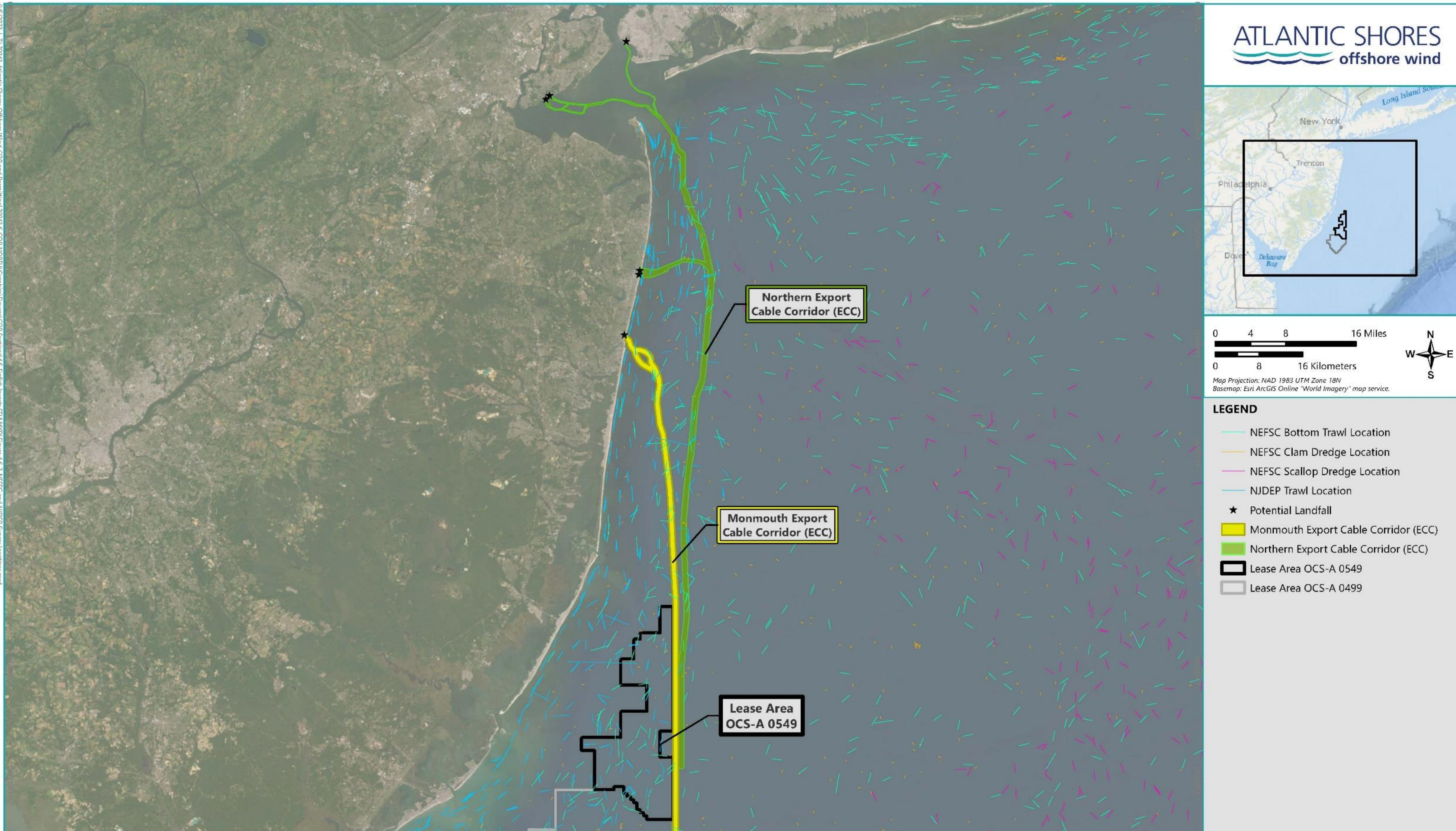



**Figure 4.6-2**

*NEFSC and NJDEP Survey Locations*

### Table 4.6-2. Top Five Numerically Dominant Demersal Species from NEFSC and NJDEP OSAP trawl surveys (2008 to 2021)[1]

| Project Area | Season[2] | Species | | | | |
|---|---|---|---|---|---|---|
| NEFSC Trawl Surveys | | | | | | |
| Lease Area | Spring | Atlantic Croaker | Northern Searobin | Scup | Spotted Hake | Spot |
| | Fall | Atlantic Croaker | Spot | Lanternfish Spp. | Scup | Northern Searobin |
| Monmouth ECC | Spring | Atlantic Croaker | Gulf Stream Flounder | Little Skate | Blackbelly Rosefish | Longspine Snipefish |
| | Fall | Scup | Atlantic Croaker | Gulfstream Flounder | Spot | Northern Searobin |
| Northern ECC[3] | Spring | Atlantic Croaker | Scup | Spot | Northern Searobin | Spotted Hake |
| | Fall | Atlantic Croaker | Spot | Acadian Redfish | Big Skate | Scup |
| NJDEP OSAP Trawl Surveys | | | | | | |
| Lease Area | Winter | American Sand Lance | Spotted Hake | Windowpane | Red Hake | Little Hake |
| | Spring | American Sand Lance | Spotted Hake | Little Skate | Windowpane | Northern Searobin |
| | Summer | Northern Searobin | Haddock | Little Skate | Clearnose Skate | Atlantic Croaker |
| | Fall | American Sand Lance | Atlantic Croaker | Spot | Northern Searobin | Scup |
| Monmouth ECC | Winter | American Sand Lance | Little Skate | Silver Hake | Windowpane | Winter Flounder*[4]<br>Winter Skate*[4] |
| | Spring | Little Skate | Spotted Hake | American Sand Lance | Windowpane | Unclassified Skate |
| | Summer | Atlantic Croaker | Clearnose Skate | Little Skate | Scup | Northern Searobin |
| | Fall | Spot | Scup | Little Skate | Atlantic Croaker | Spotted Hake |
| Northern ECC[3] | Winter | American Sand Lance | Little Skate | Spotted Hake | Windowpane | Winter Skate |
| | Spring | Unclassified Skate | Spotted Hake | Little Hake | American Sand Lance | Red Hake |

| Project Area | Season[2] | Species | | | | |
|---|---|---|---|---|---|---|
| | Summer | Spot | Scup | Northern Searobin | Little Skate | Clearnose Skate |
| | Fall | Spot | Scup | Little Skate | Winter Flounder | Winter Skate |

Notes: * Species with average catch sizes less than five individuals per tow.

[1] Ranking is based on the average catch number per tow. The five species with the largest catch numbers per tow were included in the tables above. Calculations only accounted for the number of tows, not the length or duration of each tow.
[2] Fall – September, October, November; Winter – December, January, February; Spring – March, April, May; Summer – June, July, August.
[3] Due to the limited number of tows conducted in the Northern ECC branches that extend to New York and the Asbury Branch the extends to New Jersey, those results were reported as part of the Northern ECC tow results.
[4] Cells with more than one species listed indicate equivalent average catch across all tows in a given season.

Overall, based on Federal and State trawl surveys conducted between 2008 and 2021 that overlap with the Offshore Project Area, the total number of individuals and total number of species collected were highest during fall and summer surveys. This could be attributed to migration patterns of many finfish and squid species in the Mid-Atlantic Bight that migrate offshore during winter to utilize warmer waters, then travel inshore during the spring and summer to spawn (Geo-Marine 2010).

#### 4.6.1.2 Pelagic Fish

As previously stated, the Offshore Project Area, which includes the nearshore areas of the Monmouth ECC and Northern ECC Branches, contains tidal, nearshore, and offshore habitats. Pelagic fish can be found in the nearshore and offshore environments of the Offshore Project Area. Distribution of pelagic fish varies based on availability of light, nutrients, dissolved oxygen, temperature, salinity, and water depth, as well as oceanographic phenomena like the presence of the Cold Pool and the Gulf Stream (NOAA, 2021a, Lentz 2017, Sullivan et al. 2005, Miller et al. 2016). Oceanographic features, such as the Cold Pool can influence migration and overall travel patterns in pelagic species like Atlantic butterfish (Kohut and Brodie 2019).

The distribution of many pelagic species changes seasonally with fluctuating water temperatures (Geo-Marine 2010). Many species that may occur in the Offshore Project Area migrate inshore during the spring and summer for spawning, and offshore for warmer water during late fall and winter (Geo-Marine 2010). Seasonal differences in species composition and abundance within the Offshore Project Area were observed during NEFSC and NJDEP OSAP surveys conducted between 2008 and 2021, with the largest catch numbers occurring in fall and summer (see Figure 4.6-2 for survey locations). Table 4.6-3 displays the top five numerically dominant pelagic species collected in the Offshore Project Area during State and Federal trawls for each season. Similar to demersal fish, the most numerically dominant pelagic fish species differed between survey seasons, which could be attributed to seasonal migrations.

## Table 4.6-3. Top Five Numerically Dominant Pelagic Species from NEFSC and NJDEP OSAP trawl surveys (2008 to 2021)[1]

| Project Area | Season[2] | Species | | | | |
|---|---|---|---|---|---|---|
| NEFSC Trawl Surveys | | | | | | |
| Lease Area | Spring | Atlantic Butterfish | Spiny Dogfish | Bay Anchovy | Atlantic Herring | Atlantic Menhaden |
| | Fall | Bay Anchovy | Striped Anchovy | Atlantic Butterfish | Silver Hake | Alewife |
| Monmouth ECC | Spring | Bay Anchovy | Silver Hake | Spiny Dogfish | Atlantic Mackerel | Weitzman's Pearlside |
| | Fall | Bay Anchovy | Atlantic Butterfish | Round Herring | Silver Hake | Atlantic Argentine |
| Northern ECC[3] | Spring | Atlantic Butterfish | Bay Anchovy | Spiny Dogfish | Striped Anchovy | Silver Hake |
| | Fall | Bay Anchovy | Round Herring | Striped Anchovy | Spiny Dogfish | Silver Hake |
| NJDEP OSAP Trawl Surveys | | | | | | |
| Lease Area | Winter | Atlantic Herring | Blueback Herring | Atlantic Silverside | Silver Hake | American Shad |
| | Spring | Atlantic Herring | Silver Hake | Atlantic Mackerel | Butterfish | Blueback Herring |
| | Summer | Round Herring | Atlantic Butterfish | Silver Hake | Spiny Dogfish | Bluefish* |
| | Fall | Bay Anchovy | Atlantic Butterfish | Weakfish | Round Herring | Spiny Dogfish |
| Monmouth ECC | Winter | Atlantic Herring | Atlantic Silverside | Spiny Dogfish* | Alewife*[4]<br>Atlantic Menhaden*[4]<br>Blueback Herring*[4] | |
| | Spring | Atlantic Butterfish | Bay Anchovy | Atlantic Herring | Spiny Dogfish | Alewife |
| | Summer | Atlantic Butterfish | Round Herring | Bay Anchovy | Silver Hake | Bluefish*<br>Weakfish* |
| | Fall | Atlantic Butterfish | Bay Anchovy | Spiny Dogfish | Silver Hake | Atlantic Moonfish |
| Northern ECC[3] | Winter | Atlantic Herring | Spiny Dogfish | Blueback Herring | Atlantic Silverside | Alewife |
| | Spring | Atlantic Butterfish | Alewife | Blueback Herring* | Atlantic Mackerel* | Bay Anchovy* |

| Project Area | Season[2] | Species | | | | |
|---|---|---|---|---|---|---|
| | Summer | Bay Anchovy | Atlantic Butterfish | Atlantic Moonfish | Striped Anchovy | Weakfish |
| | Fall | Bay Anchovy | Atlantic Butterfish | Round Herring | Weakfish | Silver Hake |

Notes: * Species with average catch sizes less than five individuals per tow. Low catch numbers for pelagic fish species could be attributed to the sampling method used in the NEFSC and NJDEP surveys, both of which utilize bottom trawls. Bottom trawls will likely result in higher catches of demersal fish inhabiting the seafloor than pelagic fish in the water column.

[1] Ranking is based on the average catch number per tow. The five species with the largest catch numbers per tow were included in the tables above. Calculations only accounted for the number of tows, not the length or duration of each tow.

[2] Fall – September, October, November; Winter – December, January, February; Spring – March, April, May; Summer – June, July, August.

[3] Due to the limited number of tows conducted in the Northern ECC branches that extends to New York and the Asbury Branch that extends to New Jersey, those results were reported as part of the Northern ECC tow results.

[4] Cells with more than one species listed indicate equivalent average catch across all tows in a given season.

Overall, based on Federal and State trawl surveys conducted between 2008 and 2021 that overlap with the Offshore Project Area, the total number of individuals and total number of species collected were highest during fall and summer surveys. This could be attributed to migration patterns of many finfish and squid species in the Mid-Atlantic Bight that migrate offshore during winter to utilize warmer waters, then travel inshore during the spring and summer to spawn (Geo-Marine 2010).

#### 4.6.1.3 Highly Migratory Fish

Highly migratory fish species are extremely mobile pelagic species that travel long distances both horizontally and vertically in the water column and live in the open ocean. Highly migratory species presence is not typically correlated with geological or biological features such as bottom substrate and submerged aquatic vegetation (Geo-Marine 2010). Instead, their presence is often linked to physiographic or hydrographic features such as ocean fronts, currents, the continental shelf, or seamounts (Geo-Marine 2010). Given their mobility, and that they often cross domestic and international boundaries, species management occurs at a State, Federal, and sometimes international level. Highly migratory fish species that have the potential to occur within or transit the Offshore Project Area include tunas, sharks, and swordfish (see Table 4.6-1). Within the Offshore Project Area, 13 highly migratory species have EFH designated in the Offshore Project Area, indicating the potential presence of suitable habitat for foraging, spawning, breeding, and maturation. EFH is important for maintaining healthy habitat for these species which are highly sought after by both commercial and recreational fishermen (see Section 7.4 Commercial Fisheries and For-Hire Recreational Fishing).

#### 4.6.1.4 Pelagic Invertebrates (Squid)

Important pelagic invertebrates with ranges that overlap the Offshore Project Area include longfin inshore squid (*Doryteuthis pealeii*), Northern shortfin squid (*Illex illecebrosus*), and Atlantic brief squid (*Lolliguncula brevis*). As reported by Geo-Marine (2010) and Guida et al (2017), squid was one of the dominant groups caught in NJOSAP and NEFSC independent trawl surveys for a larger area off of New Jersey that also includes the Offshore Project Area. However, commercial squid vessel activity from the smaller Offshore Project Area indicates that squid may be less prevalent in the Offshore Project Area than in other parts of New Jersey.

All three species of squid were collected to various degrees in either the NEFSC or NJDEP OSAP trawl surveys within the Offshore Project Area between 2008 and 2021 (NOAA Fisheries 2022; L. Barry, NJDEP 2020 personal communication).[34] Longfin squid were collected in both the NEFSC and NJOSAP trawl surveys within the Offshore Project Area and were numerically more abundant during fall, spring and summer surveys. Shortfin squid were collected year-round in NEFSC trawl surveys and during summer in NJDEP trawl surveys. Both longfin inshore squid and Northern shortfin squid undergo seasonal migrations, moving offshore during late autumn to overwinter along the edge of the continental shelf and returning inshore during the spring and early summer (Cargnelli et al. 1999; Hendrickson and

[34] Site-specific trawl data from 2008 to 2021 were obtained directly from NOAA and NJDEP for trawl surveys that overlapped with the Offshore Project Area (Lease Area, Monmouth ECC, Northern ECC, including the branches which extend to New York and the Asbury Branch which extends to New Jersey).

Homes 2004). Longfin and shortfin squid species have designated EFH in the Offshore Project Area (see Section 4.6.1.6).

Atlantic brief squid were collected during fall NEFSC trawl surveys in the Lease Area and during spring surveys in the ECCs. Brief squid were also occasionally collected in the Monmouth ECC in the fall and the Northern ECC in the spring. All brief squid recorded in NJOSAP trawls were collected during fall surveys. This species of squid, however, is more commonly found in waters south of Maryland (Chesapeake Bay Program 2020). NOAA has not established EFH for brief squid.

Although squid have the potential to be present in the Offshore Project Area, based on vessel monitoring system (VMS) data used for monitoring commercial squid vessel activity as well as vessel trip report (VTR) data for the Lease Area and ECCS, very little squid vessel effort occurs in the Offshore Project Area except for a small area of high vessel density along the Monmouth ECC offshore of the Manasquan Inlet (see Section 7.4 Commercial Fisheries and For-Hire Recreational Fishing).[35] Given this lower level of commercial fishing activity for a lucrative species, squid may be more abundant in surrounding waters outside of the Offshore Project Area.

### 4.6.1.5 Threatened and Endangered Fish

Five Federally listed threatened or endangered fish species are listed by NOAA as occurring in the New England/Mid-Atlantic region: Atlantic salmon (*Salmo salar)*, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), giant manta ray (*Manta birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), and shortnose sturgeon (*Acipenser brevirostrum*) (NOAA 2021a). Oceanic whitetip sharks are not known to occur in the Offshore Project Area and are reported to live in the open ocean in water depths greater than 600 ft (183 m) (NOAA 2021a), which is deeper than the water depth range in the Offshore Project Area. Atlantic salmon are also not expected to occur in the Offshore Project Area. According to the NOAA ESA Section 7 Mapper, the spatial range of Atlantic salmon does not extend south of the coast of New Hampshire (NOAA 2020b). Since the Offshore Project Area is outside the habitat range of the oceanic whitetip shark and the distribution range of the Atlantic salmon, and no critical habitat is identified within the Offshore Project Area, further evaluation of these two species in this section is not warranted. The remaining three species are evaluated for potential occurrence in the Offshore Project Area in Table 4.6-4 and the following subsections.

The likelihood of occurrence of Atlantic sturgeon, giant manta ray, and shortnose sturgeon within the Offshore Project Area is based on NOAA-published sources and literature reviews. The definitions for likelihood are as follows:

- Unlikely – species range does not overlap with the Offshore Project Area or the Offshore Project Area lacks suitable habitat;

[35] VMS data presented in Section 7.4 Commercial Fisheries and For Hire Recreational Fishing depict relative vessel density between 2015 and 2016.

- Low – species range overlaps with the Offshore Project Area and the Offshore Project Area contains marginally suitable habitat; and
- Moderate – species range overlaps with the Offshore Project Area and the Offshore Project Area contains suitable habitat.

### Table 4.6-4. List of Threatened and Endangered Species with Ranges that have Potential to Overlap the Offshore Project Area

| Species (Scientific Name) | ESA Status | Likelihood of Occurrence |
|---|---|---|
| Atlantic sturgeon (*Acipenser oxyrhynchus*) | Endangered | Moderate |
| Giant manta ray (*Manta birostris*) | Threatened | Low |
| Shortnose sturgeon (*Acipenser brevirostrum*) | Endangered | Unlikely |

Additional threatened and endangered species that are not expected to occur in the Offshore Project Area, but could be impacted by vessel movement to and from port facilities include endangered smalltooth sawfish (*Pristis pectinate)*, threatened gulf sturgeon (*Acipenser oxyrhynchus desotoi*), threatened Nassau grouper (*Epinephelus striatus)*, and threatened scalloped hammerhead shark (*Sphyrna lewini*). Potential impacts to these species are addressed in Section 4.6.2.8.

**Atlantic Sturgeon**

The Atlantic sturgeon was listed as a Federally endangered species in 2012. There are five distinct population segments (DPS) for the Atlantic sturgeon including: the Carolina DPS, Chesapeake Bay DPS, New York Bight DPS, South Atlantic DPS, and the Gulf of Maine DPS. These DPSs are listed as endangered, except for the Gulf of Maine DPS which is listed as threatened. Based on recent reviews of fishery-independent data and DNA analyses, all five DPS segments could be present in the New York Bight, and therefore within the northern extent of the Project Area (White et.al 2021). Primary threats to Atlantic sturgeon include degraded water quality, habitat impacts from dredging, bycatch in commercial fisheries, and vessel strikes (Federal Register 2012).

Atlantic sturgeon is an anadromous species that spends much of its life in estuarine and marine waters and migrates to freshwater to spawn. They can be found along rivers and nearshore habitats from Canada to Florida (Federal Register 2012; BOEM 2012). The distribution of Atlantic sturgeon changes seasonally within the Mid-Atlantic Bight. During fall and spring, aggregations of Atlantic sturgeon can be found near the mouths of large bays, in water depths less than 20 meters (Dunton et al. 2010). During the winter, these aggregations disperse. Many surveys have linked Atlantic sturgeon distribution to water depth, temperature, and salinity. In addition, Stein, Freidland, and Sutherland (2004a) found that Atlantic sturgeon distribution is strongly associated with prey availability rather than substrate type (e.g., sandy versus rocky bottom). Specifically, along the coast of New Jersey, Atlantic sturgeon feed on a variety of prey such as polychaetes, isopods, shrimp, and mollusks (Johnson et al. 1997).

Spawning timing differs geographically for Atlantic sturgeon. Spawning takes place in the spring or early summer in the northern rivers between Canada and the Delaware River. South of the Delaware River, spawning occurs in late summer and fall (NOAA 2020c). Eggs will strongly adhere to rocks, weeds, and other submerged objects (Gilbert 1989). Once the eggs hatch into larvae, they live along the bottom of the riverbed and drift downstream until they reach brackish water where they can reside as juveniles for 1 to 5 years before moving into nearshore coastal waters (NOAA 2020c).

Stein, Friedland, and Sutherland (2004b) analyzed Atlantic sturgeon bycatch rates in fisheries along the northeastern coastline of the U.S. to predict species distribution and habitat preference. The greatest bycatch rates were found between depths of 33 to 164 ft (10 to 50 m), along gravel or sandy sediment. Similar depths and sediment are found within the Offshore Project Area.

There is no Federally regulated Critical Habitat for Atlantic sturgeon that overlaps with the Offshore Project Area (NOAA 2020b). The Northern ECC branches that extend to New York are located approximately 0.5 mi (0.8 km) south of the Hudson River, a common spawning river for Atlantic sturgeon. Due to the proximity of the Offshore Project Area and identified spawning grounds for Atlantic sturgeon, it is possible that Atlantic sturgeon could migrate through the Offshore Project Area on their way to or from this spawning site. The Offshore Project Area could also provide foraging habitat given prey availability such as crustaceans, mollusks, and sand lance (NOAA 2020c, Stein et al. 2004a). Spawning adults can be found in the marine environment during the fall and winter, while non-spawning adults may remain in the marine environment during the fall, winter and summer (Stein et al. 2004a).

**Giant Manta Ray**

The giant manta ray was listed as a Federally threatened species in 2018 (Federal Register 2018). Giant manta rays are a slow growing, migratory species. Movement of giant manta rays is dependent on zooplankton movement, current circulation, tidal patterns, seasonal upwelling, seawater temperature, and mating behavior. Giant manta rays can be found in offshore, oceanic, and nearshore habitats along the Western Atlantic coast and Pacific Islands in small, highly fragmented populations (NOAA 2020c).

Threats to giant manta rays include overutilization by foreign commercial and artisanal fisheries and insufficient enforcement or lack of adequate regulatory mechanisms among foreign nations to protect manta rays from heavy fishing pressure and related mortality in waters outside of U.S. jurisdiction (Federal Register 2018). Giant manta rays are often targeted or caught as bycatch in global fisheries operating within their habitat range. In addition to fishing impacts, recent research suggests that vessel strikes may be another threat facing manta ray species (McGregor et al. 2019). Given their low reproductive output (i.e., one pup every 2 to 3 years), giant manta ray populations are vulnerable to depletion (NOAA 2020c).

Within the last century, giant manta rays have been observed as far north as New Jersey, so occurrence in the Offshore Project Area is possible. In the past, giant manta rays had been rarely sighted further north, such as near Block Island off the Rhode Island coast (Gudger, 1922). However, New Jersey currently represents the northern boundary of manta ray distribution and given their migratory nature, manta rays are likely to occur only on a transitory basis within the Offshore Project Area (NOAA 2016). A recent study by Farmer et al. (2022) evaluated the distribution of giant manta rays off the Eastern U.S. by integrating decades of survey data and sightings from numerous sources, including surveys ranging as far north as Maine. Over 5,000 reported manta ray sightings were identified in the Eastern U.S. from 1925-2020, with sightings recorded only as far north as New Jersey with the bulk of sightings recorded between 26° and 30° N (off the coast of Florida). A species distribution model was developed using these sightings. Though sightings were only recorded as far north as New Jersey, results of the model indicated that there is a non-zero probability that giant manta ray may occur in waters as far north as Nantucket from June through October. Individuals would be expected to most frequently occur either nearshore or along the continental shelf edge (Farmer et al., 2022).

**Shortnose Sturgeon**

The shortnose sturgeon was listed as a Federally endangered species in 1967. Shortnose sturgeon are an anadromous species that travel between rivers and coastal waters along the coastline from Canada to Florida (NMFS 1998). The shortnose sturgeon can be found in 41 bays and rivers along the east coast and have been documented to spawn in approximately 19 rivers (NOAA 2020c). Primary threats to the shortnose sturgeon include habitat degradation, water pollution, dredging, water withdrawal, fisheries bycatch, and habitat impediments restricting access to spawning habitat (e.g., dams) (NMFS 1998; BOEM 2012; NOAA 2020c). A recovery plan was created in 1998 which focuses on maintenance of essential habitat, and the minimization and monitoring of mortality (NMFS 1998).

There are no known shortnose sturgeon populations in rivers between the Hudson and Delaware Rivers (NMFS 1998) and therefore no populations in New Jersey coastal rivers. The closest population to the Offshore Project Area is the Hudson River population, within the Mid-Atlantic metapopulation (NOAA 2020c, NMFS 1998). Shortnose sturgeon migratory activities occur in the spring and winter, coinciding with spawning events. Spawning takes place in the Hudson River between April and May (NYSDEC 2022). Once laid, the eggs adhere to rocks, weeds, or other submerged objects (Gilbert 1989). After spawning, adults typically move quickly downstream to the lower reaches of rivers or estuaries (NYSDEC 2022).

The Offshore Project Area is not located within any shortnose sturgeon spawning areas; however as previously stated, the closest spawning location is in the Hudson River, approximately 0.5 mi (0.8 km) north of the Northern ECC. Though the Northern ECC branches that extend to New York are in proximity to the Hudson River, there is no Federally regulated Critical Habitat for shortnose sturgeon that overlaps with the Offshore Project Area (NOAA 2020b). Shortnose sturgeon could migrate through the Offshore Project Area on their way to or from spawning sites. Within the Offshore Project Area, they are most likely to be found in the Northern ECC branches that extend to New York given their proximity to the Hudson River and the species preference for estuarine habitat. Shortnose sturgeon also have the potential to be located in coastal waters in and around the ECCs, a phenomenon that had been observed in populations further north in Maine (Dionne et al. 2013). Shortnose sturgeon presence in the offshore areas of the Lease Area, Monmouth ECC, and Northern ECC is unlikely due to its lack of river or estuarine features (Geo-Marine 2010).

### 4.6.1.6 Essential Fish Habitat

EFH is an important part of the Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA) regulations and is defined as: "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. § 1802(10)). NOAA further clarifies the terms in this definition as follows (50 CFR 600.10):

- Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate.
- Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.
- Spawning, breeding, feeding, or growth to maturity covers a species' full life cycle.

EFH data were downloaded from the NOAA Fisheries Essential Fish Habitat Data Inventory for the Essential Fish Habitat Mapper, an online mapping application (NOAA 2021c). The data were then queried using GIS software to obtain results for EFH designations in the Lease Area, Monmouth ECC, and Northern ECC Within these areas that encompass the Offshore Project Area, a total of 36 fish and five invertebrate species have designated EFH for various life stages. Table 4.6-5 summarizes the life stages of each species that has designated EFH within the Lease Area, Monmouth ECC, and Northern ECC, while Table 4.6-6 summarizes EFH designations within the Northern ECC Branches, as defined by NOAA's EFH Mapper. If a life stage for a particular species is checked as potentially present in one of the offshore project areas, then some or all of that area overlaps with designated EFH for that life stage and species.

NOAA Fisheries also defines habitat areas of particular concern (HAPC) as a subset of EFH for areas that exhibit one or more of the following traits: rare, stressed by development, provides important ecological functions for Federally managed species, or is especially vulnerable to anthropogenic degradation. HAPC has the potential to occur in the Offshore Project Area within the nearshore reaches of the Monmouth ECC and Northern ECC for summer flounder (*Paralichthys dentatus*) (Figure 4.6-3); however, HAPC for summer flounder only occurs within areas designated as adult and juvenile summer flounder EFH if that area contains submerged aquatic vegetation (SAV). The definition of summer flounder HAPC is "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH is HAPC. If native species of SAV are eliminated then exotic species should be protected because of functional value; however, all efforts should be made to restore native species." According to available mapping from NOAA, which compiles data from state and local sources, including state maps published by the NJDEP, no known areas of SAV exist along the Northern ECC Branches (NOAA, 2020a, NJDEP 2023). However, the presence of SAV is possible in shallow parts of the ECCs, where the export cables make landfall. If SAV were present, it could serve as habitat for summer flounder.

If summer flounder habitat is identified in the Offshore Project Area, Atlantic Shores will coordinate with BOEM and NOAA Fisheries to avoid and minimize potential effects from Project activities.

One additional area of HAPC in the vicinity of the Offshore Project Area is for sandbar sharks (*Carcharhinus plumbeus*) around the area of Great Bay, an area that has been designated as pupping and nursey grounds for sandbar sharks (Figure 4.6-3). Though this HAPC is located approximately 8 miles west of the Offshore Project Area, vessels transiting to and from existing O&M infrastructure in Atlantic County, New Jersey would cross these areas. However, it should be noted that vessel traffic is common off the coast of Atlantic County, including within Absecon Channel which contains mapped HAPC and is located adjacent to existing O&M infrastructure that may be used for the Project. Vessel traffic from the Project is not expected to significantly increase existing vessel traffic off the coast of Atlantic County, New Jersey, therefore impacts to sandbar HAPC are not expected and not discussed further in this report.

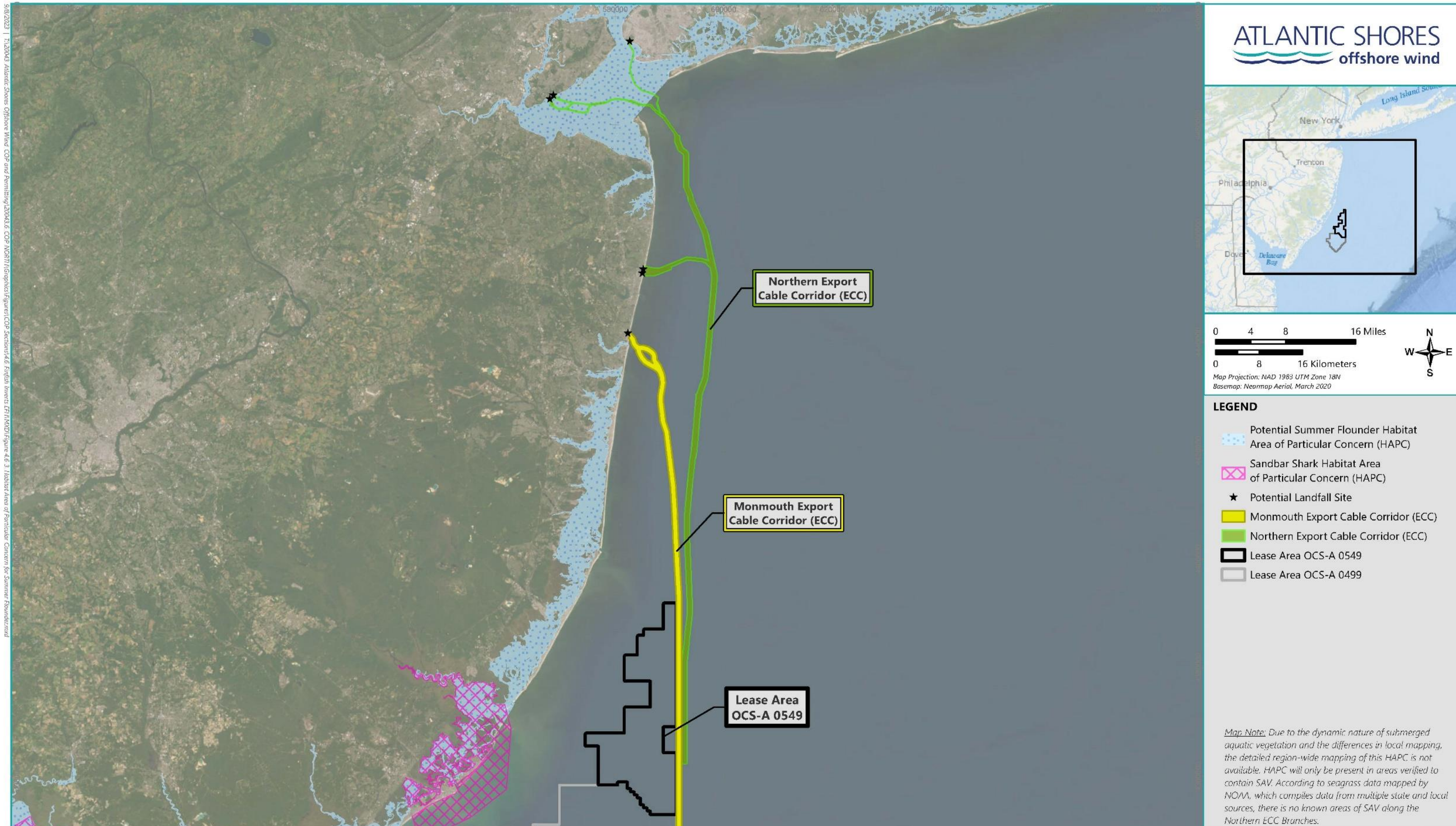



**Figure 4.6-3**

*Potential Habitat Area of Particular Concern for Summer Flounder and Sandbar Shark*

## Table 4.6-5. EFH Designations for Species in the Offshore Project Area[1]

| Species and Life Stages | Eggs | | | Larvae/ Neonate | | | Juvenile | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC |
| **New England Finfish Species** | | | | | | | | | | | | |
| Atlantic Cod (*Gadus morhua*) | | X | X | X | X | X | | | | X | X | X |
| Atlantic Herring (*Clupea harengus*) | | | | | | | X | X | X | X | X | X |
| Clearnose Skate (*Raja eglanteria*) | | | | | | | X | X | X | X | X | X |
| Haddock (*Melanogrammus aeglefinus*) | | | | | | | X | X | X | | | |
| Little Skate (*Leucoraja erinacea*) | | | | | | | X | X | X | X | X | X |
| Monkfish (*Lophius americanus*) | X | X | X | X | X | X | | | | X | X | X |
| Ocean Pout (*Macrozoarces americanus*) | X | X | X | | | | | | | X | X | X |
| Pollock (*Pollachius virens*) | | | | | X | X | | | | | | |
| Red Hake (*Urophycis chuss*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Silver Hake (*Merluccius bilinearis*) | X | X | X | X | X | X | | | | X | X | X |
| White Hake (*Urophycis tenuis*) | | | | | | | | | | X | X | X |
| Windowpane Flounder (*Scophthalmus aquosus*) | X | X | X | X | X | X | X | X | X | X | X | X |

| Species and Life Stages | Eggs | | | Larvae/ Neonate | | | Juvenile | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC |
| Winter Flounder (*Pseudopleuronectes americanus*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Winter Skate (*Leucoraja ocellate*) | | | | | | | X | X | X | X | X | X |
| Witch Flounder (*Glyptocephalus cynoglossus*) | X | X | X | X | X | X | | | | X | X | X |
| Yellowtail Flounder (*Limanda ferruginea*) | X | X | X | X | X | X | X | X | X | X | X | X |
| **Mid-Atlantic Finfish Species** | | | | | | | | | | | | |
| Atlantic Butterfish (*Peprilus triacanthus*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Atlantic Mackerel (*Scomber scombrus*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Black Sea Bass (*Centropristis striata*) | | | | X | X | X | X | X | X | X | X | X |
| Bluefish (*Pomatomus saltatrix*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Scup (*Stenotomus chrysops*) | | | | | | | X | X | X | X | X | X |
| Spiny Dogfish[3] (*Squalus acanthias*) | | | | | | | | | | X | X | X |
| Summer Flounder (*Paralichthys dentatus*) | X | X | X | X | X | X | X | X | X | X | X | X |
| **New England Invertebrate Species** | | | | | | | | | | | | |

| Species and Life Stages | Eggs | | | Larvae/ Neonate | | | Juvenile | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC |
| Atlantic Sea Scallop *(Placopecten magellanicus)* | X | X | X | X | X | X | X | X | X | X | X | X |
| **Mid-Atlantic Invertebrate Species** | | | | | | | | | | | | |
| Atlantic Surfclam (*Spisula solidissima*) | | | | | | | X | X | X | X | X | X |
| Longfin Inshore Squid (*Doryteuthis pealeii*) | X | X | X | | | | X | X | X | X | X | X |
| Northern Shortfin Squid *(Illex illecebrosus*) | | | | | | | X | X | X | | | |
| Ocean Quahog (*Arctica islandica*) | | | | | | | | | | X | X | X |
| **Highly Migratory Species** | | | | | | | | | | | | |
| **Tunas** | | | | | | | | | | | | |
| Albacore Tuna (*Thunnus alalunga*) | | | | | | | X | X | X | | | |
| Bluefin Tuna (*Thunnus thynnus*) | | | | | | | X | X | X | | X | X |
| Skipjack Tuna (*Katsuwonus pelamis*) | | | | | | | X | X | X | X | X | X |
| Yellowfin Tuna (*Thunnus albacares*) | | | | | | | X | X | X | | | |
| **Sharks** | | | | | | | | | | | | |
| Blue Shark (*Prionace glauca*) | | | | | | | | X | | | X | |
| Common Thresher Shark (*Alopias vulpinus*) | | | | X | X | X | X | X | X | X | X | X |
| Dusky Shark (*Carcharhinus obscurus*) | | | | X | X | X | X | X | X | X | X | X |

| Species and Life Stages | Eggs | | | Larvae/ Neonate | | | Juvenile | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC | Lease | M.ECC | N.ECC |
| Sand Tiger Shark (*Carcharias taurus*) | | | | X | X | X | X | X | X | | | |
| Sandbar Shark (*Carcharhinus plumbeus*) | | | | X | X | X | X | X | X | X | X | X |
| Shortfin Mako Shark (*Isurus oxyrinchus*) | | | | X | X | X | X | X | X | X | X | X |
| Smoothhound Shark Complex (Atlantic Stock) (*Mustelus canis*) | | | | X | X | X | X | X | X | X | X | X |
| Tiger Shark (*Galeocerdo cuvieri*) | | | | | | | X | X | X | X | X | X |
| White Shark (*Carcharodon carcharias*) | | | | X | X | X | | X | X | | X | X |
| **South Atlantic Finfish Species** | | | | | | | | | | | | |
| King Mackerel (*Scomberomorus cavalla*) | X | X | X | X | X | X | X | X | X | X | X | X |
| Spanish Mackerel (*Scomberomorus maculatus*) | X | X | X | X | X | X | X | X | X | X | X | X |

[1] For the purpose of this analysis, the Offshore Project Area is separated into three parts: Lease Area, Monmouth ECC, and Northern ECC.
[2] M.ECC- Monmouth ECC; N.ECC – Northern ECC
[3] Spiny dogfish EFH can be further broken down by sub-male and sub-female life stages. These life stages refer to smaller adults that are not full grown. These stages have a different spatial distribution than full-grown adults. Spiny dogfish sub-female and sub-male EFH can be found in the Lease Area, Monmouth ECC, and Northern ECC.
[4] Based on consultations with NOAA, EFH for king and Spanish mackerel occurs in the Mid-Atlantic Bight, and therefore was added to the analysis; however, based on a review of available data, EFH for these species does not exist in the Offshore Project Area.

## Table 4.6-6. EFH Designations for Species in the Northern ECC Branches[1]

| Species and Life Stages | Eggs | | | | Larvae/Neonate | | | | Juvenile | | | | Adult | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | W | L | F | A | W | L | F | A | W | L | F | A | W | L | F |
| **New England Finfish Species** | | | | | | | | | | | | | | | | |
| Atlantic Cod (*Gadus morhua*) | X | X | X | X | X | X | X | X | | | | | X | | | |
| Atlantic Herring (*Clupea harengus*) | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| Clearnose Skate (*Raja eglanteria*) | | | | | | | | | X | X | X | X | X | X | X | X |
| Little Skate (*Leucoraja erinacea*) | | | | | | | | | X | X | X | X | X | X | X | X |
| Monkfish (*Lophius americanus*) | X | X | X | X | X | X | X | X | | | | | | | | |
| Ocean Pout (*Macrozoarces americanus*) | X | X | X | X | | | | | | | | | X | X | X | X |
| Red Hake (*Urophycis chuss*) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Silver Hake (*Merluccius bilinearis*) | X | X | X | X | X | X | X | X | | | | | X | X | X | X |
| Windowpane Flounder (*Scophthalmus aquosus*) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Winter Flounder | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

| Species and Life Stages | Eggs | | | | Larvae/Neonate | | | | Juvenile | | | | Adult | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | W | L | F | A | W | L | F | A | W | L | F | A | W | L | F |
| (*Pseudopleuronectes americanus*) | | | | | | | | | | | | | | | | |
| Winter Skate (*Leucoraja ocellate*) | | | | | | | | | X | X | X | X | X | X | X | X |
| Witch Flounder (*Glyptocephalus cynoglossus*) | X | | | | | X | X | X | | | | | | | | |
| Yellowtail Flounder (*Limanda ferruginea*) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Mid-Atlantic Finfish Species** | | | | | | | | | | | | | | | | |
| Atlantic Butterfish (*Peprilus triacanthus*) | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | X |
| Atlantic Mackerel (*Scomber scombrus*) | X | X | X | X | | X | X | X | | X | X | X | X | X | X | X |
| Black Sea Bass (*Centropristis striata*) | | | | | X | | | | X | X | X | X | X | X | X | X |
| Bluefish (*Pomatomus saltatrix*) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Scup (*Stenotomus chrysops*) | | X | X | X | | X | X | X | X | X | X | X | X | X | X | X |
| Spiny Dogfish[3] | | | | | | | | | | | | | X | X | X | X |

| Species and Life Stages | Eggs | | | | Larvae/Neonate | | | | Juvenile | | | | Adult | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **A** | **W** | **L** | **F** | **A** | **W** | **L** | **F** | **A** | **W** | **L** | **F** | **A** | **W** | **L** | **F** |
| (*Squalus acanthias*) | | | | | | | | | | | | | | | | |
| Summer Flounder (*Paralichthys dentatus*) | X | | | | X | X | X | X | X | X | X | X | X | X | X | X |
| **New England Invertebrate Species** | | | | | | | | | | | | | | | | |
| Atlantic Sea Scallop *(Placopecten magellanicus)* | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Mid-Atlantic Invertebrate Species** | | | | | | | | | | | | | | | | |
| Atlantic Surfclam (*Spisula solidissima*) | | | | | | | | | X | | | | X | | | |
| Longfin Inshore Squid (*Doryteuthis pealeii*) | X | X | X | X | | | | | X | X | X | X | X | X | X | X |
| Ocean Quahog (*Arctica islandica*) | | | | | | | | | | | | | X | X | X | X |
| **Highly Migratory Species** | | | | | | | | | | | | | | | | |
| Tunas | | | | | | | | | | | | | | | | |
| Bluefin Tuna (*Thunnus thynnus*) | | | | | | | | | X | | | | X | | | |
| Skipjack Tuna (*Katsuwonus pelamis*) | | | | | | | | | X | | | | X | X | X | X |
| Sharks | | | | | | | | | | | | | | | | |

| Species and Life Stages | Eggs | | | | Larvae/Neonate | | | | Juvenile | | | | Adult | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | W | L | F | A | W | L | F | A | W | L | F | A | W | L | F |
| Common Thresher Shark (*Alopias vulpinus*) | | | | | X | X | X | X | X | X | X | X | X | X | X | X |
| Dusky Shark (*Carcharhinus obscurus*) | | | | | X | X | X | X | X | | | | X | | | |
| Sand Tiger Shark (*Carcharias taurus*) | | | | | X | X | X | X | X | X | X | X | | | | |
| Sandbar Shark (*Carcharhinus plumbeus*) | | | | | X | | | | X | X | X | X | X | X | X | X |
| Shortfin Mako Shark (*Isurus oxyrinchus*) | | | | | X | | | | X | | | | X | | | |
| Smoothhound Shark Complex (Atlantic Stock) (*Mustelus canis*) | | | | | X | X | X | X | X | X | X | X | X | X | X | X |
| Tiger Shark (*Galeocerdo cuvieri*) | | | | | | | | | X | | | | X | | | |
| White Shark (*Carcharodon carcharias*) | | | | | X | | | | X | X | X | X | X | X | X | X |

[1] The Northern ECC is broken into four potential branches: A – Asbury; W – Wolfe Pond; L – Lemon Creek; F – Fort Hamilton.

[2] The Asbury Branch contains two landfall options, however due to their close proximity, the routes to both landfalls are collectively referred and analyzed under the Asbury Branch.

[3] Spiny dogfish EFH can be further broken down by sub-male and sub-female life stages. These life stages refer to smaller adults that are not full grown. These stages have a different spatial distribution than full-grown adults. Spiny dogfish sub-female EFH is mapped within all Northern ECC branches. No sub-male EFH is located in the Northern ECC Branches.

### 4.6.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect finfish and pelagic invertebrate resources, and their respective EFH, during Project construction, operations and maintenance (O&M), or decommissioning are presented in Table 4.6-7.

**Table 4.6-7. Impact Producing Factors for Finfish and Pelagic Invertebrates**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Installation and maintenance of new structures and cables | ● | ● | ● |
| Anchoring and jack-up vessels | ● | ● | ● |
| Noise | ● | ● | ● |
| Electromagnetic fields | | ● | |
| Light | ● | ● | ● |
| Presence of structures and cables | | ● | ● |
| OSS Operation | | ● | ● |
| Vessel movement | ● | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for impacts to finfish and pelagic invertebrate resources and EFH is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I), assuming the use of all piled foundations for the assessment of underwater noise. Potential impacts from offshore spills, discharges, and accidental releases are considered to have a low likelihood of occurrence and are discussed in Section 9.2.3. Section 3.2 Water Quality provides further detail on measures to minimize the potential for drilling fluid release and frac-outs during horizontal directional drilling (HDD) installation at the landfall sites, including the development of an HDD Contingency Plan.

Due to the important conservation status of the threatened and endangered species that have the potential to occur in the Offshore Project Area, a brief discussion of potential effects to these species is provided. As described in Section 4.6.1.5, based on their range and habitat preference, it is unlikely for the endangered shortnose sturgeon to occur in the Offshore Project Area. Therefore, potential impacts from Project activities to protected finfish species were only considered for Atlantic sturgeon and giant manta ray.

Potential Project-related impacts to the Atlantic sturgeon and giant manta ray would not be materially different from those described for other fish species in the following subsections. As described in Section 4.6.1.5, no spawning areas or Federally regulated Critical Habitat for Atlantic sturgeon overlap with the Offshore Project Area (NOAA 2020b). Therefore, no eggs or larvae of Atlantic sturgeon are expected to be present in the Offshore Project Area. Seasonal migratory patterns allow the potential for juvenile and/or adult Atlantic sturgeon to be present in the Offshore Project Area. However, they are not expected to be a regular visitor or occupant in large numbers. Similarly, giant manta rays may occur only on a transitory basis in the Offshore Project Area given that New Jersey represents the northern boundary of their distribution, and they are migratory in nature (NOAA 2016, Farmer et al. (2022). Where relevant, IPFs evaluated in the following subsections identify how Project activities may affect Atlantic sturgeon and giant manta ray.

#### 4.6.2.1 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new foundation structures and offshore cables includes installation of associated scour and cable protection. These activities may affect finfish and pelagic invertebrate resources and EFH through direct seafloor disturbance and temporary increases in suspended sediment and deposition; however, as evident from environmental assessments and surveys performed in the Offshore Project Area, this area is dynamic in nature and experiences regular disturbance from natural (e.g., waves, storms, mobile sediment) and anthropogenic (e.g., fishing and vessel activity) sources. In addition, the area of disturbance will be small relative to the total area of surrounding habitat.

This section focuses on the temporary direct and indirect disturbances that will primarily occur during the construction phase. Section 4.6.2.6 addresses permanent seafloor disturbance from the footprints of foundations, scour protection, and offshore cable protection that will result in habitat conversion of primarily sandy substrate to hard substrate. The O&M phase is expected to have significantly lower seafloor disturbance than Project construction. During O&M, Project components will be carefully monitored as described in Volume I, Section 5.0. If portions of buried offshore cables require maintenance, the sediment cover may need to be removed temporarily for inspection and possible replacement of a portion of the cable. These activities would temporarily disturb the seafloor but would be short-term and extremely localized. The decommissioning phase is expected to have similar, but less seafloor disturbance than Project construction.

**Temporary Habitat Loss and Disturbance from Direct Seafloor Disturbance**

Benthic habitat will be temporarily disturbed during construction. However, as evidenced by site-specific HRG and benthic survey images conducted for the Project, this area is dynamic in nature and exhibits wide-spread bottom disturbance from existing marine uses and mobile sediment. The species and habitat in the Offshore Project Area, including EFH, are adapted to disturbance and are expected to recover in the short-term. In addition, the area of disturbance is small relative to the total area of available surrounding habitat (Table 4.6-8).

Seafloor-disturbing activities during construction of the wind turbine generator (WTG) and offshore substation (OSS) foundations include jack-up vessel positioning and anchoring (impacts described in Section 4.6.2.2), seabed preparation, foundation placement, and scour protection installation. Seabed preparation may be required for gravity-based foundations or in areas with large sand bedforms. Seafloor-disturbing activities during installation of the offshore cables include anchoring, pre-installation activities (e.g., sand bedform removal, boulder relocation, and a pre-lay grapnel run), offshore cable installation, cable protection installation, where needed, and excavation of the HDD pit. Detailed methodologies for conducting these activities are described in Section 4.0 of Volume I.

The maximum area of seabed disturbance associated with these activities in the Offshore Project Area is summarized in Table 4.6-8. Based on the range of activities in the Project lifecycle associated with the maximum case PDE, the total area of temporary seafloor disturbance (not including the area of the seafloor that will be permanently occupied by structures or cables [see Section 4.6.2.6]) in the Lease Area is 4.0 square miles ($mi^2$) (10.36 square kilometers [$km^2$]), which represents only approximately 3.2% of the 126.76 $mi^2$ (328.3 $km^2$) Lease Area. The total temporary seafloor disturbance in the Monmouth ECC is 2.21 $mi^2$ (5.73 $km^2$) and the total temporary seafloor disturbance in the Northern ECC is 3.0 $mi^2$ (7.76 $km^2$), for a total temporary disturbance of 5.21 $mi^2$ (13.5 $km^2$) for both ECCs combined (Table 4.6-8). This estimated area of disturbance represents approximately 5.5% of the entire ECC area which is small relative to the total area of available surrounding habitat in the Lease Area and ECCs. Temporary direct seabed disturbance from the Project will be limited to these areas.

### Table 4.6-8. Maximum Total Seabed Disturbance

| Offshore Project Area Component | Maximum Area of Seafloor Disturbance | | |
|---|---|---|---|
| | Permanent Disturbance | Additional Temporary Disturbance | Total |
| Maximum Total Seabed Disturbance in the Lease Area[1, 2, 3] | 1.38 $mi^2$ (3.58 $km^2$; 883 ac) | 4.00 $mi^2$ (10.36 $km^2$; 1,920 ac) | 5.38 $mi^2$ (13.93 $km^2$; 3,443 ac) |
| Maximum Total Seabed Disturbance in the ECCs[4] | 0.75 $mi^2$ (1.94 $km^2$; 480 ac) | 5.21 $mi^2$ (13.5 $km^2$; 3,334 ac) | 5.96 $mi^2$ (15.44 $km^2$; 3,814 ac) |
| Monmouth ECC | 0.35 $mi^2$ (0.90 $km^2$; 224 ac) | 2.21 $mi^2$ (5.73 $km^2$; 1,411 ac) | 2.56 $mi^2$ (6.63 $km^2$; 1,638 ac) |
| Northern ECC[5] | 0.40 $mi^2$ (1.04 $km^{2;}$ 256 ac) | 3.00 $mi^2$ (7.76 $km^2$; 1,920 ac) | 3.40 $mi^2$ (8.80 $km^2$; 2,195 ac) |

Notes:

Basis of Calculations is described in detail in Sections 4.5 and 4.11 of Volume I.

[1] Impacts calculations in the Lease Area include impacts from seabed preparation activities, which may include dredging operations. A total area of 111,987.6 square feet (10,404.0 square meters) per foundation, assuming the use of a suction bucket jacket foundation, may be required for seabed preparation activities. Assuming the use of 157 wind turbine foundations, the total area of seabed preparation that would be required totals approximately 17.5 million square feet (1.6 million square meters). The total volume of material anticipated for seabed preparation is approximately 1.1 million cubic yards (861,634 cubic meters).

[2] Total impact calculations within the Lease Area include seabed preparation activities, which may include dredging operations, around the OSS foundations. A total area of 369,676 square feet (34,344 square meters) around each OSS foundation, assuming the use of three large OSS with a suction bucket jacket foundation, may be subject to seabed preparation. Assuming the use of three large OSS foundations, a total area of 1.1 million square feet (103,032 square meters) may be required for seabed preparation activities. The total volume of material anticipated for seabed preparation is approximately 135,000 cubic yards (103,214 cubic meters).

[3] Total impact calculations in the Lease Area account for dredging activities along the inter-array and interlink cables. Along the inter-array and inter-link cables, dredging activities would total approximately 0.67 square miles (1.73 square kilometers) and 0.18 square miles (0.46 square kilometers), respectively. These activities will result in a total of approximately 2.2 million (1.7 million cubic meters) cubic yards and 588,600 cubic yards (450,000 cubic meters) of dredged material from inter-array and inter-link cable installation, respectively.

[4] Impact values within the ECC includes impacts from dredging activities. Along the Monmouth and Northern ECC, dredging activities would total approximately 0.96 square miles (2.48 square kilometers) and 1.19 square miles (3.08 square kilometers), respectively. These activities will result in a total of approximately 3.2 million cubic yards (2.4 million cubic meters) and 4.0 million cubic yards (3.0 million cubic meters) of dredged material for the Monmouth and Northern ECC, respectively.

[5] Disturbance values for the Northern ECC include four export cables extending to the Asbury branch and three extending to the New York Landfall sites.

Given the dynamic nature of sediment processes and existing disturbances in the Offshore Project Area, Project seabed disturbing activities are expected to create only temporary and localized alterations to the seafloor habitat. The benthic community associated with the fine, medium, and gravelly sand that dominates the Offshore Project Area is expected to rapidly recover following construction (Brooks et al. 2004, Guarinello et al. 2017, Guida et al. 2017). A review of studies of the recovery and recolonization along the U.S. East Coast by Brooks et al. (2004) reported that recovery of benthic assemblages to background levels following dredging disturbance can range from 3 months to 2.5 years with recovery time dependent on site-specific taxa, type of sediment disturbance, and environmental conditions. Fine grain sediments typically recover to pre-disturbance conditions more quickly, in a matter of months, than sand and gravel sediments which may take 2-3 years to recover (Wilber and Clarke 2007). One study, which examined the impacts of mobile fishing gear on benthic habitat recovery, found that the recovery of benthic habitat will vary based on the frequency, severity, and spatial extent of disturbance (Watling and Norse 1998). BOEM (2021) reported that benthic assemblages subjected to physical disturbance in soft sediment communities typically recover in 6 to 18 months through dispersal from adjacent areas, assuming the affected area is not disturbed during the recolonization period. The Project will be isolated within the Offshore Project Area, which is a relatively small area compared to the surrounding environment. Additionally, disturbances from the Project will primarily occur during the construction phase, therefore the frequency of disturbance to the benthic habitat would be relatively low. Therefore, Project-related seabed disturbance is unlikely to result in long-term adverse effects to benthic habitat or displacement of finfish or invertebrate species. These habitats have persisted through natural and anthropogenic disturbances (e.g., vessel traffic and fishing activities) and the finfish, invertebrate, and EFH species in these dynamic areas are adapted to survive periodic disturbances (Guida et al. 2017) similar to those associated with Project activities. For these reasons, Project-related impacts from the installation and maintenance of structures and cables to the benthic community, which supports benthic and demersally oriented finfish species and their EFH, are expected to be temporary and localized.

For those locations in the Offshore Project Area identified by site-specific surveys as complex habitat, the installation and maintenance of new structures, cables, and associated vessel anchoring and jacking activities could result in longer-term effects to finfish habitat, including EFH, because complex habitats are reported to have longer recovery times than areas with soft sediment (HDR 2020). In areas that are not adapted to severe disturbances at frequent intervals, marine organisms may have less ability to withstand disturbance (Watling and Norse 1998); however, the Project represents a one-time disturbance that is limited in its spatial extent. Freese et al. (1999) conducted a single trawl pass in an area of hard-bottom habitat in Alaska that had recently experienced no or minimal trawling activity. Immediate changes to habitat and the benthic community consisted of boulder displacement and removal and damage of large epifaunal invertebrates, sponges, and anthozoans; however, there were not significant impacts to mobile invertebrate densities and individuals were not obviously damaged (Freese et al. 1999). Mapped complex habitat in the Lease Area, Monmouth ECC, and Northern ECC is reported in site-specific benthic grab and video surveys (see Appendix II-G1) and in the EFH Assessment (see Appendix II-J1). Though complex habitat does exist in the Offshore Project Area, Atlantic Shores has selected installation tools and methods that minimize disturbance to bottom habitats, including complex habitats, to the maximum extent practicable.

In addition, the Offshore Project Area does not contain any salt marshes, coral reefs, or significant areas of submerged aquatic vegetation such as eel grass, which are considered sensitive habitats for finfish, invertebrates and EFH species.

Most species in the Offshore Project Area, including those with designated EFH, have pelagic early life histories (eggs and larvae) and are not dependent on benthic habitat. Therefore, modification and/or disturbance of the seafloor, including temporary sediment suspension and deposition will not impact these species or life stages. There may be some temporary impacts on the use of specific areas by these species during construction resulting from increased sediment suspension in the lower water column; however, as stated in the following section (Suspended Sediment and Deposition), any sediment plume generated during Project construction is expected to be small, localized, and temporary. In addition, given their mobile nature, pelagic juvenile and adult life stages, including manta rays, should largely avoid these areas during the period of disturbance. During this time, these species will be able to forage in nearby areas and are expected to return soon after sediment disturbing activities are complete.

Sessile benthic species (e.g., Atlantic surfclam and ocean quahog) or species with early life stages that are dependent on benthic habitat (e.g., ocean pout [*Macrozoarces americanus*] eggs, winter flounder eggs and larvae, Atlantic sea scallop eggs and larvae, and longfin inshore squid eggs) will be more susceptible to injury or mortality from seabed disturbing Project activities. Mortality of these species will most likely be limited to the direct footprint of the disturbance. These species will also be more susceptible to temporary increases in sediment suspension and deposition; however, as stated in the following section (Suspended Sediment and Deposition), any sediment plume generated during Project construction is expected to be small, localized, and temporary. Any injury or mortality to these species and life stages is not expected to result in population level effects given the surrounding available habitat that will not be disturbed. The extent of impacts on the early life stages of these species will also be dependent on the time of year that Project activities occur, as early life stages will only be present for short periods during specific times of year depending on the species. Therefore, the potential exposure of the most vulnerable early life stages to seabed disturbance will be limited to only their seasonal presence in the Offshore Project Area.

Mobile juvenile and adult life stages of benthic and demersal finfish species are less likely to experience injury or mortality during seafloor disturbing activities because they are expected to temporarily leave the immediate area during these activities. By moving away from Project-related activities, mobile finfish would be able to avoid direct mortality and injury; however, they may be temporarily displaced from a portion of available habitat in the Offshore Project Area. During this time, these species will be able to forage in nearby areas and are expected to return soon after sediment disturbing activities are complete. The extent of impacts to individual older life stages of species is also affected by the time of year that Project activities occur. Many species within the Offshore Project Area migrate seasonally, such as black sea bass, scup, monkfish (*Lophius americanus*), and spiny dogfish and use benthic habitat for only a portion of their life stage. Therefore, the potential exposure of these species to seabed disturbance will be limited to their seasonal presence in the Offshore Project Area.

Based on documented cases of habitat recolonization and recovery after significant disturbances involving benthic communities like those found in the Offshore Project Area, and the assumption that the surrounding available habitat will not be disturbed, seafloor-disturbing Project activities are not expected to result in long-term population-level effects to the resident benthic organisms and communities that support finfish, pelagic invertebrates, and their EFH. Although localized mortality of some benthic invertebrates is anticipated in the Offshore Project Area, impacts are not expected to be significant at the population level and would not measurably alter the environmental baseline, as similarly concluded in BOEM (2021a).

Environmental protection measures such as using HDD techniques to avoid seabed disturbance impacts at the landfall sites, burying offshore cables to a target depth of 5 to 6.6 ft (1.5 to 2 m), using installation tools that minimize seabed disturbance to the maximum extent practicable, and using anchor midline buoys and an anchoring plan, where feasible, will support the avoidance and/or minimization of impacts to finfish, pelagic invertebrates, and their EFH.

**Suspended Sediment and Deposition**

Various sediment-disturbing Project activities conducted during construction, O&M, and decommissioning have the potential to suspend sediments into the water column resulting in the transport and deposition of these sediments on the seafloor. As described in Section 2.1 Geology, sediments disturbed during Project activities are not expected to contain hazardous contaminants. Therefore, during all phases of the Project, finfish and pelagic invertebrates will primarily be affected by the short-term, localized, and temporary physical suspension of sediments and resulting deposition.

The primary construction activities that will result in elevated suspended sediment concentrations and deposition include seabed foundation preparation, sand bedform removal, inter-array and offshore export cable installation, and excavation at the offshore HDD pit. In order to determine the extent of suspended sediment and deposition produced by construction activities, a Sediment Transport Modeling study was conducted (see Appendix II-J2). This study examined the extent and duration of elevated total suspended solids (TSS) concentrations and sediment deposition as a result of seabed preparation for WTG and OSS foundation installation, sand wave clearance in the Lease Area and along the ECCs, inter-array and offshore export cable installation, and HDD activities at the Monmouth and Northern ECC Landfall Sites[36]. Results of the study represent a maximum case scenario by modeling facility components and activities that would result in the greatest impact including, but not limited to, the use of a TSHD for seabed preparation activities, use of a suction bucket jacket for all foundations (both WTG and OSS), and the presence of three large OSS structures. A summary of these findings is provided in the following subsections.

[36] For modeling purposes, the Sediment Transport Report selected one route along the Northern ECC. The route selected uses the South Beach Branch due to the length of the route and the complex hydrodynamic conditions that exist along the route. This branch is no longer under consideration for this Project but remains representative of the conditions in the areas of the New York landfall sites.

*Suspended Sediment Concentration Predictions*

Model simulation results of above-ambient TSS concentrations stemming from seabed preparation for WTG and OSS foundation installation; sand wave clearance; cable installation for the inter-array cable, Monmouth ECC, and Northern ECC; and HDD activities remained relatively close to the area where seabed preparation and installation activities would take place, were constrained to the bottom of the water column, and were relatively short-lived. Table 4.6-9 summarizes the extent and duration of suspended sediment concentrations resulting from seabed preparation for WTG and OSS foundation installation, sand wave clearance, cable installation, and HDD activities. Two TSS concentration thresholds are provided in Table 4.6-9, 10 milligram per liter (mg/L) and 100 mg/L. A threshold of ≥10 mg/L is cited in literature as within the range of ambient TSS concentration conditions of the Mid-Atlantic Bight (Balthis et al., 2009). A threshold of ≥100 mg/L has been cited in literature as a level at which larval fish exhibit signs of sensitivity (Auld and Schubel 1978, Turner and Miller 1991, Wilber and Clarke 2001, Anderson and Mackas 1986).

Simulations of seabed preparation for WTG and OSS foundation installation and sand wave clearance using a trailing suction hopper dredge, and several possible inter-array cable or offshore export cable installation methods using either jet trenching installation parameters (for inter-array cable and export cable installation) or mechanical trenching installation parameters (for inter-array cable installation only) predicted above-ambient TSS of ≥10 mg/L stayed relatively close to the representative foundation locations and route centerline. This is due to sediments being introduced to the water column close to the seabed. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 0.7 miles (1.1 kilometers) from the representative WTG foundation site, up to approximately 1.6 miles (2.6 kilometers) from representative OSS foundation sites, and 2.4 miles (3.9 kilometers), 2.0 miles (3.2 kilometers), and 2.8 miles (4.5 kilometers) from the sand wave clearing route for the inter-array cables, Monmouth ECC, and Northern ECC, respectively. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 1.7 miles (2.7 kilometers), 1.6 miles (2.6 kilometers), and 1.5 miles (2.4 kilometers) for inter-array, Monmouth ECC, and Northern ECC cable installation, respectively (Table 4.6-9). For the landfall approach scenarios, use of an excavator was assumed and sediment was introduced at the surface. This resulted in a maximum distance for the predicted above-ambient TSS concentrations ≥10 mg/L of approximately 2.1 miles (3.3 kilometers) and 1.1 miles (1.9 kilometers) for the Monmouth and Northern ECC HDD pits, respectively (Table 4.6-9).

For the model scenario of seabed preparation for the representative WTG foundation location, above-ambient TSS concentrations were predicted to substantially dissipate within 4 hours, with full dissipation occurring in less than 5 hours. Modeling scenarios for seabed preparation for OSS foundations predicted above-ambient TSS concentrations to substantially dissipate within 7 to 10 hours, with full dissipation occurring between 9 to 12 hours. Sand wave clearing model scenarios for the inter-array cable, Monmouth ECC, and Northern ECC predicted above-ambient TSS concentrations to substantially dissipate within 4 to 6 hours, with full dissipation in less than 15 hours. For the inter-array cable installation model scenario, above-ambient TSS concentrations substantially dissipated within 4 to 6 hours and fully dissipated in 9 or less hours. For the Monmouth and Northern ECC installation model scenarios, above-ambient TSS concentrations substantially dissipated within 2 to 6 hours but required between 12 and 18 hours to fully dissipate, likely due to the relatively longer route (i.e., larger volume of suspended sediment), route orientation in relation to currents, and more frequent occurrence of fine sediment.

For the landfall approach scenarios, the tails of the plumes, with concentrations of ≥10 mg/L, were transported away from the source and were short-lived, while concentrations around the HDD pits dissipated within approximately 6 to 12 hours for the Monmouth HDD pit and approximately 6 to 10 hours for the Northern HDD pit. The larger areas of TSS concentrations above thresholds and the longer time for the plume to diminish to ambient conditions for the Monmouth HDD pit may be attributed to sediments being released in deeper water, the higher fraction of fine sediments taking longer to settle, and slightly stronger currents transporting the sediments parallel with the shore.

### Table 4.6-9. Suspended Sediment Modeling Results from Seabed Preparation for Foundations, Cable Installation, and HDD Activities

| Scenario | Maximum Duration of TSS >10 mg/L (hrs) | Maximum Extent of TSS ≥10 mg/L | Maximum Duration of TSS >100 mg/L (hrs) | Maximum Extent of TSS ≥100 mg/L |
|---|---|---|---|---|
| Seafloor Preparation for Foundations | | | | |
| Representative WTG Seabed Foundation Preparation[1] | 4.9 | 0.7 mi (1.11 km) | 4.4 | 0.7mi (1.05 km) |
| Large OSS Seabed Foundation Preparation – 1[1,2] | 11.9 | 1.5 mi (2.4 km) | 7.6 | 1.4 mi (2.3 km) |
| Large OSS Seabed Foundation Preparation – 2[1,2] | 12.1 | 1.5 mi (2.4 km) | 9.1 | 1.4 mi (2.3 km) |
| Large OSS Seabed Foundation Preparation – 3[1,2] | 8.9 | 1.6 mi (2.6 km) | 7.2 | 1.4 mi (2.2 km) |
| Sand Wave Clearance | | | | |
| Representative IAC – Sand Wave Clearance | 14.3 | 2.4 mi (3.9 km) | 8.3 | 2.0 mi (3.2 km) |
| Representative Sand Wave Clearance, Monmouth ECC | 12.5 | 2.0 mi (3.2 km) | 7.0 | 1.3 mi (2.1 km) |
| Representative Northern ECC– Sand Wave Clearance | 8.7 | 2.8 mi (4.5 km) | 7.0 | 0.8 mi (1.3 km) |
| Offshore Cable Installation | | | | |

| Scenario | Maximum Duration of TSS >10 mg/L (hrs) | Maximum Extent of TSS ≥10 mg/L | Maximum Duration of TSS >100 mg/L (hrs) | Maximum Extent of TSS ≥100 mg/L |
|---|---|---|---|---|
| Representative Inter-array Cable - Jet Trencher | 8.0 | 1.4 mi (2.2 km) | 2.5 | 0.5 mi (0.8 km) |
| Representative Inter-array Cable - Mechanical Trencher | 8.7 | 1.7 mi (2.7 km) | 3.8 | 0.4 mi (0.6 km) |
| Representative Monmouth Export Cable - Jet Trencher | 12.8 | 1.6 mi (2.6 km) | 6.0 | 0.9 mi (1.5 km) |
| Representative Northern Export Cable- Jet Trencher | 17.7 | 1.5 mi (2.4 km) | 3.0 | 0.3 mi (0.4 km) |
| HDD Activities at Landfall Site | | | | |
| Monmouth Landfall Representative HDD Pit Excavator | 12.3 | 2.1 mi (3.3 km) | 11 | 0.3 mi (0.4 km) |
| Northern Landfall Representative HDD Pit Excavator | 10.3 | 1.1 mi (1.9 km) | 10.2 | 0.1 (0.18 km) |

[1] A suction bucket jacket foundation, which represents the maximum disturbance of all foundation types under consideration, was used to model impacts from seafloor preparation for WTG and OSS installation.
[2] The modeling assumed three large OSS structures for the Project.

These model predictions agree with modeling results conducted for similar projects in similar sediment conditions (BOEM, 2021; Elliot et al., 2017; West Point Partners, LLC 2013; ASA, 2008). Actual suspended sediment concentrations and sediment transport during installation may be even lower given that environmental monitoring surveys conducted during installation of the Block Island Wind Farm submarine cable found that suspended sediment levels measured during jet plow installation were up to 100 times lower than those predicted by the modeling (Elliot et al. 2017).

Elevated suspended sediment concentrations have the potential to influence feeding and foraging behavior, respiratory functionality, and survival of finfish species; however, impacts vary by species and life stage (Wilber and Clark 2001). Historically, studies on the impacts of suspended sediments on marine organisms have heavily focused on sediment concentrations. More recent studies have shown that exposure duration is also an important influencing factor (Wilber and Clark 2001). Wilber and Clark (2001) compiled numerous studies which examined the impacts of suspended sediment concentration and exposure duration. A majority of the studies observed lethal impacts at high sediment concentrations and long exposure durations. One study conducted by Auld and Schubel (1978) showed a 13% mortality rate in American shad larvae when exposed to suspended sediment concentration of 100 mg/L for a duration of 4 days (Wilber and Clark 2001). Another study conducted by Sherk et al. (1974) showed a 10% mortality in Atlantic silverside juveniles and adults when exposed to sediment concentrations of 580 mg/L for 1 day (Wilber and Clark 2001).

Results from the Sediment Transport Modeling report showed that suspended sediment concentrations greater than 100 mg/L are only anticipated to last up to 5 hours for seabed preparation activities for the representative WTG foundation, approximately 9 hours for seabed preparation activities for representative OSS foundation locations, approximately 8 hours for sand wave clearing activities, approximately 11 hours for HDD activities, and approximately 6 hours for cable installation, both of which are significantly less than the multiple-day studies compiled by Wilber and Clark (2001). Additionally, concentrations greater than 100 mg/L are expected to be localized, extending up to a maximum distance of 0.7 mile (1.1 km) from the representative WTG foundation location, 1.4 miles (2.3 kilometers) from representative OSS foundation locations, 2.0 miles (3.2 kilometers) from sand wave clearing routes, 0.9 mile (1.5 kilometers) from cable centerlines, and 0.3 mile (0.4 kilometer) from HDD activities. Therefore, while effects could occur to sessile and less mobile individuals and early life stages of EFH species in the immediate vicinity of seabed preparation, cable installation, and HDD activities, these effects are expected to be short-term and not result in high levels of mortality.

Effects to finfish species, including those with designated EFH, are dependent on the time of year of that these activities occur, as species presence differs seasonally. Demersal and pelagic egg and larval stages of fish species potentially present in the Offshore Project Area will be most sensitive to the increased suspended sediment concentrations. Juvenile and adult EFH life stages will likely temporarily avoid the disturbed area which could have a temporary displacement effect; however, these species are expected to return after the activities cease in a given location. Potential impacts to finfish species would be short-term and localized since sediment-disturbing Project activities are expected to only reach high TSS concentrations for a limited time and the sediment plume is expected to be limited to the relative proximity of the activity. In addition, as described above, much of the habitat in the Offshore Project Area is indicative of a dynamic system and the species that live in the mobile sandy habitat areas are adapted to survive periodic natural disturbances similar to what they would experience from sediment-disturbing Project activities. Furthermore, the area affected by increased suspended sediment is expected to be small compared to the surrounding habitat. Therefore, population-level effects to finfish, including those with designated EFH are not anticipated.

*Sediment Deposition Predictions*

Installation and maintenance of structures and cables will also result in the transport of sediment that will subsequently deposit over time as sediment particles settle through the water column to the seabed. Sediment deposition levels were modeled, as part of the Sediment Transport Modeling study, for seabed preparation activities for WTG and OSS foundations, sand wave clearing activities, the offshore installation of inter-array cables, the Monmouth ECC, Northern ECC, and HDD activities at the Monmouth and Northern ECC Landfall Sites (see Appendix II-J2).

Table 4.6-10 summarizes the areal extent and maximum distance of sediment deposition due to seabed preparation activities, cable installation, HDD activities, and sandwave clearance.

Two depositional thresholds are provided in the table below, 0.04 inch (1 millimeter) and 0.4 inch (10 millimeters). A threshold of 0.04 inch (1 millimeter) is cited in literature as the level at which burial and mortality occurs in demersal eggs (Berry et al., 2011). A threshold of 0.4 inch (10 millimeters) is cited in literature as the level at which sessile benthic invertebrates exhibit signs of sensitivity (Essink 1999).

### Table 4.6-10. Deposition Modeling Results from Seabed Preparation for Foundations, Cable Installation, and HDD Activities

| Scenario | Area of Deposition 0.04 in (≥1 mm )[1] | Maximum Extent of Deposition ≥0.04 in (1 mm)[1] | Area of Deposition ≥0.4 in (10 mm)[2] | Maximum Extent of Deposition ≥0.4 in (10 mm)[2] |
|---|---|---|---|---|
| Seafloor Preparation for Foundations | | | | |
| Representative WTG Seabed Foundation Preparation[3] | 0.2 $mi^2$ (0.6 $km^2$) | 2,821 ft (860 m) | 0.04 $mi^2$ (0.1 $km^2$) | 1,214 ft (370 m) |
| Large OSS Seabed Foundation Preparation – 1[3, 4] | 1.0 $mi^2$ (2.6 $km^2$) | 6,890 ft (2,100 m) | 0.2 $mi^2$ (0.4 $km^2$) | 2,493 ft (760 m) |
| Large OSS Seabed Foundation Preparation – 2[3, 4] | 1.0 $mi^2$ (2.7 $km^2$) | 7,152 ft (2,180 m) | 0.2 $mi^2$ (0.5 $km^2$) | 3,182 ft (970 m) |
| Large OSS Seabed Foundation Preparation – 3[3, 4] | 1.1 $mi^2$ (2.8 $km^2$) | 6,660 ft (2,030 m) | 0.2 $mi^2$ (0.5 $km^2$) | 2,690 ft (820 m) |
| Sand Wave Clearance | | | | |
| Representative IAC – Sand Wave Clearance | 1.4 $mi^2$ (3.5 $km^2$) | 4,002 ft (1,220 m) | 0.3 $mi^2$ (0.8 $km^2$) | 492 ft (150 m) |
| Representative Sand Wave Clearance, Monmouth ECC | 2.0 $mi^2$ (5.2 $km^2$) | 2,821 ft (860 m) | 0.9 $mi^2$ (2.3 $km^2$) | 558 ft (170 m) |
| Representative Northern ECC– Sand Wave Clearance | 2.0 $mi^2$ (5.2 $km^2$) | 1,903 ft (580 m) | 1.1 $mi^2$ (2.9 $km^2$) | 656 ft (200 m) |
| Offshore Cable Installation | | | | |
| Inter-array Cable - Jet Trencher | 0.01 $mi^2$ (<0.01 $km^2$) | 164 ft (50 m) | N/A | N/A |
| Inter-array Cable - Mechanical Trencher | N/A[5] | N/A[5] | N/A | N/A |
| Monmouth Export Cable - Jet Trencher | 3.21 $mi^2$ (8.32 $km^2$) | 656 ft (200 m) | 0.01 $mi^2$ (0.02 $km^2$) | 98 ft (30 m) |

| Scenario | Area of Deposition 0.04 in (≥1 mm )[1] | Maximum Extent of Deposition ≥0.04 in (1 mm)[1] | Area of Deposition ≥0.4 in (10 mm)[2] | Maximum Extent of Deposition ≥0.4 in (10 mm)[2] |
|---|---|---|---|---|
| Northern Export Cable- Jet Trencher | 1.71 $mi^2$ (4.45 $km^2$) | 295 ft (90 m) | N/A[6] | N/A[6] |
| HDD Activities at Landfall Site | | | | |
| Monmouth Landfall Representative HDD Pit Excavator | 0.03 $mi^2$ (0.09 $km^2$) | 1,572 ft (479 m) | <0.01 $mi^2$ (0.01 $km^2$) | 335 ft (102 m) |
| Northern Landfall Representative HDD Pit Excavator | <0.01 $mi^2$ (0.01 $km^2$) | 479 ft (146 m) | <0.01 $mi^2$ (<0.01 $km^2$) | 230 ft (70 m) |

[1] A depositional threshold of 0.04 inch (1 millimeter) was used in the Sediment Transport Modeling report as it is the burial and mortality threshold for demersal eggs (Berry et al 2011).
[2] Sensitivity in sessile benthic organisms has been observed 0.4 inch (10 millimeter) (Essink, 1999).
[3] A suction bucket jacket foundation, which represents the maximum disturbance of all foundation types under consideration, was used to model impacts from seafloor preparation for WTG and OSS installation.
[4] The modeling assumed three large OSS structures for the Project.
[5] Installation of inter-array cables resulted in deposition less than 0.04 inch (1 millimeter) for both jet and mechanical trenching.
[6] Installation of the Northern ECC resulted in a deposition less than 0.4 inch (10 millimeter).

This Project-induced sediment deposition has the potential to bury demersal eggs or larvae of finfish or squid that are within the zone of deposition. Thresholds for lethal burial depths are species-dependent, with sessile organisms being most sensitive (Essink, 1999). According to Berry et al. (2011), deposition of ≥0.04 inch (1 millimeter) can result in delayed hatching or mortality of demersal eggs (e.g., Atlantic herring, winter flounder, longfin inshore squid). Results from the Sediment Transport Modeling report show that deposition greater than 0.04 inch (1 millimeter) (e.g., the threshold of burial for demersal eggs) will occupy a maximum area of 0.2 square miles (0.6 square kilometers) around the representative WTG foundation location, 1.1 square miles (2.8 square kilometers) around the representative OSS foundation locations, 3.21 square miles (8.32 square kilometers) for cable installation, and 0.03 square miles (0.09 square kilometer) for HDD activities. Based on the modeling results, the area of deposition of ≥ 0.04 inch (1 millimeter) will be minimal compared to the surrounding available habitat and limited to the cable corridor.

Sediment deposition could result in delayed hatching or mortality of non-mobile finfish life stages (e.g., demersal eggs and larvae); however, impacts will be restricted to the vicinity of cable installation and HDD activities. Therefore, sediment disturbing Project activities are not expected to result in population-level effects to finfish species, including those with designated EFH.

The degree of suspended sediment and deposition will be significantly lower during O&M activities than during Project construction. Some sediment suspension and deposition may occur from maintenance of structures and cables if repairs are required, but impacts are expected to be short-term and temporary, due to the predominantly sandy seafloor and shallow sediments in the Offshore

Project Area. Decommissioning of structures and cables is expected to have similar limited impacts as those described for construction. During all Project phases, dynamically positioned vessels and jet plow embedment will be used to the maximum extent practicable to reduce sediment disturbance during cable laying processes.

**Impingement or Entrainment of Fish Larvae during Cable Installation**

Project installation operations requiring the use of water, such as standard vessel operations, jet plow, jet trenching, or dredging activities, will likely result in the impingement and/or entrainment of pelagic planktonic species. During the construction, operation, and decommissioning phases, direct mortality of pelagic planktonic species is expected as a result of entrainment and impingement during water withdrawals for vessel operation, jet plowing, and dredging activities. Based on the location of the Offshore Project Area, EFH species with pelagic egg and larval stages that could be susceptible to entrainment and impingement impacts include, but are not limited to, pollock (*Pollachius virens*), bluefish (*Pomatomus saltatrix*), Atlantic mackerel (*Scomber scombrus*), and Atlantic butterfish (Walsh et al. 2015, Berrien and Sibunka 1999). Entrainment of planktonic species typically results in high levels of mortality due to temperature changes and injury as organisms travel through piping systems (USDOE 2009). With respect to jet plowing activities, injury to entrained organisms can occur when water is injected into sediments at high pressure, resulting in mortality. However, such occurrence will be limited to periods of vessel operation and jet plowing.

Assuming an installation rate between 150 meters and 300 meters (492 feet and 984 feet) per hour for export, inter-array, and interlink cable installation using jet plowing, and a water withdrawal rate between 400 cubic meters and 1,400 cubic meters (14,125 and 49,441 cubic feet) per hour for jet plow activities, water withdrawal volumes are expected to range from approximately 5,230 to 9,150 million liters (1,381 to 2,417 million gallons) from jet plowing activities for the Project. Additional water withdrawal may be required for sandwave clearance using a hydraulic dredge. Sandwave clearing activities may require up to two passes with a hydraulic dredge, one which serves as the initial clearing pass and the other which serves as a clean-up pass. Though the exact locations of sandwave clearance will be determined closer to construction, a conservative estimate for the initial clearing path of 20% of the export and interlink cable lengths, and 10% for inter-array cable lengths was used to calculate total water withdrawal. Additionally, a conservative estimate of 10% of the export and interlink cable lengths and 5% for inter-array cable lengths was used to calculate total water withdrawal during the clean-up pass for sandwave clearing. Assuming an installation rate between 105 meters and 240 meters (344 feet and 788 feet) per hour for export, inter-array, and interlink cable and a water withdrawal rate between 10,000 cubic meters and 30,000 cubic meters (353,147 cubic feet and 1,059,400 cubic feet) per hour, water withdrawal volumes are expected to range from approximately 30,200 to 39,650 million liters (7,977 to 10,474 million gallons) from initial sandwave clearing activities using a hydraulic dredge for the Project. Assuming an installation rate for a clean-up pass for sandwave clearing between 210 meters and 450 meters (689 feet and 1,476 feet) per hour for export, inter-array and interlink cable, and a water withdrawal rate between 10,000 cubic meters and 30,000 cubic meters (353,147 cubic feet and 1,059,400 cubic feet) per hour, water withdrawal volumes are expected to range from approximately 7,550 to 10,600 million liters (1,994 to 2,800 million gallons).

Mortality of ichthyoplankton is considered likely due to water withdrawal activities; however, many species that inhabit the Offshore Project Area produce millions of eggs each year (e.g., Atlantic herring, Atlantic cod, haddock, winter flounder) which allows the species to persist in the presence of natural and anthropogenic-related effects (NOAA 2020c, Adams 1980).

Additionally, cable installation activities requiring water withdrawal will be limited in time and space. As a result, water withdrawal activities are not expected to cause population-level impacts to icthyoplankton.

### 4.6.2.2 Anchoring and Jack-Up Vessels

Temporary anchoring and use of jack-up vessels within the Offshore Project Area may occur during construction and decommissioning and to a lesser extent during O&M with variations in duration and extent according to the specific work activity. All vessel anchoring and jacking-up associated with Project activities will occur within surveyed areas of the Lease Area or ECCs. These activities may affect finfish and pelagic invertebrate resources and EFH through direct seafloor disturbance and temporary increases in suspended sediment and deposition and effects are expected to be similar to those described in Section 4.6.2.1.

Positioning of anchors and jack-up vessels is expected to result in temporary impacts in the immediate area where anchors, chains, or jack-up legs meet the seafloor. Potential effects to finfish, invertebrates and EFH during anchoring and jack-up vessel positioning include temporary surficial disturbances of the seafloor and increases in suspended sediments and deposition, which could cause mortality to early life stages of benthic and demersal species or cause temporary habitat disruption in limited areas. The severity of impacts for each event would depend on the specific location, habitat type, and season, with greater effects expected when seafloor-disturbing activities interact with sensitive habitats, early life stages (eggs and larvae), and sessile or slow-moving species. The Offshore Project Area does not contain any eelgrass (see Section 4.2 Coastal and Terrestrial Habitat and Fauna) or critical habitat for Atlantic sturgeon (see Section 4.6.1.5). Benthic and demersal early life stages of finfish, squid, or EFH species (e.g., ocean pout eggs, winter flounder eggs and larvae, Atlantic sea scallop eggs and larvae, and longfin inshore squid eggs) in the direct path of anchor or jack-up vessel disturbance may be subject to injury or mortality; however, this is not expected to result in population-level effects given the surrounding available habitat that will remain undisturbed (Table 4.6-8).

Juvenile and adult life stages of benthic and demersal species, including those of the Atlantic sturgeon, are less likely to experience these impacts as they are mobile and more likely to leave the area during anchoring activities. By moving away from Project-related activities, mobile finfish would be able to avoid direct mortality and injury; however, they may be temporarily displaced from a portion of available habitat in the Offshore Project Area. While temporarily displaced, these species likely will be able to forage in nearby areas and are expected to return after anchoring activities are complete.

The maximum seabed disturbance in the Lease Area and ECCs resulting from jack-up or anchored vessel use is included in the temporary seafloor disturbance calculations presented in Table 4.6-8. Disturbance caused by anchoring and jack-up vessels will occur in small areas relative to the total available surrounding habitat in the Lease Area, ECCs. Impacts would be temporary and localized, and any isolated mortality of early life stages or sessile organisms are not expected to have population-level effects. As described in more detail in Section 4.6.2.1, benthic macroinvertebrates (prey for many finfish and EFH species) are expected to recolonize the area after the physical disturbance ceases, allowing these temporarily disturbed areas to continue to serve as habitat. HDR (2019a) as cited in BOEM (2021) reported that post-construction monitoring at the Block Island Wind Farm showed seabed scars from anchoring disturbance recovered to baseline conditions within 18 months to 2 years.

As previously stated, Atlantic Shores is committed to minimizing the impacts to complex habitat to the maximum extent practicable by using tools and installation methods that minimize the potential disturbance. Atlantic Shores also proposes to use midline buoys on anchored construction vessels to minimize seabed disturbance and will develop an anchoring plan for areas where anchoring is required to avoid impacts to sensitive habitats to the maximum extent practicable, including hard bottom and structurally complex habitats, as identified in site-specific HRG and benthic surveys.

Vessels are not expected to anchor or use jack-up positioning during O&M activities unless the WTGs, OSSs, or offshore cables require major maintenance (e.g., component replacement or cable repair). Impacts associated with potential vessel positioning with anchors or jack-up legs during O&M and decommissioning are expected to be similar, but less than those described for the construction phase.

#### 4.6.2.3 Noise

This section addresses underwater sound that may be generated during activities conducted in the Offshore Project Area, including impulsive pile driving and other noise sources (e.g., HRG surveys, vessels, cable installation, vibratory pile driving, operational WTGs, operational offshore cables, and decommissioning) and assesses the potential effects noise generated from these activities may have on finfish and pelagic invertebrates, including EFH-designated species. Noise, defined as unwanted sound, is detected by fish and invertebrates as particle motion, with some fish additionally sensing pressure. Noise generated during Project construction, O&M, and decommissioning has the potential to result in physiological stress and behavioral changes, as well as limited mortality or injury in finfish and pelagic invertebrates when the noise is present. As described in the following subsections, effects to finfish and pelagic invertebrates from underwater noise will be limited to radial distances from the source where sound levels are above regulatory thresholds. Pile driving noise during construction (if a piled foundation type is chosen or an HDD conductor barrel is used) would be mitigated through the use of noise abatement systems such as bubble curtains and hydro-dampeners and noise mitigating measures such as soft starts and ramp up procedures.

Fish and invertebrates are sensitive to particle motion and some fish are additionally sensitive to pressure. Particle motion is described by displacement, velocity, and acceleration. Because the ears of fish function as inertial accelerometers, all fish are sensitive to particle motion. In contrast, sensitivity to sound pressure and frequency in fish is functionally correlated to the presence or absence of gas-filled chambers, such as the swim bladder (Wiernicki et al. 2020). Sensing pressure extends hearing to higher frequencies (Ladich and Popper 2004, Braun and Grande 2008). The presence of a swim bladder, or other gas-filled cavity, makes fish more susceptible to injury from anthropogenic sound as these loud, often impulsive, noises can cause swim bladders to vibrate with enough force to cause damage to tissues and organs around the bladder (Halvorsen et al. 2011, Casper et al. 2012). Many invertebrates and crustaceans lack swim bladders and are therefore less sensitive to sound. However, some aquatic invertebrates, including all cephalopod species, have statocysts, which are a complex sensory organ comprised of a fluid-filled chamber containing sensitive hairs and one or more statocysts.

Cephalopods can detect particle motion using these statocysts, but do not have gas-filled cavities associated with these sensory structures and lack the ability to detect pressure; therefore, cephalopods are also less susceptible to injury from anthropogenic sound compared to fish with a swim bladder (Budelmann et al. 1992).

The most sensitive fish species are those with swim bladders connected or close to the inner ear. These species can acquire both recoverable and mortal injuries at lower sound levels than other species (Thomsen et al. 2006, Popper et al. 2014). EFH-designated species and other NOAA Trust Resource species[37] that may be present in the Lease Area and are considered high-sensitivity fish species (Popper et al. 2014) due to swim bladder involvement in hearing, include Atlantic cod, Atlantic herring, silver hake, white hake (*Urophycis tenuis)*, alewife (*Alosa pseudoharengus)*, blueback herring (*Alosa aestivalis)*, American eel (*Anguilla rostrata)*, American shad (*Alosa sapidissima*), Atlantic menhaden (*Brevoortia tyrannus)*, and weakfish.

Some fish found in the Lease Area have swim bladders not involved in hearing (e.g., Atlantic sturgeon, Atlantic butterfish, Atlantic mackerel [*Scomber scombrus]*, black sea bass, bluefish [*Pomatomus saltatrix]*, haddock, monkfish, ocean pout, red hake, scup, bluefin tuna [*Thunnus thynnus]*, yellowfin tuna [*Thunnus albacares]*, striped bass [*Morone saxatilis]*, tautog). Their detection of sound is mediated primarily through particle motion, and these species have relatively low susceptibility to anthropogenic sound-induced effects (Popper et al. 2014). The least sound-sensitive fish species are those that have no swim bladder, including elasmobranchs (i.e., sharks and rays) and flatfish such as summer flounder.

Research suggests that cephalopods may be sensitive to low frequency sound sources and sound exposure can affect statocyst functionality and physiology (André et al. 2011; Budelmann et al. 1992; Mooney et al. 2010; Solé et al. 2013, 2017). More recently, studies have specifically examined the impacts of sound sources from offshore wind energy development on cephalopods. Solé et al. (2022) exposed cuttlefish adults and eggs in a laboratory setting pile-driving and drilling noise, with maximum levels of 170 dB re 1 µPa2 and 167 dB re 1 µPa2, respectively. Adults experienced damage to their statocyst sensory epithelia but did not exhibit any behavioral reactions; the larvae statocysts were damaged similarly to the adults . There was an increase in larvae mortality and a decrease in egg hatching success with increasing sound levels, but exposed larva and hatchlings born of exposed eggs presented normal size, healthy appearance, and normal behavior. Researchers determined these effects were acute in the very vicinity of the sound source where they have the potential to affect cephalopod populations and offspring (Solé et al. 2022).

[37] NOAA GARFO provided a list of Other NOAA Trust Resources to be evaluated in the EFH Assessment in a virtual meeting held on May 20, 2020.

Laboratory studies on the impacts of pile driving noise in the cephalopod species longfin inshore squid have been conducted using sound recordings from Block Island Wind Farm construction. The studies found exposure to pile driving noise may elicit alarm responses and changes in feeding behavior leading to a reduced capacity to hunt. However, alarm responses rapidly decreased within the first minute of noise exposure suggesting the squid developed an increased tolerance to the noise over time and may have behaviorally habituated (Jones et al. 2020; Jones et al. 2021). In a separate study on longfin inshore squid, Cones et al. (2022) found that pile driving noise disrupts fine-scale movements in the short-term, indicating that wind farm construction may minimally impact the species' energetics. Jones et al. (2023) found that pile driving noise had no significant effects on occurrence rates of agonistic behaviors, mate guarding, mating, and egg laying. Further, longfin inshore squid have a relatively short lifespan, around one year, and individuals engaging in these reproductive behaviors are both highly motivated to reproduce despite environmental stressors (i.e., pile driving noise) and are nearing the end of their lifespan. Therefore, it is anticipated that Project-related noise would not significantly affect longfin inshore squid and other cephalopod species. Additionally, individuals in the wild may be able to escape Project-related noise by temporarily leaving the area.

Impact (impulsive) pile driving may occur if piled foundation types (monopile and jackets) are chosen as the foundation type for the Project. Impulsive sounds are discontinuous, high intensity sounds that are extremely short in duration (with a rapid onset and decay) but may be repetitive. There are also other noise sources associated with offshore Project construction, O&M, and decommissioning that are primarily non-impulsive in nature. Non-impulsive sounds are continuous sounds that remain constant and relatively stable over time (e.g., vessel sounds, WTG operational noise, vibratory pile driving noise).

To assess the potential effects from impact pile driving to finfish and pelagic invertebrates (specifically pelagic cephalopods), if piled foundations or an HDD conductor barrel are used, and vibratory pile driving, if a cofferdam or casing pipe is used, Atlantic Shores conducted quantitative acoustic modeling and compared the results against impulsive acoustic thresholds. For other sound sources from the Project, Atlantic Shores provides a qualitative assessment of potential impacts to finfish and invertebrates in relation to the relevant acoustic thresholds. These other sound sources will not be quantitatively modeled because the potential acoustic impact of these sound sources is expected to be much less than impulsive pile driving.

Injury and behavioral response exposure criteria for impulsive and non-impulsive sounds are based on relevant regulatory-defined thresholds and best available science for fish (NOAA 2005, Andersson et al. 2007, Wysocki et al. 2007, FHWG 2008, Mueller-Blenkle et al. 2010, Purser and Radford 2011). Table 4.6-11 provides regulatory approved acoustic thresholds to evaluate the potential for finfish to experience injury and behavioral response from impulsive sounds. Because few data are available regarding particle motion sensitivity in fish (Popper and Fay 2011, Popper et al. 2014), the thresholds for acoustic sensitivity are based on sound pressure only (FHWG 2008, Stadler and Woodbury 2009). The thresholds that are currently used by NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) and BOEM to assess potential impacts to fish exposed to pile driving sounds are based on criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008, Stadler and Woodbury 2009). Table 4.6-11 also presents threshold levels suggested by Popper et al. (2014) for injury and temporary threshold shift (TTS) for impulsive sounds, which are based on the presence, and role, of a swim bladder, as well as the behavioral thresholds as defined by GARFO (2020). Additionally, although literature on the hearing capabilities of pelagic cephalopods is limited, research shows them to be most vulnerable to particle motion (Mooney, Samson, and Zacarias 2016) and they are therefore expected to have hearing thresholds most similar to fish without swim bladders, but that can detect particle motion.

### Table 4.6-11. Interim Fish Injury and Behavioral Acoustic Thresholds Currently Used by NOAA Fisheries GARFO and BOEM for Impulsive Pile Driving

| Fish Group | Injury Thresholds | | TTS | Behavioral Threshold |
|---|---|---|---|---|
| | SEL[1] (unweighted) | $L_{pk}$[1] (unweighted) | SEL[1] (unweighted) | $L_{pk}$[1] (unweighted) |
| Fish without a swim bladder (particle motion detection)[2] | >216 | >213 | ≫186 | — |
| Fish with swim bladder not involved in hearing (particle motion detection)[2] | 203 | >207 | >186 | — |
| Fish with swim bladder involved in hearing (primarily sound pressure detection)[2] | 203 | >207 | 186 | — |
| Fish weighing ≥2 grams[3] | 187 | 206 | — | 150 |
| Fish weighing <2 grams[3] | 183 | 206 | — | 150 |

Source: BOEM 2022, GARFO 2020.

1. Threshold units: SEL in dB re 1 μPa2·s; Lpk in dB re 1 μPa
2. Popper et al. (2014)
3. NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (2008)

Impulsive underwater noise generated from Project activities has the potential to cause mortality or injury (e.g., ruptured gas bladders, damage to auditory processes) mainly to the finfish identified above that have swim bladders connected or close to the inner ear (Casper et al. 2012; Popper and Hastings 2009; Riefolo et al. 2016). Exposure to intense anthropogenic sound levels can also cause an increase in the hearing thresholds of fishes, resulting in less sensitive (i.e., poorer) hearing abilities. This change in hearing threshold may be temporary (i.e., temporary threshold shift [TTS]) or permanent (i.e., permanent threshold [PTS]). In addition, underwater noise may elicit a behavioral response in finfish and pelagic invertebrates, such as avoidance, changes in feeding, breeding, schooling, migration behavior, or masking of environmental auditory cues (Buerkle 1973; Mitson and Knudsen 2003; Olsen et al. 1983; Ona et al. 2007; Sarà et al. 2007; Schwarz and Greer 1984; Soria et al. 1996; Vabø et al. 2002). Behavioral responses in fish differ depending on species and life stage, with younger, less mobile age classes being the most vulnerable (Gedamke et al. 2016; Popper and Hastings 2009).

The effects of impulsive sound on fish eggs and larvae have been studied in the context of offshore pile driving. Bolle et al. (2012) investigated the risk of mortality in common sole larvae by exposing them to impulsive stimuli in an acoustically well-controlled study. Even at the highest exposure level tested, at a sound exposure level (SEL) of 206 dB re 1 μPa$^2$·s (corresponding to 100 strikes at a distance of 100 m), no statistically significant differences in mortality were found between exposure and control groups. Popper et al. (2014) published exposure guidelines for fish eggs and larvae, which are based on pile driving data. The guidelines proposed a precautionary threshold for mortality of fish eggs and larvae of greater than 207 dB re 1 μPa PK, which they note is likely conservative. As no thresholds exist for pelagic invertebrates, fish eggs and larvae thresholds are used as a proxy for these species.

There are very few studies on the effect of non-impulsive sound sources on fish and pelagic cephalopods and no data exist for eggs and larvae (Popper et al. 2014). Acoustic thresholds for fish used to qualitatively evaluate impacts from non-impulsive sounds are provided in Table 4.6-12.

### Table 4.6-12. Interim Fish Injury and Behavioral Acoustic Thresholds Currently Recommended by Bureau of Ocean Energy Management (BOEM) for Non-Impulsive Sources

| Fish Group | Injury | TTS |
|---|---|---|
| | $L_{pk}$[1] (unweighted) | $L_{pk}$[1] (unweighted) |
| Fish without a swim bladder (particle motion detection)[2] | — | — |
| Fish with swim bladder not involved in hearing (particle motion detection)[2] | — | — |
| Fish with swim bladder involved in hearing (primarily sound pressure detection)[2] | 170 (for 48 hours) | 158 (for 12 hours) |
| Fish weighing ≥2 grams[3] | — | — |
| Fish weighing <2 grams[3] | — | — |

Source: BOEM 2022

1. Threshold units: SEL in dB re 1 μPa2·s; Lpk in dB re 1 μPa
2. Popper et al. (2014)
3. NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (2008)

#### 4.6.2.3.1 Impact Pile Driving Noise

Atlantic Shores conducted site-specific hydroacoustic propagation modeling assuming the maximum PDE to assess the potential risks to marine organisms, including fish, from pile driving noise during construction of foundations and HDD support structures (i.e., HDD conductor barrel) (see Appendix II-L). The model evaluated distances to NMFS thresholds based on a range of operational conditions (e.g., foundation type, hammer type, pile-driving schedule) as well as levels of potential noise attenuation (ranging from 0 to 15 dB) that could potentially be achieved through the application of industry standard noise abatement systems (NAS). For the exposure assessment conducted for foundation installation, the 10 dB attenuation level was conservatively chosen as the minimum sound reduction achievable with the application of a single NAS. The acoustic modeling maximum radial distances to regulatory thresholds results are provided in Tables 4.6-13 and 4.6-14 and in detail in Appendix II-L.

### Table 4.6-13. Maximum Radial Distance (in kilometers) to the 95th Percentile of the Thresholds for Fish due to the Impact Pile Driving of One 15-meter monopile with a 3,015 kJ Hammer at varying Levels of Sound Attenuation for the Shallow Model Site

| FISH GROUP | METRIC | THRESHOLD | DISTANCE FROM PILE TO THRESHOLD (KM) | | | |
|---|---|---|---|---|---|---|
| ATTENUATION LEVEL | | | 0 DB | 6 DB | 10 DB | 15 DB |
| Fish without a swim bladder (particle motion detection)[1] | Injury ($L_{PK}$) | 213 | 0.785 | 0.350 | 0.250 | 0.150 |
| | Injury ($L_E$) | 216 | 1.250 | 0.685 | 0.300 | 0.150 |
| | *TTS* ($L_E$) | 186 | 9.635 | 7.285 | 5.885 | 4.385 |
| Fish with swim bladder not involved in hearing (particle motion detection) [1] | Injury ($L_{PK}$) | 207 | 1.200 | 0.785 | 0.550 | 0.250 |
| | Injury ($L_E$) | 203 | 3.835 | 2.385 | 1.685 | 1.050 |
| | *TTS* ($L_E$) | 186 | 9.635 | 7.285 | 5.885 | 4.385 |
| Fish with swim bladder involved in hearing (primarily sound pressure detection) [1] | Injury ($L_{PK}$) | 207 | 1.200 | 0.785 | 0.550 | 0.250 |
| | Injury ($L_E$) | 203 | 3.835 | 2.385 | 1.685 | 1.050 |
| | *TTS* ($L_E$) | 186 | 9.635 | 7.285 | 5.885 | 4.385 |
| Fish weighing ≥2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 1.300 | 0.850 | 0.600 | 0.300 |
| | Injury ($L_E$) | 187 | 9.185 | 6.885 | 5.585 | 4.085 |
| | Behaviour ($L_P$) | 150 | 13.245 | 9.850 | 8.135 | 6.385 |
| Fish weighing <2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 1.300 | 0.850 | 0.600 | 0.300 |
| | Injury ($L_E$) | 183 | 11.170 | 8.350 | 6.885 | 5.270 |
| | Behaviour ($L_P$) | 150 | 13.245 | 9.850 | 8.135 | 6.385 |

Notes:
All thresholds are unweighted.
$L_{PK}$ – peak sound pressure (dB re 1 µPa).
$L_E$ – sound exposure level (dB re 1 µPa$^2$·s).
$L_p$ – root mean square sound pressure (dB re 1 µPa).
TTS – temporary, recoverable hearing effects.
1 Popper et al. (2014).
2 NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
3 Stadler and Woodbury (2009)
4 Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007)

## Table 4.6-14. Maximum Radial Distance (in kilometers) to the 95th Percentile of the Thresholds for Fish due to the Impact Pile Driving of One 15-meter monopile with a 3,015 kJ Hammer at varying Levels of Sound Attenuation for the Deep Model Site

| FISH GROUP | METRIC | THRESHOLD | DISTANCE FROM PILE TO THRESHOLD (KM) | | | |
|---|---|---|---|---|---|---|
| ATTENUATION LEVEL | | | 0 DB | 6 DB | 10 DB | 15 DB |
| Fish without a swim bladder (particle motion detection)[1] | Injury ($L_{PK}$) | 213 | 0.650 | 0.300 | 0.200 | 0.100 |
| | Injury ($L_E$) | 216 | 1.435 | 0.500 | 0.250 | 0.150 |
| | *TTS* ($L_E$) | 186 | 18.280 | 12.035 | 9.070 | 6.500 |
| Fish with swim bladder not involved in hearing (particle motion detection) [1] | Injury ($L_{PK}$) | 207 | 1.400 | 0.650 | 0.400 | 0.200 |
| | Injury ($L_E$) | 203 | 5.635 | 3.300 | 2.050 | 1.035 |
| | *TTS* ($L_E$) | 186 | 18.280 | 12.035 | 9.070 | 6.500 |
| Fish with swim bladder involved in hearing (primarily sound pressure detection) [1] | Injury ($L_{PK}$) | 207 | 1.400 | 0.650 | 0.400 | 0.200 |
| | Injury ($L_E$) | 203 | 5.635 | 3.300 | 2.050 | 1.035 |
| | *TTS* ($L_E$) | 186 | 18.280 | 12.035 | 9.070 | 6.500 |
| Fish weighing ≥2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 1.450 | 0.750 | 0.450 | 0.250 |
| | Injury ($L_E$) | 187 | 16.865 | 11.170 | 8.435 | 6.050 |
| | Behaviour ($L_P$) | 150 | 27.245 | 18.640 | 13.935 | 9.950 |
| Fish weighing <2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 1.450 | 0.750 | 0.450 | 0.250 |
| | Injury ($L_E$) | 183 | 22.095 | 14.500 | 11.170 | 7.900 |
| | Behaviour ($L_P$) | 150 | 27.245 | 18.640 | 13.935 | 9.950 |

Notes:
All thresholds are unweighted.
$L_{PK}$ – peak sound pressure (dB re 1 µPa).
$L_E$ – sound exposure level (dB re 1 µPa$^2$·s).
$L_p$ – root mean square sound pressure (dB re 1 µPa).
TTS – temporary, recoverable hearing effects.
1 Popper et al. (2014).
2 NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
3 Stadler and Woodbury (2009)
4 Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007)

Exposure assessments were also conducted for impact pile driving activities associated with HDD support structures. Impact pile driving activities that would support the HDD installation of the export cables include the installation of an HDD conductor barrel.

Table 4.6-15 provides the acoustic modeling maximum radial distances to regulatory thresholds results. Additional details are provided in Volume II, Appendix II-L of the COP.

### Table 4.6-15. Maximum Radial Distance (in meters) to the 95th Percentile of the Thresholds for Fish due to the Impact Pile Driving for the Installation or Removal of the HDD Conductor Barrel at the Representative Landfall Sites in Monmouth, NJ and Wolfe's Pond, NY Using an 18 kJ Hammer with No Sound Attenuation

| FISH GROUP | METRIC | THRESHOLD | DISTANCE FROM LANDFALL SITE (M) | |
|---|---|---|---|---|
| | | | MONMOUTH, NJ | WOLFE'S POND, NY |
| Fish without a swim bladder (particle motion detection)[1] | Injury ($L_{PK}$) | 213 | 16 | 11 |
| | Injury ($L_E$) | 216 | 51 | 26 |
| | *TTS* ($L_E$) | 186 | 850 | 300 |
| Fish with swim bladder not involved in hearing (particle motion detection) [1] | Injury ($L_{PK}$) | 207 | 25 | 11 |
| | Injury ($L_E$) | 203 | 167 | 76 |
| | *TTS* ($L_E$) | 186 | 850 | 300 |
| Fish with swim bladder involved in hearing (primarily sound pressure detection) [1] | Injury ($L_{PK}$) | 207 | 25 | 11 |
| | Injury ($L_E$) | 203 | 167 | 76 |
| | *TTS* ($L_E$) | 186 | 850 | 300 |
| Fish weighing ≥2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 25 | 11 |
| | Injury ($L_E$) | 187 | 800 | 300 |
| | Behaviour ($L_P$) | 150 | 630 | 250 |
| Fish weighing <2 grams[2,3,4] | Injury ($L_{PK}$) | 206 | 25 | 11 |
| | Injury ($L_E$) | 183 | 910 | 385 |
| | Behaviour ($L_P$) | 150 | 630 | 250 |

Notes:
All thresholds are unweighted.
$L_{PK}$ – peak sound pressure (dB re 1 μPa).
$L_E$ – sound exposure level (dB re 1 μPa$^2$·s).
$L_p$ – root mean square sound pressure (dB re 1 μPa).
TTS – temporary, recoverable hearing effects.
1 Popper et al. (2014).
2 NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
3 Stadler and Woodbury (2009)
4 Andersson et al. (2007), Mueller-Blenkle et al. (2010), Purser and Radford (2011), Wysocki et al. (2007)

Based on the regulatory-defined thresholds for fish and the corresponding exposure ranges, and the intermittent nature of the sound source, effects on finfish and pelagic invertebrates from pile driving noise are expected to be localized and short-term. Therefore, the risk of noise-related impacts from pile driving is expected to be low. In addition, the most sensitive species will likely only be present in the Lease Area between fall and winter. By spring, all high-sensitive species discussed above, except for Atlantic cod, are expected to migrate inshore or southward, to spawn (NOAA 2020c; ASMFC 2020; Geo-Marine 2010). Additionally, installation of the HDD conductor barrel will only occur for a short duration, and distances to potential injurious effects will be concentrated within the area of the landfall site; therefore, impacts during these pile driving activities is expected to be low.

Atlantic Shores is implementing measures to avoid Project-related impacts to finfish and invertebrates. In addition to continuing existing marine programs to study important habitats, key noise mitigation and monitoring strategies that will be implemented throughout all phases of the Project include equipment operating procedures to protect or prevent finfish and invertebrate species from harmful underwater sound levels generated by pile driving. For example, noise abatement systems that reduce the likelihood for exposure to threshold sound levels arising from pile driving for marine mammals will also benefit other marine fauna, including finfish. Soft starts will be implemented for activities such as impact pile driving. Standard soft-start procedures are a “ramp-up” procedure whereby the sound source level is increased gradually before full use of power. In combination, these impact mitigation strategies are expected to minimize impacts to fish and invertebrates.

##### 4.6.2.3.2 Vibratory Pile Driving from Cofferdam Installation

Non-impulsive vibratory pile driving may be used in support of HDD installation of the export cables if construction of a cofferdam or casing pipe is necessary. Use of a cofferdam would require the installation of sheet piles which would result in the generation of underwater noise. Modeling of cofferdam installation was conducted for two representative locations, one along the Monmouth ECC and the other along the Northern ECC (Appendix II-L). Results of the modeling show that within 164 feet (50 meters) of the cofferdam site, fish with swim bladders that are involved in hearing could experience injury or TTS. Other fish groups could experience behavioral impacts within the 164 feet (50 meters) of the cofferdam site but are not expected to receive injury or hearing impairment from the construction of the cofferdam.

Installation of a casing pipe is also considered to facilitate HDD installation activities of the export cables. Installation of a casing pipe would also require non-impulsive vibratory pile driving. Modeling of this installation was conducted for two representative locations, one near Monmouth, New Jersey and another in Wolfe’s Pond, New York. The results of the modeling show that injury to fishes with swim bladders would only occur within approximately 52 feet (16 meters) of the landfall site, while temporary, recoverable impacts may occur up to approximately 249 feet (76 meters) from the landfall site. The remaining fish groups may experience behavioral impacts, but the extent of those impacts is only anticipated to extend approximately 820 feet (250 meters) from the landfall site. Additional information on noise modeling for casing pipe installation is provided in Volume II, Appendix II-L of the COP.

Noise impacts from decommissioning are expected to be equal to or less than those predicted for construction. Based on the modeling results, noise impacts are expected to occur relatively close to the cofferdam or casing pipe installation sites. Given the localized extent of impacts and the mobile nature of fish, impacts to fish from cofferdam or casing pipe installation or decommissioning is expected to be minimal and localized.

#### 4.6.2.3.3 Other Noise Sources

There are several other potential anthropogenic sound sources associated with offshore Project construction, O&M, and decommissioning. These sources were not quantitatively modeled because the potential acoustic impact of these noise sources is expected to be much less than impulsive pile driving. A qualitative assessment of possible effects to finfish and pelagic invertebrates from other noise sources generated by Project activities, including HRG surveys, vessels, cable installation, vibratory pile driving (if needed), operational WTGs, operational offshore cables, and decommissioning is summarized in this section.

As detailed in Sections 4.5.3 and 4.5.9 of Volume I, HRG surveys may be conducted to support pre-construction site clearance activities as well as post construction facilities surveys. The HRG survey equipment used for this type of survey work would be the same or similar to the equipment deployed during Atlantic Shores' 2019-2022 site characterization surveys including multibeam echosounders, side scan sonars, sub-bottom profilers, and high-resolution seismic equipment. Of this equipment, sub-bottom profilers and high-resolution seismic equipment emit acoustic signals vertically downwards into the water column, some of which will penetrate the seabed. Studies of stronger HRG survey equipment (not being deployed by Atlantic Shores, e.g., seismic airguns), have shown mortality is very unlikely; however, behavioral responses have been observed in fish exposed to airgun sound levels exceeding 147–151 sound pressure level (SPL) (Fewtrell and McCauley 2012) and some HRG active acoustic sound sources can produce these sound levels within tens to a few hundred meters of the source (Halvorsen and Heaney 2018). In the Biological Assessment for data collection activities on the Atlantic OCS, Baker and Howson (2021) found that mobile HRG sound sources are not likely to result in PTS for fish and any temporary avoidance of the survey area that may occur for short periods would have discountable effects on the five listed fish species that may occur in the broader region (Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper). Based on the variable responses observed in studies used to establish threshold levels of sound for impulsive sources (see Table 4.6-11), finfish would be expected to either vacate the survey area, experience short-term TTS and/or masking of biologically relevant sounds, show no visible effects, or be completely unaffected. Given the results of these studies, the mobile and intermittent nature of HRG surveys, the short-term and infrequent nature of surveying small areas of the seafloor relative to the overall area, and the likelihood that finfish will move away from the sound source, noise from HRG surveys is not expected to pose a risk to finfish or pelagic invertebrates.

Vessel noise includes non-impulsive sounds that arise from vessel engines, propellers, and thrusters. Sound levels emitted from vessels depend on the vessel's operational state (e.g., idling, in transit) and are strongly weather dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 μPa for numerous vessels with varying propulsion power.

Noise from Project vessels is likely to be similar in frequency characteristics and sound levels to existing commercial vessel traffic in the region. Given the rapid attenuation of underwater vibrations with increasing distance from a sound source (Morley et al. 2014), it is unlikely that these stimuli will cause more than short-term behavioral effects (e.g., flight or retraction) or physiological (e.g., stress) responses. Overall, impacts to finfish and pelagic invertebrates from vessel noise are expected to be short-term and localized and are not anticipated to pose a risk to these resources.

Noise impacts from cable installation activities (e.g., from sand bedform removal [if needed], jet trenching, plowing/jet plowing, mechanical trenching, dredging) are expected to be minimal, with most activities generating noise impacts similar to those described for vessel noise. A detailed modeling and measurement study conducted for construction activities associated with cable installations concluded that underwater sound generated by cable laying vessels was similar to that of other vessels already operating in the area and no significant acoustic impacts were identified (JASCO 2006). A review of studies published by the U.S. Army Corps of Engineers examined noise impacts from dredging operations on a variety of species, including fish, and found that based on available literature, dredging induced sounds were not considered to pose significant risk of direct injury or mortality to juvenile or adult fish (Suedel et al., 2019). Therefore, noise associated with cable laying activities is not expected to pose a risk to finfish or pelagic invertebrates.

Non-impulsive, vibratory pile driving could be an additional source of noise generated during construction of the WTGs. Vibratory pile driving may be used for a short period at the beginning of pile driving or to install the entire pile, depending on sediment conditions (see Section 4.2.1 of Volume I). Compared to noise generated from impulsive pile driving, vibratory pile installation typically produces lower amplitude sounds in the marine environment (Rausche and Beim 2012). Received peak sound pressure levels (PK) and sound exposure levels (SEL) near impact pile driving can exceed 200 dB, while studies of vibratory pile driving measured source levels ranging from 177 to 195 dB PK and 174.8 to 190.6 dB SEL (Hart Crowser and Illingworth and Rodkin 2009, Houghton et al. 2010). Suction bucket installation, which is also a non-impulsive pile installation method, is expected to result in lower peak pressure levels than impact pile driving. Exposure to vibratory hammer and suction bucket installation noise is unlikely to induce injury in fish or pelagic invertebrates because of its lower peak pressure levels and its relatively short duration.

During Project operation, WTGs will generate non-impulsive sound in the nacelle that will be transmitted down the WTG tower to the foundation and then radiated into the water. Underwater sound levels generated by an operational WTG are related to the WTG's power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Under normal conditions, the sound level that results from WTG operation is of low intensity (Madsen et al. 2006), with energy concentrated at low frequencies (below a few kilohertz) (Tougaard et al. 2008). At high wind speeds, Wahlberg and Westerberg (2005) estimated permanent avoidance by fish would only occur within a range of 13 ft (4 m) to 820 ft (250 m) of a turbine. These findings were dependent on the number and size of windmills, wind speed, background noise level, hearing abilities of the fish, bathymetry, and seabed characteristics (Wahlberg and Westerberg 2005).

Pangerc et al. (2016) recorded SPL measurements at approximately 164 ft (50 m) from two individual 3.6 megawatt (MW) monopile wind turbines over a 21-day operating period. The sound pressure level increased with wind speed up to an average value of 128 dB re 1 µPa at a wind speed of about 10 meters per second (m/s), and then showed a general decrease. Additional studies conducted during operation of the Block Island Wind Farm measured sound levels below 120 dB SPL at wind speeds less than 13 m/s (HDR 2019b). These sound levels are expected to be similar to those reported for cable laying/trenching and are well below existing non-impulsive acoustic thresholds for injury or behavioral response in fish (Table 4.6-12). Overall, current literature indicates sound generated from the operation of wind farms is of minor significance for fish (Wahlberg and Westerberg 2005, Stenberg et al. 2015). Therefore, the effects of WTG noise on finfish, while long-term, are not expected to be substantial and will not cause population-level effects.

High-voltage alternating current (HVAC) offshore cables are expected to produce non-impulsive low-frequency tonal vibration sound in the water. High voltage direct current (HVDC) cables do not produce a similar tonal sound because the current is not alternating. Low level tonal sound from an existing 138 kV transmission line buried up to 4 ft (1 m) was measured in Trincomali Channel, offshore Vancouver Island, British Columbia during a quiet period of recording. The SPL at approximately 328 ft (100 m) from the cable was below 80 dB. Assuming cylindrical spreading of sound, the source level of the submarine cable was approximately 100 dB SPL (JASCO 2006). Anticipated SPL arising from the vibration of AC cables during operation are significantly lower than SPL that may occur during cable installation (Meißner et al. 2006) and may be undetectable in the ambient soundscape of the Lease Area. Based on these studies, no effects to finfish or pelagic invertebrates are expected from low-frequency tonal vibration sound emitted during cable operation.

Sounds associated with decommissioning are reasonably assumed to be similar to, or less than, those produced during either the construction or O&M phases of the Project. The methods used to decommission and remove the Project's foundations will depend on the type of foundation (see Section 6.2.3 of Volume I); therefore, the level and duration of sounds emitted during decommissioning will depend on the type (e.g., gravity versus piled foundation), size, and location of the foundation. Piled foundations, if used, will be cut below the mudline, likely using underwater acetylene cutting torches, mechanical cutting, and/or a high-pressure water jet. Mechanical cutting tools and high-pressure water jetting will generate non-impulsive broadband sound (Topham and McMillan 2017). Regardless of the foundation type used, removal and transport of Project components (e.g., foundations, WTGs, OSSs, etc.), will require the use of vessels, which will also generate non-impulsive sound. Potential impacts to finfish and pelagic invertebrates, including EFH species, from sound generated during decommissioning activities are expected to be similar or less than those produced during the construction or O&M phases of the Project.

The risk of noise-related impacts from other sound sources to finfish, pelagic invertebrates, and EFH species due to noise exposure and associated behavioral responses are expected to be very low. The mitigation measures that will be implemented for both marine mammals and sea turtles (see Sections 4.7 Marine Mammals and 4.8 Sea Turtles), including noise abatement systems and soft starts, are expected to minimize any sound-related impacts during all phases of the Project.

### 4.6.2.4 Electromagnetic Fields

This section addresses electromagnetic fields (EMF) generated during operation of the Project and the localized effects on finfish and pelagic invertebrate resources. EMFs are invisible areas of electric and magnetic energy that occur both naturally and anthropogenically in the marine environment. Atlantic Shores conducted an EMF study to predict EMF levels from operation of the Project's submarine electrical system which includes a combination of HVDC and HVAC cables and OSSs (see Appendix II-I). The modeling results show that EMF levels are predicted to decrease exponentially with increasing distance from the cables and are therefore expected to cause minimal risk to finfish or pelagic invertebrates.

Within the Offshore Project Area, the only groups of finfish anticipated to be electrosensitive are elasmobranchs (i.e., sharks, skates, rays, and ratfishes), lampreys, and sturgeon. Studies have shown that these groups detect changes in electric fields using ampullary receptors for the purposes of prey and predator detection and navigation (CSA Ocean Sciences Inc. and Exponent 2019; Normandeau et al. 2011). However, due to cable configuration and shielding, electric fields will not be released into the marine environment from Project cable operation, and therefore were not modeled in Appendix II-I and are not further discussed in this section.

Magnetic fields will however be generated by the offshore cable system, which includes HVAC and HVDC export cables, HVAC inter-link cables, and HVAC inter-array cables. Multiple theories have been proposed for finfish detection of magnetic fields. The most supported theory proposes the use of a magnetite-based system which involves the presence of magnetic crystals (magnetite) that can detect differences in magnetic fields (CSA Ocean Sciences, Inc. and Exponent 2019; Normandeau et al. 2011). Researchers believe magnetosensitive species use magnetic fields for migration, navigation, and to locate food, habitat, and spawning grounds (CSA Ocean Sciences, Inc. and Exponent 2019). Magnetosensitivity has been observed in elasmobranchs and select bonyfish, including species of commercial and recreational importance that could be present in the Offshore Project Area. Such species include, but are not limited to American eel, blacktip shark (*Carcharhinus limbatus*), blue shark (*Prionace glauca*), clearnose skate, common thresher shark, cownose ray, little skate, porbeagle shark (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), smooth dogfish, spiny dogfish, and tiger shark (*Galeocerdo cuvier*) (CSA Ocean Science Inc. and Exponent 2019). Other finfish and pelagic invertebrate species of commercial or recreational value in the Offshore Project Area (e.g., flounder species, longfin squid, spot (*Leiostomus xanthurus)*, scup, bluefish, hake species, black sea bass) likely lack the physiological components necessary to detect electric and magnetic fields and therefore are not expected to be adversely affected by EMF outputs from Project HVAC and HVDC export cables, HVAC inter-link cables, and HVAC inter-array cables.

Well-established magnetic field thresholds are lacking for finfish; however, research suggests that fish may be more likely to detect magnetic fields from DC sources than AC sources (Normandeau et al. 2011). Magnetic fields generated from HVAC and HVDC export cables, HVAC inter-link cables, and HVAC inter-array cables used for the Project will be minimized by cable burial (between approximately 5 to 6.6 ft [1.5 to 2 m]) and armoring (see Section 4.5.1 of Volume I), which will minimize potential impacts to demersal and pelagic species.

Table 4.6-16 summarizes the modeled peak magnetic field production anticipated for Project HVAC and HVDC export cables and HVAC inter-array cables under maximum power generation scenarios for cable crossing and normal conditions. Model results also showed that magnetic fields produced by HVAC and HVDC export cables and HVAC inter-array cables decrease exponentially with increasing horizontal and vertical distance (see Appendix II-I).

### Table 4.6-16. Peak Magnetic Fields Modeled under Maximum Power Generation for the Atlantic Shores Export and Inter-Array Cables

| Cable Type | Peak Magnetic Field (mG) for Maximum Modeled Case |
|---|---|
| HVAC[1] | |
| Export Cable | 107.82 |
| Export Cable (at cable crossing) | 244.42 |
| Inter-array Cable | 60.07 |
| HVDC | |
| Export Cable | 152.68 |
| Export Cable (at cable crossing) | 349.22 |

Notes:
[1] HVAC inter-link cables are part of the larger OSS electrical system, and were not analyzed as isolated, individual cables. However, due to the configuration of the inter-link cables, they are expected to operate in a similar fashion as either HVAC export cables or the inter-array cables.

Biologically significant impacts to finfish, pelagic invertebrates, and EFH species have not been documented for EMF generated from AC cables (BOEM 2020). Multiple studies provide evidence that fish are unlikely to detect high frequency fields (e.g., 60 hertz [Hz]) produced by AC cables (CSA Ocean Sciences Inc. and Exponent 2019; Normandeau et al. 2011). Laboratory studies examining frequency impacts from an AC source on skates found decreasing sensitivity as frequencies incrementally increased above 1 Hz (CSA Ocean Sciences Inc. and Exponent 2019). Researchers also believe that marine species with magnetite-based systems may not be able to detect magnetic fields below 50 milligauss (mG) from a high frequency (e.g., 50 or 60 Hz) AC source (Normandeau et al. 2011). Modeling of the Atlantic Shores' HVAC export and inter-array cables, which will operate at 60 Hz, predict magnetic fields ranging from 60.07 to 244.42 mG at the cable centerline. However, the field is predicted to drop to approximately 50 mG between 5.4 and 8.4 ft (1.6 to 2.6 m) in horizontal distance from the HVAC export cables and between 1.7 and 2.8 ft (0.52 to 0.85 m) in horizontal distance from the inter-array cables. Additionally, magnetic field strength will drop to approximately 50 mG between 3.0 and 5.0 ft (0.91 and 1.5 m) in vertical distance from HVAC export cables and 0.61 ft (0.19 m) in vertical distance from inter-array cables. Since the HVAC export and inter-array cables will operate at 60 Hz, and the magnetic fields are predicted to drop to approximately 50 mG at a maximum horizontal distance of 8.4 ft (2.6 m) and a maximum vertical distance of 5.0 ft (1.5 m), it can reasonably be assumed that magnetic fields produced by Project HVAC offshore cables will result in minimal impacts to fish and pelagic invertebrate species in the Offshore Project Area.

It is likely that fish and pelagic invertebrates potentially present in the immediate vicinity of the HVAC and inter-array cables, where modeled magnetic levels are larger than 50 mG, may not experience effects. Studies on bamboo sharks, a small shark in the same family as dogfish (Scyliorhinidae), observed no impacts to behavior when exposed to magnetic field strengths of 14,300 mG from a 50 Hz AC source (CSA Ocean Sciences Inc. and Exponent 2019). Additional studies conducted on Atlantic salmon and American eel in the presence of a 950 mG magnetic field from a 50 Hz AC power source showed no impact on swimming behavior (CSA Ocean Sciences Inc. and Exponent 2019). Results of these studies provide evidence that magnetosensitive species may not be able to detect magnetic fields above 50 mG emitted from a high frequency AC source. Since magnetosensitive species have shown minimal effects in the presence of high magnetic field strengths emitted from high frequency AC sources, it can reasonably be assumed that other species in the Offshore Project Area which lack the physiological components to detect magnetic fields would not experience adverse impacts from magnetic fields produced by AC cable operation.

As previously stated, studies have shown finfish to be more sensitive to magnetic fields produced by DC cables than AC cables (Normandeau et al. 2011). Though thresholds have not been established for marine species in the presence of magnetic fields from a DC source, studies have aimed to determine potential impacts from such sources. Hutchison et al. (2018) examined behavioral impacts in little skates when exposed to a magnetic field of 655 mG from a DC cable. Results of this field study showed changes in behavior such as altered travel patterns and increased travel speed; however, the cable did not represent a barrier for crossing. Additional field studies observed migrating European eels (*Anguilla anguilla*) across a DC cable. While slower swimming speeds were observed when crossing the DC cable, the cable did not create a barrier to crossing or present any permanent obstacles to migrating adult eels or elvers (Normandeau et al. 2011). Woodruff et al. (2013) studied responses in the non-mangetosensitive Atlantic halibut (*Hippoglossus hippoglossus*) to graduated magnetic field strengths from a DC source ranging from 2,700 to 12,300 mG and found no significant changes in behavior. Klimley et al. (2017) studied the effects of the Trans Bay Cable, an HVDC transmission line in California, on adult green sturgeon (*Acipenser medirostris*) and found that increases in the magnetic field did not impact the migration or travels of green sturgeon as they were able to successfully travel to spawning grounds. Given that the magnetic fields used in many of these studies far exceed the modeled magnetic fields from HVDC export cables for the Project (see Table 4.6-16) and the results of those studies did not result in substantial effects to the subject species, impacts from the Project's HVDC export cables are not expected to adversely affect fish behavior in the Offshore Project Area.

Demersal and benthic-oriented species that live on or close to the bottom have the greatest likelihood of encountering EMF from the Project. Pelagic species that swim higher in the water column have a lower likelihood of encountering Project-generated EMF given the modeling results which showed an exponential decrease in magnetic fields with increasing vertical distance from the export or inter-array cable. CSA Ocean Sciences, Inc. and Exponent (2019) concluded that finfish species that are exposed to EMF from buried power cables may experience a behavioral effect during the time of exposure; however, most exposures would be short in duration (minutes, not hours) and the area affected would be small compared to surrounding available habitat for fish. Therefore, although magnetic fields would be present as long as the Project is in operation, impacts from EMFs generated by Project offshore cables on finfish, pelagic invertebrates, and EFH species would be highly localized and would likely be biologically insignificant, a conclusion also reached by BOEM (2020).

#### 4.6.2.5 Light

Artificial light can attract or deter certain finfish and invertebrates with reactions being highly species dependent. The amount of artificial Project lighting that would penetrate the sea surface is expected to be minimal and not likely to cause adverse effects to finfish or invertebrates, including EFH-designated species.

During construction, O&M, and decommissioning, vessels working or transiting during periods of darkness and fog will utilize navigational and deck lighting. During O&M, regardless of the foundation type selected, all WTG and OSS foundations will contain marine navigational lighting and marking in accordance with USCG and BOEM guidance. In addition to any required marine navigational lighting, some outdoor lighting on the OSS structures will be necessary for maintenance at night, which would be illuminated only when the OSS is manned.

Artificial light has the potential to cause behavioral reactions in finfish or pelagic invertebrates such as attraction or avoidance in a highly localized area. Artificial light could also disrupt diel vertical migration patterns in some fish and potentially increase the risk of predation or disrupt predator/prey interactions (Orr 2013; BOEM 2020). Artificial light generated from Project vessels used during construction, O&M, and decommissioning would be more intense from downward directed deck lighting compared to navigational lights. However, potential impacts from vessel lights will be transient and will only occur in a limited and localized area relative to surrounding unlit areas. Therefore, no substantial impacts to finfish or pelagic invertebrates are expected from vessel and deck lighting. The navigation lighting on the WTG and OSS structures during O&M is also not expected to substantially impact finfish or pelagic invertebrates since it is not downward-focused and the amount of light penetrating the sea surface is expected to be minimal (BOEM 2020).

#### 4.6.2.6 Presence of Structures and Cables

The seafloor of the Offshore Project Area is predominately comprised of flat, sandy and gravelly habitat inhabited by both demersal and pelagic species. Introduction of new foundations, scour protection, offshore cables, and offshore cable protection introduces habitat complexity and diversity in a largely homogenous environment. Within the Offshore Project Area, the presence of foundations, cable protection, and scour protection may result in habitat conversion/creation, increased food availability, localized hydrodynamic alterations, and species attraction. This section addresses the potential effects that the presence of structures and cables in the Offshore Project Area may have on finfish and pelagic invertebrate resources and EFH.

The presence of foundations and scour protection will result in localized habitat conversion of any sandy, soft bottom habitat to a coarser, complex habitat. The maximum total area of permanent seafloor disturbance in the Lease Area, using the foundation type with the maximum footprint, is 1.37 $mi^2$ (3.58 $km^2$) (Table 4.6-8), which represents approximately 1.1% of the 126 $mi^2$ (326 $km^2$) Lease Area.

The maximum total permanent seafloor disturbance in the Monmouth and Northern ECCs from the placement of cable protection is 0.35 $mi^2$ (0.90 $km^2$) and 0.40 $mi^2$ (1.04 $km^2$), respectively (Table 4.6-8). The combined permanent seafloor disturbance for the Monmouth and Northern ECCs represents 0.8% of the total ECC area. This permanent habitat conversion of predominantly sandy and sandy gravel benthic habitat to hard structure habitat will be localized and restricted to the foundation, cable protection, and scour protection footprints (ICF, 2020).

Even though the presence of foundations, cable and scour protection will eliminate a small percentage of flat sandy habitat in the Offshore Project Area, the Project is expected to produce ecological benefits by creating new, diverse habitat for structure-oriented species (e.g., black sea bass, tautog, cunner). In two different wind farms, the Block Island Wind Farm off the coast of Rhode Island and the Horns Rev Wind Farm in the North Sea, abundance within soft-bottom communities largely remained the same between pre- and post-construction (ICF 2020). At the Block Island Wind Farm, abundance of small invertebrates (e.g., nematodes and polychaetes) in existing soft-bottom benthic communities increased after construction around some WTGs. The presence of structures can also increase the presence of fouling and colonial communities such as corals. A study conducted by Schweitzer and Stevens (2019) showed that biogenic structural communities like artificial reefs facilitated the growth of sea whips (*Leptogorgia virgulate*), which ultimately led to higher abundances of fish. The increase in smaller invertebrate species can lead to finfish attraction due to prey availability (ICF 2020).

Foundations can create a “reef effect”, providing ecological benefits and habitat diversity in the Mid-Atlantic Bight. Introduction of hard structures such as WTG, OSS, and met tower foundations and scour protection provide shelter and feeding opportunities as well as spawning and nursery grounds in an area that is largely comprised of flat, sandy habitat (ICF 2020). Leonhard et al. (2011) studied fish assemblages 1 year before and 8 years after the construction of the Horns Rev Wind Farm in the North Sea and observed an increase in species diversity close to WTGs, specifically in reef fishes (Leonhard et al. 2011). This increase in fish diversity may be attributed to the diversification of feeding opportunities by newly established epibenthic invertebrates (Leonhard et al. 2011). A visual transect study of two windfarms in the Baltic Sea observed higher fish abundance in the vicinity of the turbines, and at individual turbines when compared with the surrounding environment, indicating that turbine foundations may function as combined artificial reefs and fish aggregation devices for small demersal and semi-pelagic fish (Wilhelmsson et al. 2006). The same study observed the retreat of some species to the monopile foundation upon the introduction of disturbance, which could indicate that turbines provide a source of refuge (Wilhelmsson et al. 2006). Similarly, Reubens et al. (2011) reported that wind turbines can have an aggregating effect for fish populations. In the Belgian part of the North Sea, pouting densities were highly enhanced near the windmill artificial reef at Thorntonbank. Pouting demonstrated a preference for hard substrate prey species that were recorded in high densities at the wind turbine studied. However, it is unclear whether the windmill artificial reef increased local pouting productivity or simply attract and concentrate the species (Reubens et al. 2011).

The presence of foundations and scour protection have the potential to provide supporting habitat for structure-oriented species (e.g., black sea bass, Atlantic cod, and tautog) that seasonally migrate from nearshore to offshore environments, a common phenomenon for species off the coast of New

Jersey and within the Offshore Project Area (Steimle and Zetlin 2000; Causon and Gill 2018). Impacts of these structures in the offshore environment and the subsequent impact to structure-oriented species has already been documented around the Block Island Wind Farm, where studies conducted showed an increase in catch per unit effort of black sea bass and Atlantic cod following turbine installation (Wilber et al. 2022). Studies on black sea bass have shown that the species primarily occurs within less than 3.3 feet (1 meter) of hard bottom substrata and can occur near newly introduced structures with little overgrowth (Stevens et al. 2019). Structures may also attract highly migratory species. However, limited evidence of this behavior in operating windfarms has been documented (ICF 2020). Studies have shown aggregations of highly migratory species around oil platforms and artificial reefs. One study in the North Sea examined the presence of porbeagle sharks at an oil platform and found a minimum of 20 individuals aggregating around the structure at one time (Haugen and Papastamatiou 2019). In the United States, a study off the coast of North Carolina found a high presence of transient predator density (e.g., sand tiger shark and sandbar shark) around artificial reefs compared to natural reefs (Paxton et al. 2020). Similar aggregation of highly migratory species could occur at structures within the Offshore Project Area. Though foundations and cable protection could be utilized by migratory species for food and shelter, migration is largely driven by water temperatures and seasonality rather than the availability of resources (BOEM 2020). Therefore, any use of structures by migratory species is expected to be temporary, and the overall presence of foundations and cable protection is not expected to hinder migration patterns (BOEM 2020).

Some studies have shown that the addition of foundations, cable, and scour protection may play a role in facilitating the establishment of non-indigenous species. The new hard-bottom habitat could act as stepping stones for these species and allow them to expand into new areas from which they were previously excluded. At the Block Island Wind Farm, the non-indigenous invasive tunicate (*Didemnum vexillum*) has been observed, which was already common to the region (Hutchison et al. 2020). In the Belgian part of the North Sea, non-indigenous species that were already present in the southern North Sea colonized parts of the turbine foundations (De Mesel et al. 2015). Vertical zonation was apparent on the foundations, with both indigenous and non-indigenous species present; competition with indigenous species may be excluded depending on the zone (De Mesel et al. 2015). However, though these structures could act as stepping stones between habitats for non-indigenous species, it is unlikely that this phenomenon would result in population-level impacts to native species, which would be dominated by species inhabiting soft sediments (BOEM, 2021).

The presence of WTGs and other foundation structures in the Lease Area may affect currents and water movement within the Lease Area; however, effects are expected to be highly localized at the foundations. As water moving along a current approaches a turbine or foundation, it changes and accelerates around a structure, creating turbulence (ICF 2020). This phenomenon is known as the wake effect (ICF 2020). The magnitude of wake effect depends on the diameter of foundation structures, volume of impervious surface in the water column and seafloor, and current speed (ICF 2020; English et al. 2017). Wake effect from monopile foundations has been observed approximately 600 ft (200 m) down-current of the structures (English et al. 2017). During peak tidal movements, turbulent wakes have been observed as far as 1,312 ft (400 m) from the monopile (English et al. 2017). These localized wake effects could influence primary productivity and feeding efficiency of predators (ICF 2020; English et al. 2017; Vanhellemont and Ruddick 2014). Changes in turbulence around the foundations could result in increased food availability for plankton-consuming finfish and could result in fish aggregations (e.g., Atlantic silverside and Atlantic menhaden) (Andersson 2011; ICF 2020). Increased turbulence also has the potential to reduce visibility around the turbine which may reduce feeding efficiency of predators, thereby indirectly affecting the risk of predation on prey species (English et al. 2017; Vanhellemont and Ruddick 2014).

Monitoring the physical dynamics in the Mid-Atlantic Bight and Cold Pool is important to understanding how placement of wind turbines may affect ocean mixing and marine resources like fish and pelagic invertebrates. The formation and the nutrient fluxes of the Cold Pool are important to fish and their movement in the Mid-Atlantic Bight. The breakdown of the stratified Cold Pool is known to influence the timing of migration for species such as winter flounder (*Pseudopleuronectes americanus*), summer flounder (*Paralichthys dentatus*), black sea bass (*Centropristis striata*), and Atlantic butterfish (*Peprilus triacanthus*) (Kohut and Brodie 2019). Modeling studies, considering varying sizes of wind projects and technology, have indicated that wind turbines may cause atmospheric disturbances to near-surface winds that influence ocean mixing (Afsharian and Taylor, 2019). The extent of changes to ocean mixing at local and regional, or mesoscale, scales is not well known and can vary widely in magnitude as local mixing is dependent on atmospheric forcing, daily heating and cooling, wind, changes in temperature and humidity associated with mesoscale weather, and other processes (Paskyabi et al., 2015). Measuring and predicting any possible effects to ocean mixing is highly dependent on the characteristics of the wind project (e.g., spacing between turbines, size of turbines) and the local and regional atmospheric and oceanographic conditions (Moum and Smyth 2019), including conditions of fish and fisheries in the local and regional areas.

Conditions and observations at local and regional scales are necessary to understand if effects to mixing may occur from the Project and if so, whether those effects may influence the Cold Pool dynamics. Drawing early conclusions from European or modeling studies have inherent differences, as the Mid-Atlantic Bight has weaker tidal currents and more intense stratification than the North Sea and is different from other western boundary currents or mesoscale circulation features in European waters. It has been suggested that slower ocean velocities in the southern Mid-Atlantic Bight would result in significantly less mixing than has been found in Europe (Carpenter et al. 2016). European studies are more representative of Mid-Atlantic Bight conditions during weaker stratification. Therefore, it is not likely that structure-induced mixing would be sufficient to overcome intense summer stratification to influence the Cold Pool and cause broader ocean mixing (Miles et al., 2020). As a result, substantial impacts to the Cold Pool and ocean mixing from the presence of Project WTGs is not expected. However, considering the seasonal, annual, and longer scale changes in the Cold Pool and Mid-Atlantic Bight, Atlantic Shores is supportive of contributing to regional collaborative science to study and monitor the Cold Pool and its influence on benthic invertebrates, fish, and fisheries.

In 2019, Atlantic Shores, in collaboration with Rutgers University and MARACOOS, deployed a metocean buoy to contribute to the study of the Mid-Atlantic Cold Pool. This buoy contains sensors at the atmospheric-boundary layer and ocean floor that will allow for continuous measurements of the Cold Pool, as well as support regional oceanographic and atmospheric modeling efforts.

The data collected by this buoy is publicly accessible and can be accessed through MARACOOS' data portal at https://ioos.noaa.gov/regions/maracoos. Once operational, the Project will also represent a living laboratory as they provide abundant opportunities for direct ocean and ecological observations, such as the anticipated beneficial effects of introducing structure to a homogenous sandy sea floor.

As stated, the presence of foundations and cable and scour protection could create a range of effects to finfish, invertebrates, and EFH species during the O&M phase of the Project. Foundations and cable and scour protection are expected to produce ecologically beneficial effects that could outweigh the risk of introducing hard structure to a small area of the vast flat, sandy habitat found in the Mid-Atlantic Bight. Once the Project is decommissioned, the local environmental and ecological features of the area are expected to revert to pre-construction conditions. Potential impacts from decommissioning include the loss of Project-related hard structures, which are expected to be colonized at the time of decommissioning. Reef or structure-oriented finfish will be displaced during decommissioning as the foundations and scour protection are removed.

### 4.6.2.7 Offshore Substation Operation

As discussed in Section 4.4.2 of Volume I, if the Project uses an HVDC OSS, seawater may be used in a once-through cooling system to provide cooling to the HVDC OSS. Operation of an HVDC OSS will require continuous water withdrawal for cooling purposes; the seawater used for cooling will subsequently discharge back to the environment with an elevated temperature and residual chlorine concentration. This section addresses the potential effects to finfish and pelagic invertebrate resources from the operational withdrawal and discharge of an HDVC OSS.

**OSS Seawater Withdrawal**

Operation of an HVDC OSS will require continuous water withdrawal with a maximum water withdrawal rate from OSS operation of approximately 8.8 million gallons per day (mgd). Water withdrawal from operation of the OSS could result in the entrainment and/or impingement of pelagic fish eggs and larvae. Based on the location of the Offshore Project Area, EFH species with pelagic egg and larval stages that could be susceptible to entrainment and impingement impacts include, but are not limited to, pollock (*Pollachius virens*), bluefish (*Pomatomus saltatrix*), Atlantic mackerel (*Scomber scombrus*), and Atlantic butterfish (Walsh et al. 2015, Berrien and Sibunka 1999). Impingement impacts will be minimized through an intake design that utilizes an appropriately sized inlet port and screens to prevent impingement and a through-screen intake water velocity of less than 0.5 feet/second (see Section 4.4.2 of Volume I). Entrainment impacts will be mitigated by minimizing and managing the water use required for OSS cooling to the greatest extent practicable.

The intake of water from the HVDC OSS would create a hydraulic zone of influence (HZI). The HZI is the portion of the waterbody that is hydraulically influenced by the withdrawal of ambient water by the intake system. Beyond the HZI, the ambient currents dominate flow (Golder Associates, 2008). In order to estimate the HZI of the HVDC OSS intake withdrawal, and thus the localized area within which eggs and larvae could be susceptible to entrainment or impingement, Atlantic Shores performed calculations to estimate the HZI (see Appendix II-W).

The HZI for the HVDC OSS was calculated using the expected maximum and minimum operational intake flow rates during both the 5th- and 95th-percentile current speeds exhibited in the study area. Under all calculated conditions, the maximum HZI is predicted to be 0.38 feet (0.116 meters) from the intake location and the minimum HZI is predicted to be 0.003 feet (0.001 meters) from the intake location. It should be noted that during operation, the HZI will vary with changing current speeds and intake rates. As the intake velocities increase and the ambient current speeds decrease, a larger HZI would form. Conversely, with higher current speeds and lower intake velocities, the HZI would decrease in size.

These predictions indicate that the HZI for the HVDC OSS will be highly localized and is not expected to extend beyond 0.38 feet (0.116 meters) under maximum calculated conditions. Only eggs and larvae that enter this highly localized HZI would be susceptible to entrainment and impingement. In addition, many species that inhabit the Offshore Project Area produce millions of eggs per year (e.g., Atlantic herring, Atlantic cod, haddock, winter flounder) which allows the species to persist in the presence of natural and anthropogenic-related effects (NOAA, 2021b; Adams, 1980). Therefore, entrainment and impingement impacts from the HVDC OSS are not expected to result in substantial impacts to eggs or larvae of finfish, including those with designated EFH.

**OSS Discharge**

To cool the HVDC OSS, seawater is brought into the unit via a subsurface intake, pumped through the system to absorb the excess heat, and discharged back into the environment at an elevated temperature. The seawater may be filtered to remove small particulates and disinfected with hypochlorite to prevent biofouling.

Atlantic Shores performed a water quality assessment to investigate the HZI created during water intake operations, and using the USEPA-approved CORMIX model, computational effluent discharge modeling was conducted to predict the magnitude, and extent of the effluent plumes above background values and in association with the potential dilution that would result. From these analyses, the dilution of the thermal plume and residual chlorine concentrations from a representative large OSS location were predicted (see Appendix II-W).

These studies accounted for seasonality, the influence of ambient current velocities, and variable flow rates from two, 2100 MW and 1400 MW, potential OSS cooling water systems. To bound the potential environmental and design conditions associated with the OSSs, 24 effluent discharge configurations were evaluated using design configurations associated with a 2,100 MW and 1,400 MW HVDC systems. To be conservative, the largest temperature differential was evaluated for both the 1,400 MW and 2,100 MW HVDC's, while the influence of flow rate was evaluated using the 2,100 MW HVDC as an upper bound and the 1,400 MW HVDC as a lower bound.

The discharge modeling showed that plume dynamics and dilution factors were primarily affected by the total volume of the release, seasonality of the release, and the associated current speeds. All simulated cases met the water quality standards for both the excess temperature threshold of 3°C temperature excess and the residual chorine threshold of 0.5 mg/L of residual chlorine concentration at the regulatory distance threshold of 328 feet (100 meters) from the discharge point. In fact, the thermal discharge water quality standard was generally met within 32.8 feet (10 meters) or less of the discharge point, but two simulated cases reached up to 105 feet (32 meters) from the discharge point before dropping below the thresholds. The residual chorine water quality standard was generally met within 3.3 feet (1 meter) or less from the discharge point, but two simulated cases reached up to 17.7 and 19 feet (5.4 and 5.8 meters) from the discharge point before dropping below the thresholds.

As each simulated plume was discharged into the ambient environment, the thermal plumes experienced rapid mixing and were sufficiently diluted as they traveled downstream from the discharge point. Higher rates of discharge predicted faster mixing in close proximity (<3.3 feet [1 meter]) with the discharge pipe, which was observed with the 2,100 MW HVDC scenarios. Contrarily, the 1,400 MW HVDC scenarios showed similar, but slightly less mixing within the same <3.3 feet (1 meter) distance. Seasonality differences were observed in the plume simulations, mostly due to stratification effects within the water column, where the most stratified season (summer) showed the lowest potential for mixing. The least stratified environment (winter) predicted the most potential for mixing in general. Current speeds also affected the plume dynamics. In general, higher current speeds exhibited the plume traveling further downstream before meeting the water quality standards, but also predicted the smallest lateral plume radius. In summary, the plume behavior and dilution is highly dependent on the environmental conditions present at the discharge location and the operational conditions that initialize the discharged plume. However, based on the model input parameters, the predicted dilution would be sufficient to minimize potential water quality impacts outside of 328 feet (100 meters) for all scenarios considered (see Appendix II-W for the full results of the OSS discharge modeling).

These model predictions indicate that impacts from the OSS discharge to finfish with designated EFH are expected to be minimal given the highly localized extent of the thermal and residual chorine discharge plume. In addition, impacts to EFH will also be minimal given the dynamic nature of the plume and the dilution that occurs within a maximum distance of 328 feet (100 meters) for all modeled scenarios. The final design, configuration, and operation of the cooling water system and discharge will be permitted as part of an individual NPDES permit with the U.S. Environmental Protection Agency (EPA).

#### 4.6.2.8 Vessel Movement

Vessel movement to and from ports during the construction, operations and maintenance, and decommissioning phases of the Project have the potential to impact threatened and endangered species that reside outside of the Offshore Project Area (Table 4.6-4 provides a list of threatened and endangered species that could occur within the Offshore Project Area). Ports under consideration for use by the Project include several in New Jersey, three in New York, one in Viriginia, and one in Texas, in addition to existing ports for O&M and other support minor services. Threatened and endangered species that could be encountered during vessel traffic transiting from the ports include endangered smalltooth sawfish, threatened gulf sturgeon, threatened Nassau grouper, and threatened scalloped hammerhead shark. However, interactions between transiting vessels and these species are expected to be minimal and brief in duration, given that vessels will be moving from one point to another and not performing any Project-related construction in waters outside the Offshore Project Area.

Additionally, given that these ports are utilized by many large vessels, Project-related vessels are not expected to significantly increase the potential for interactions with listed species beyond existing traffic conditions.

#### 4.6.2.9 Summary of Proposed Environmental Protection Measures

The majority of potential effects to finfish, invertebrates and EFH are expected to be temporary and localized as described in the previous sections. Many of the permanent effects from the presence of structures, including cable and scour protection, are expected to be ecologically beneficial. Atlantic Shores has extensively studied the benthic habitat in the Offshore Project Area and has already taken precautionary steps and commitments to avoid, mitigate, and monitor Project effects on finfish, invertebrates and EFH during construction, O&M, and decommissioning. Additional avoidance and mitigation measures and tools will be evaluated further as the Project progresses through development and permitting and in cooperation and coordination with Federal and State jurisdictional agencies and other stakeholders. The following provides a summary of proposed environmental protection measures that Atlantic Shores will implement to reduce impacts to finfish, invertebrates, and EFH within the Offshore Project Area.

- Comprehensive benthic habitat surveys (seafloor sampling, imaging, and mapping) have been, and continue to be, conducted in consultation with BOEM and NOAA to support the identification of sensitive and complex habitats and the development of strategies for minimizing impacts to identified areas to the maximum extent practicable.
- HDD will be used to avoid seabed disturbance impacts to benthic habitat at the landfall sites. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. All drilling fluids will be collected and recycled upon HDD completion.
- Inter-array, inter-link, and export cables will be buried to a target depth of 5 to 6.6 ft (1.5 to 2 m) which will allow the benthic community to recover and recolonize, avoid direct interaction with finfish and benthic invertebrates, and minimize impacts from EMF.
- Dynamically positioned vessels and jet plow embedment will be used to the maximum extent practicable to reduce sediment disturbance during cable laying processes.
- Vessels will operate in compliance with regulatory requirements related to the prevention and control of discharges and accidental spills.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (see Appendix I-C).
- Anchor midline buoys will be used on anchored construction vessels, where feasible, to minimize seabed disturbance.

- An anchoring plan will be employed for areas where anchoring is required to avoid impacts to sensitive habitats to the maximum extent practicable, including hard bottom and structurally complex habitats, identified through the interpretation of site-specific HRG and benthic assessments.
- Soft starts and gradual "ramp-up" procedures (i.e., gradually increase sound output levels) will be employed for activities such as pile driving to allow mobile individuals to vacate the area during noise-generating activities.
- During impact pile-driving, a noise abatement system consisting of one or more available technologies (e.g., bubble curtains evacuated sleeve systems, encapsulated bubble systems, Helmholtz resonators) will be implemented to decrease the propagation of potentially harmful noise.
- A fisheries monitoring plan will be implemented to monitor baseline environmental conditions relevant to fisheries and how these conditions may change throughout Project construction and operation. Proposed fisheries surveys detailed in the Fisheries Monitoring Plan (see Appendix II-K) include a demersal fish trawl survey, fish pot survey, and clam dredge survey.
- During HRG surveys, compliance with the mitigation and monitoring efforts outlined in NOAA Fisheries GARFO's June 2021 Programmatic Agreement will be implemented to the extent feasible.
- During operation of an HVDC OSS, impingement impacts will be minimized through an intake design that utilizes an appropriately sized inlet port and screens to prevent impingement and a through-screen intake water velocity of less than 0.5 feet/second. Entrainment impacts will be mitigated by minimizing and managing the water use required for OSS cooling to the greatest extent practicable.
- Coordination and consultation will occur throughout the filing of the NPDES permitting associated with an HVDC OSS to ensure impacts are minimized and reduced to the greatest extent practicable.

## 4.7 Marine Mammals

This section describes marine mammals that may be present in the Offshore Project Area, which includes the Lease Area, the Monmouth Export Cable Corridor (ECC), and the Northern ECC. This section also assesses the impact producing factors (IPFs) and anticipated measures to avoid, minimize, or mitigate potential impacts to marine mammals during construction, operations and maintenance (O&M), and decommissioning. Marine mammals are charismatic and important species to any marine ecosystem, occupying many ecological roles in the world's oceans, including predators, prey, and nutrient vectors (e.g., whale falls; Roman et al. 2014, Doughty et al. 2016). Whales also enhance primary productivity in their feeding areas by concentrating nitrogen at the surface (Roman and McCarthy 2010), and have even been identified as important for both the storage and transfer of carbon (Pershing et al. 2010). All marine mammals are protected under the Marine Mammal Protection Act (MMPA), and some species (e.g., North Atlantic right whale [NARW]) are protected under the Endangered Species Act (ESA). Given these statutory protections, marine mammals are a biological resource that must be considered in environmental and acoustic impact assessments for offshore wind development.

Atlantic Shores is conducting an assessment that considers how the Project activities may affect marine mammals in the Offshore Project Area based on marine mammal distributions in the larger context of the Mid-Atlantic Bight. Broadly, the distribution of marine mammals in the Mid-Atlantic Bight region is influenced by many factors including oceanographic features ,animal's physiology, behavior, and ecology (Waring et al. 2009), and prey distribution. Because of these different distribution drivers, Atlantic Shores' marine mammal assessment builds upon and fills data gaps from previously completed Federally and State funded research efforts. Relevant studies, both completed and ongoing, have provided data to inform which species occupy these habitats by conducting state-of-the-art underwater acoustic modeling; animal movement and exposure modeling; and aerial digital surveys to document wildlife usage of the Offshore Project Area.

### 4.7.1 Affected Environment

The marine mammal species that occur in the Offshore Project Area during construction, O&M, or decommissioning may experience certain effects from Project-related activities. Descriptions of the marine mammal species, their distribution and abundance, and estimated densities in the vicinity of the Offshore Project Area are based on reviews of existing technical reports, academic publications, and public reports (e.g., press releases), where relevant, to describe recent events not yet published. Examples of primary data sources referenced in this assessment include the following:

- Marine Mammal Stock Assessment Reports and Potential Biological Removal (PBR) Levels (Hayes et al. 2017, 2018a, 2019, 2020, 2021);

- Ocean Wind Power Ecological Baseline Studies conducted for the New Jersey Department of Environmental Protection (NJDEP) Office of Science by the Geo-Marine, Inc. (Geo-Marine 2010);

- NOAA Northeast Fisheries Science Center's (NEFSC's) Atlantic Marine Assessment Program for Protected Species (AMAPPS);
    - Phase I surveys conducted from 2010 to 2014 (NEFSC and SEFSC 2011a, 2011b, 2012, 2014a, 2014b);
    - Phase II surveys from 2015 to 2019 (NEFSC and SEFSC 2015, 2016, 2018, 2019); and
- Duke University Habitat-based Cetacean Density Models (Roberts et al. 2015, 2016a, 2016b, 2017, 2018, 2020, 2021, 2022) that combine data from 15 aerial and shipboard surveys covering 556,127 mile (mi) (895,000 kilometers [km]) of track line in the Western Atlantic over 22 years from 1992 to 2014.

Atlantic Shores has completed an underwater acoustic and animal exposure modeling analysis for impact pile-driving and other sound sources based on the maximum Project Design Envelope (PDE) (see Appendix II-L). The results of this analysis and its potential effects on marine mammals are discussed in Section 4.7.2.2.

### 4.7.2 Marine Mammal Species

There are 16 marine mammal species that are known to be present either seasonally or year-round in the Northwest Atlantic Outer Continental Shelf (OCS) (see Section 4.7-1). Marine mammals present in this region are represented by the Cetacea order, which includes five mysticetes (baleen whales) and nine odontocetes (toothed whales, dolphins, and porpoise), and the Pinnipedia order, which includes two species of phocids (earless seals). Baleen whales migrate seasonally between cold high-latitude feeding grounds in summer and warm low-latitude breeding/nursery grounds in winter, rarely spending extended time in a single area. Odontocetes, or toothed whales, occupy coastal, shelf, and slope/deep water habitats inclusive, and further offshore, of the Mid-Atlantic Bight. Most toothed whale species do not undergo long-range seasonal migrations, instead moving between southern and northern waters of the western North Atlantic or between shelf waters and deeper waters beyond the shelf break within a relatively regionalized area (Hayes et al. 2020). Phocid species of the western North Atlantic primarily occupy coastal and shelf habitats in the cooler waters north of Cape Cod, Massachusetts to eastern Canada and Maine throughout the year (Hayes et al. 2020).

Table 4.7-1 provides a list of the 16 marine mammal species present in the OCS and their relative occurrence in the Offshore Project Area. Species categories for relative occurrence include:

- Common – Occurring consistently in moderate to large numbers.
- Regular – Occurring in low to moderate numbers on a regular basis or seasonally.
- Uncommon – Occurring in low numbers or on an irregular basis.

The protection status, stock identification, occurrence, and abundance estimate of the species listed in Table 4.7-1 and categorized as common, regular, and uncommon, are discussed in more detail.

There were no Risso's dolphins, pilot whales or Atlantic white-sided dolphin sightings during the New Jersey Ecological Baseline Studies conducted by Geo-Marine (2010); however, these species are characterized as uncommon and discussed in this section because they are expected to be seasonal visitors off of New Jersey and New York based on historic occurrence data (Roberts et al. 2018, NYSERDA 2017).

### Table 4.7-1. Marine Mammal Species in the Mid- and North Atlantic Outer Continental Shelf

| Species | Scientific name | Stock | Regulatory status[a] | Relative occurrence in Atlantic Shores | Abundance[b] | Modeled species |
|---|---|---|---|---|---|---|
| **Baleen whales (Mysticeti)** | | | | | | |
| Fin whale | *Balaenoptera physalus* | West North Atlantic | ESA Endangered<br>MMPA Depleted and Strategic | Common | 6,802 | Y |
| Humpback whale | *Megaptera novaeangliae* | Gulf of Maine | MMPA Non-strategic | Common | 1,396 | Y |
| Minke whale | *Balaenoptera acutorostrata* | Canadian East Coast | MMPA Non-strategic | Common | 21,968 | Y |
| North Atlantic right whale | *Eubalaena glacialis* | West North Atlantic | ESA Endangered<br>MMPA Depleted and Strategic | Common | 338[c] | Y |

| Species | Scientific name | Stock | Regulatory status[a] | Relative occurrence in Atlantic Shores | Abundance[b] | Modeled species |
|---|---|---|---|---|---|---|
| Sei whale | *B. borealis* | Nova Scotia | ESA Endangered<br>MMPA Depleted and Strategic | Common | 6,292 | Y |
| **Toothed whales (Odontoceti)** | | | | | | |
| **Sperm whale (Physeteridae)** | | | | | | |
| Sperm whale | *Physeter macrocephalus* | North Atlantic | ESA Endangered<br>MMPA Depleted and Strategic | Uncommon | 4,349 | Y |
| **Dolphin family (Delphinidae)** | | | | | | |
| Atlantic spotted dolphin | *Stenella frontalis* | West North Atlantic | MMPA Non-strategic | Uncommon | 39,921 | Y |
| Atlantic white-sided dolphin | *Lagenorhynchus acutus* | West North Atlantic | MMPA Non-strategic | Common | 93,233 | Y |

| Species | Scientific name | Stock | Regulatory status[a] | Relative occurrence in Atlantic Shores | Abundance[b] | Modeled species |
|---|---|---|---|---|---|---|
| Bottlenose dolphin | *Tursiops truncatus* | West North Atlantic, Offshore | MMPA Non-strategic | Common | 62,851[d] | Y |
| Bottlenose dolphin | *T. truncatus* | West North Atlantic, Northern Migratory Coastal | MMPA Non-strategic | Common | 6,639[d] | Y |
| Pilot whale, long-finned | *Globicephala melas* | West North Atlantic | MMPA Non-strategic | Uncommon | 39,215 | Y |
| Pilot whale, short-finned | *Globicephala macrorhynchus* | West North Atlantic | MMPA Non-strategic | Uncommon | 28,924 | Y |
| Risso's dolphin | *Grampus griseus* | West North Atlantic | MMPA Non-strategic | Uncommon | 35,215 | Y |
| Short-beaked common dolphin | *Delphinus delphis* | West North Atlantic | MMPA Non-strategic | Common | 172,974 | Y |
| **Dwarf and pygmy sperm whales (Kogiidae)** | | | | | | |
| **Porpoises (Phocoenidae)** | | | | | | |
| Harbor porpoise | *Phocoena phocoena* | Gulf of Maine/Bay of Fundy | MMPA Non-strategic | Common | 95,543 | Y |

| Species | Scientific name | Stock | Regulatory status[a] | Relative occurrence in Atlantic Shores | Abundance[b] | Modeled species |
|---|---|---|---|---|---|---|
| **Earless seals (Phocidae)** | | | | | | |
| Gray seal | *Halichoerus grypus* | West North Atlantic | MMPA Non-strategic | Common | 27,300[f] | Y |
| Harbor seal | *Phoca vitulina* | West North Atlantic | MMPA Non-strategic | Common | 61,336 | Y |

[a] Denotes the highest Federal regulatory classification. A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal level; 2) that is declining and likely to be listed as threatened under the ESA; or 3) that is listed as threatened or endangered under the ESA or as depleted under the MMPA (NOAA Fisheries 2019).

[b] Best available population estimate is from NOAA Fisheries Stock Assessment Reports (NOAA Fisheries 2021a).

[c] Best available population estimate is from NOAA Fisheries Stock Assessment (NOAA Fisheries 2023). NARW consortium has released the 2021 report card results estimating a NARW population of 336 for 2020 (Pettis et al. 2022). However, the consortium “alters” the methods of (Pace et al. 2017) to subtract additional mortality. This method is used in order to estimate all mortality, not just the observed mortality, therefore, the 2022 SAR (NOAA Fisheries 2023) will be used to report an unaltered output of the (Pace et al. 2017, 2021) model (DoC and NOAA 2020).

[d] Common bottlenose dolphins occurring in the Project Area could belong to either the Western North Atlantic Offshore stock or the Western North Atlantic Coastal Migratory stock.

[e] Estimate of gray seal population in US waters. Data are derived from pup production estimates. NOAA Fisheries (2021a) notes that uncertainty about the relationship between whelping areas along with a lack of reproductive and mortality data make it difficult to reliably assess the population trend.

### 4.7.2.1 Baleen Whales

**Fin Whales (*Balaenoptera physalus*)**

Fin whales are the second largest species of baleen whale that occur in the northern hemisphere, with a maximum length of about 75 feet (ft) (22.8 meters [m]) (NOAA Fisheries 2018b). These whales have a sleek, streamlined body with a V-shaped head that makes them fast swimmers. Fin whales have a distinctive coloration pattern: the dorsal and lateral sides of their bodies are black or dark brownish-gray while the ventral surface is white. The lower jaw is dark on the left side and white on the right side. Fin whales feed on krill (*Euphausiacea*), small schooling fish (e.g., herring [*Clupea harengus*], capelin [*Mallotus villosus*], sand lance [Ammodytidae spp.]), and squid (*Teuthida* spp.) by lunging into schools of prey (Kenney and Vigness-Raposa 2010). Fin whales are low-frequency cetaceans producing short duration down sweep calls between 15 and 30 Hertz (Hz), typically termed “20-Hz pulses”, as well as other signals up to 1 kilohertz (kHz) (Southall et al. 2019). The sound level (SL) of fin whale vocalizations can reach 186 decibels (dB) re 1 µPa, making them one of the most powerful biological sounds in the ocean (Charif et al. 2002).

Distribution

Fin whales found offshore U.S. Atlantic, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991), which has been named the Western North Atlantic stock. The current understanding of stock boundaries, however, remains uncertain (Hayes et al. 2019). The range of fin whales in the western North Atlantic extends from the Gulf of Mexico and Caribbean Sea to the southeastern coast of Newfoundland. Fin whales are common in waters of the U.S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward. There is evidence that fin whales are present year-round throughout much of the U.S. EEZ north of 35° N, but population densities change seasonally (NOAA Fisheries 2018b, Hayes et al. 2019). Fin whales are the most commonly observed large whales in continental shelf waters from the Mid-Atlantic coast of the United States to Nova Scotia (Sergeant 1977, Sutcliffe and Brodie 1977, CeTAP 1982, Hain et al. 1992), and were the most common baleen whale species detected in an ecological baseline survey conducted in coastal New Jersey waters, which surveyed an area that encompassed 97% of the New Jersey Wind Energy Area (Geo-Marine 2010, BOEM 2012). They were also documented to have a consistent occurrence in the NYSERDA area of analysis offshore New York (NYSERDA 2017). Fin whales are the dominant large cetacean species during all seasons from Cape Hatteras to Nova Scotia, having the largest standing stock, the largest food requirements, and, therefore, the largest influence on ecosystem processes of any baleen whale species (Hain et al. 1992, Kenney et al. 1997).

Fin whales have a high multi-seasonal relative abundance in U.S. Mid-Atlantic waters, and surrounding areas. During the Geo-Marine (2010) survey, most fin whale sightings were observed during winter and summer and this was confirmed byacoustic data (CETAP 1982)during the Geo-Marine sighting study (Geo-Marine 2010).

Within the study area, group size ranged from one to four animals with a mean distance from shore of 20 km and a mean water depth of 21.5 m (Geo-Marine 2010). One calf was observed with an adult fin whale in the area (Geo-Marine 2010). There were mixed aggregations of feeding humpbacks during fin whale sightings, and with the presence of known prey species, it is possible that fin whales feed in this area (Geo-Marine 2010).

While fin whales are reported to feed in the Gulf of Maine and the waters surrounding New England, their mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992, Hayes et al. 2019). Recordings from the Atlantic Continental Shelf and deep-ocean areas have detected fin whale vocalizations from September through June (Watkins et al. 1987, Clark and Gagnon 2002, Morano et al. 2012, Davis et al. 2020). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the western North Atlantic for most of the year (Hayes et al. 2021). It is likely that fin whales occurring within the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions; however, the hypothesis that fin whale populations make distinct annual migrations like other mysticetes has been questioned(Hayes et al. 2021). Based on an analysis of neonate stranding data, Hain et al. (1992) suggest that calving occurs during October to January in latitudes of the U.S. Mid-Atlantic region.

Low-frequency vocalizing fin whale pulses were detected in the northern and eastern range of the study area where shelf waters are typically deeper (Geo-Marine 2010). Fin whales were acoustically detected on 281 days between March 2008 to October 2009 (46%) and documented in every month of acoustic recording indicating a lack of seasonal trends (Geo-Marine 2010). As the detection range for fin whale vocalizations is more than 108 nautical miles (nm) (200 km), detected signals may have originated from areas far outside of the study area; however, the acoustic presence suggest that this species can be found regularly along the New Jersey outer continental shelf (Geo-Marine 2010).

Abundance

The best available abundance estimate for the western North Atlantic fin whale stock in U.S. waters from National Marine Fisheries Service (NMFS) stock assessments is 6,802 individuals (Hayes et al. 2021). Current and maximum net productivity rates and population trends are unknown for this stock due to relatively imprecise abundance estimates and variable survey design (Hayes et al. 2020). From 2015 to 2019, the annual estimated human-caused mortality rate was approximately two whales per year, caused by incidental fishery interactions and vessel collisions; however, this estimate is biased low due to haphazard detections of carcasses (Hayes et al. 2021). Potential biological removal (PBR) for fin whales (11) was calculated based on the most recent stock assessment reports (Hayes et al. 2021).

Status

The fin whale is Federally listed under the United States Endangered Species Act (ESA) as an endangered marine mammal, listed as endangered under the NJDEP Endangered Species Conservation Act, and listed as endangered under the New York State Department of Environmental Conservation (NYSDEC) Endangered Species Regulations. It is also designated as a strategic stock under the Marine Mammal Protection Act (MMPA) due to its endangered status under the ESA, uncertain human-caused mortality, and incomplete survey coverage of the stock's defined range.

**Humpback Whales (*Megaptera novaeangliae*)**

Humpback whale body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify humpback whale individuals. This baleen whale species feeds on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales use unique behaviors, including lunge feeding, bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NMFS 1991). Humpback whales are sexually dimorphic with females larger than males, reaching lengths of up to 59 ft (18 m) (NOAA Fisheries 2018d), and reaching sexual maturity between the ages four and ten with females producing a single calf every two to three years.

Humpback whales are low-frequency cetaceans but have one of the most varied vocal repertoires of baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic "song". Songs are variable but typically occupy frequency bands between

300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham 2004, Vu et al. 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, low-frequency pulses (with sound levels up to 176 dB re 1 μPa) between 25 and 90 Hz (Clark and Clapham 2004, Vu et al. 2012).

Distribution

Humpback whales are a cosmopolitan species and widely distributed in the Western Atlantic. Most humpback whales that inhabit the waters within the U.S. Atlantic EEZ belong to the Gulf of Maine stock, formerly called the Western North Atlantic Stock. Humpback whales in the Gulf of Maine stock typically feed in the waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but have also been observed feeding off the coast of New York (Sieswerda et al. 2015). Humpback whales from feeding areas encompassing the Gulf of Maine, migrate to the West Indies (including the Antilles, Dominican Republic, Virgin Islands, and Puerto Rico) in winter, where they mate and calve their young (Katona and Beard 1990, Palsbøll et al. 1997). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies during winter as significant numbers of animals have been observed in mid- and high-latitude regions at this time (Swingle et al. 1993). There have been several wintertime humpback whale sightings in coastal waters of the eastern U.S., including 46 sightings in the New York-New Jersey Harbor Estuary documented between 2011 and 2016 (Brown et al. 2017).

Humpback whales are known to occur regularly throughout the Mid-Atlantic Bight, including New Jersey waters Geo-Marine 2010) and New York waters (NYSERDA 2017). The occurrence of this population is strongly seasonal with most observations occurring during the spring and fall, with a peak from April to June (Geo-Marine 2010, Curtice et al. 2019). There have also been documented strandings from the New Jersey coast (Barco et al. 2002). Geo-Marine (2010) observed humpback whales during all seasons including seven observations during winter. Group size tended to be single animals or pairs with a mean distance from shore of 11.4 mi (18.4 km) and a mean depth of 67 ft (20.5 m) (Geo-Marine 2010). Acoustic data indicate that humpback whales may be present within the surrounding areas year-round, with the highest rates of acoustic detections in adjacent waters in winter and spring (Kraus et al. 2016). Acoustic detections do not differentiate between individuals, so detections on multiple days could be the same or different individuals. Humpback whales have previously been observed feeding off the coast of New Jersey with juveniles exhibiting feeding behavior just south of the study area near the mouth of the Chesapeake Bay (Swingle et al. 2006). There was one instance of observed lunge-feeding within the study area (Geo-Marine 2010). Additionally, one cow-calf pair was seen north of the study area boundary (Geo-Marine 2010).

Abundance

The Gulf of Maine humpback whale stock consists of approximately 1,396 whales and is characterized by a positive trend in abundance with a maximum annual production rate estimate of 6.5% (Barlow and Clapham 1997, Hayes et al. 2020). The most significant anthropogenic causes of mortality to humpback whales remain incidental fishery entanglements, responsible for roughly eight whale mortalities, and vessel collisions, responsible for four mortalities both on average annually from 2013 to 2017 (Hayes et al. 2020).

Status

The humpback whale was listed under the ESA as endangered throughout its range until 2016 when NOAA Fisheries revised the listing and defined 14 distinct population segments (DPS) based on breeding populations. Under the final determination, the three DPSs that occur in U.S. waters are listed as threatened or endangered (81 FR 62259, September 8, 2016). The humpback whale is also listed as endangered under the NJDEP Endangered Species Conservation Act and the NYSDEC Endangered Species Regulations.

The Gulf of Maine humpback whale stock is not considered depleted because it does not coincide with any ESA-listed DPS. The detected level of U.S. fishery-caused mortality and serious injury, derived from the limited records, , does not exceed the calculated PBR and, therefore, negates this as a strategic stock (if the recovery factor is set at 0.5) (Hayes et al. 2019) under the MMPA.

Humpback whales in the western North Atlantic have been experiencing an Unusual Mortality Event (UME) since January 2016 that appears to be related to a larger than usual number of vessel collisions (NOAA Fisheries 2018g). In total, 76 humpback whale mortalities were documented through July 25, 2018, as part of this event (NOAA Fisheries 2018g). A biologically important area (BIA) for humpback whales for feeding from March to December has been designated in the Gulf of Maine, Stellwagen Bank, and the Great South Channel; all of which are north of the Lease Area (LaBrecque et al. 2015).

**Minke Whales (*Balaenoptera acutorostrata*)**

Minke whales are a relatively small baleen whale species reaching 33 ft (10 m) in length with a dark gray-to-black back and a white ventral surface (NOAA Fisheries 2018j). The minke whale diet is comprised primarily of crustaceans, schooling fish, and copepods. Minke whales generally travel in small groups (one to three individuals), but larger groups have been observed on feeding grounds (NOAA Fisheries 2018j). Like other baleen whales, minke whales use low-frequency sounds to communicate with one another and to locate prey. They are believed to make mechanical sound calls and a variety of grunts, moans, and belches (Gedamke 2004).

Distribution

This species has a cosmopolitan distribution in temperate, tropical, and high latitude waters (Hayes et al. 2018b). Common and widely distributed within the U.S. Atlantic EEZ, these whales are the third most abundant great whale (any of the larger marine mammals of the order Cetacea) within the U.S. Atlantic EEZ (CETAP 1982). Until better information is available, minke whales within the U.S. Atlantic EEZ are considered part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45°W) to the Gulf of Mexico. It is uncertain if separate sub-stocks exist within the Canadian East Coast stock.

Like many of the other pelagic baleen whales, minke whales conduct seasonal migrations between high latitude summer feeding waters and low latitude winter breeding and calving grounds. Acoustic monitoring surveys indicate minke whales leave wintering grounds for their northern migrations from March through April and move south once again in mid-October through November (Risch et al. 2014).

Although primarily documented near the continental shelf offshore of New Jersey (Schwartz 1962, Mead 1975, Potter 1979, Rowlett 1980, Potter 1984, Winn et al. 1985, DoN 2005), minke whales have been sighted nearshore at water depths of 36 ft (11 m) (Geo-Marine 2010). Acoustic recordings of minke whales have been detected north of the Lease Area within the New York Bight during the fall (August to December) and winter (February to May) (Biedron et al. 2009). A juvenile minke whale was sighted north of the Lease Area near New York Harbor in April, 2007 (Hamazaki 2002). The expected occurrence of minke whales near the Lease Area is likely due to the availability of prey species, such as capelin, herring, mackerel, and sand lance in this region (Kenney et al. 1985, Horwood 1989). Based on habitat information and predictive habitat models, Hamazaki (2002) determined that minke whales are likely to occur in nearshore waters off New Jersey.

Minke whales are most common off New Jersey in coastal waters in the spring and early summer as they move north to feeding ground in New England and fall as they migrate south (Geo-Marine 2010). Geo-Marine (2010) observed four minke whales near the Lease Area and surrounding waters during winter and spring. This species demonstrated a distinct seasonal habitat usage pattern that was consistent throughout the study. The two winter sightings were recorded in February, northeast of Barnegat Light whereas the two spring sightings were recorded in June, southeast of Sea Isle City. Minke whale sightings off the coast of New Jersey were within water depths of 36 to 79 ft (11 to 24 m) and temperatures ranging from 5.4 to 11.5°C (47°F) (Geo-Marine 2010).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammal. Common calls for minke whales found in the North Atlantic include repetitive, low-frequency (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short duration (50 to 70 milliseconds [ms]) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 ms) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a six to 14 minute pattern of 40 to 60 second pulse trains over several hours (Risch et al. 2013). Minke whales produce a unique sound called the "boing", which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but unidentified for many years and had scientists widely speculating as to its source (Rankin and Barlow 2005).

Abundance

Recent abundance estimates for the Canadian East Coast minke whale stock is 21,968 individuals as of 2016 (Hayes et al. 2021). Current population trends and net productivity rates of minke whales in this region are currently unknown. The average annual human-caused mortality is estimated to be 10.55 whales per year caused by entanglement in fishing gear and vessel strike between 2015 and 2019 (Hayes et al. 2021).

Status

Minke whales are not listed as threatened or endangered under the ESA or under the NJDEP Endangered Species Conservation Act or NYSDEC Endangered Species Regulations. Minke whales are also not designated as a strategic stock under the MMPA.

### North Atlantic Right Whales *(Eubalaena glacialis)*

North Atlantic right whales (NARW) are among the most endangered of all marine mammal species in the Atlantic Ocean. The average adult NARW can grow to approximately 50 ft (15 m) in length, while calves are typically 14 ft (4 m) at birth (NOAA Fisheries 2018m). Members of this species have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2019). They are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NOAA Fisheries 2018m). Female whales become sexually mature at about age ten and carry a single calf during a year-long gestation period every six to ten years. The life span of NARW is estimated at 70 years, based on the estimated age of found deceased right whales and other closely related species (NOAA Fisheries 2020b).

NARWs are low-frequency cetaceans that vocalize using several distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al. 2014). One typical right whale vocalization is the "up call": a short sweep that rises from roughly 50 to 440 Hz over a period of 2 seconds. These up calls are characteristic of the NARW and are used by research and monitoring programs to determine species presence. A characteristic "gunshot" call is believed to be produced by male NARWs. These pulses can have sound levels of 174 to 192 dB re 1 μPa with frequency range from 50 to 2,000 Hz (Parks et al. 2005, Parks and Tyack 2005). Other tonal calls range from 20 to 1,000 Hz and have sound levels between 137 and 162 dB re 1 μPa.

Distribution

NARWs in U.S. waters belong to the Western Stock. This stock ranges primarily from calving grounds in coastal waters of the southeastern U.S. to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2019). Surveys indicate that there are seven distinct areas where NARWs congregate seasonally: the coastal waters of the southeastern U.S., the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Hayes et al. 2018b). National Marine Fisheries Service (NMFS) has designated two critical habitat areas for the NARW under the ESA: The Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida. Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009). Davis et al. (2017) recently pooled detections from a large number of passive acoustic devices and documented broad-scale use of the Atlantic Seaboard than previously believed. Further, there has been an apparent shift in habitat use patterns (Davis et al. 2017), which includes an increased use of Cape Cod Bay (Mayo et al. 2018) and decreased use of the Great South Channel.

Movements within and between habitats are extensive (Hayes et al. 2019), and there is a high interannual variability in NARW use of some habitats (Pendleton et al. 2009).

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the Mid-Atlantic region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). NARWs are mainly present in the Lease Area in winter, with another smaller peak in spring, ranging elsewhere for their main feeding and breeding/calving activities (Geo-Marine 2010). NARW typically occupy coastal and shelf waters within 56 mi (90 km) of the shoreline; however, they have been observed as far as 87 mi (140 km) offshore. These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the eastern U.S. coast to their calving grounds in the waters of the southeastern United States (Kenney and Vigness-Raposa 2010). The Lease Area is located within the NARW migration BIA (Figure 4.7-1). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008). Migrating NARWs have been detected acoustically north of the Lease Area in the New York Bight from February to May and then again in August through December (Biedron et al. 2009). The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the Mid-Atlantic region and has been recorded off the coast of New Jersey in all months of the year (Whitt et al. 2013). The NARW population peaks in the Lease Area during winter, with another smaller peak during spring, ranging elsewhere for their main feeding and breeding/calving activities (Geo-Marine 2010). NARW typically occupy coastal and shelf waters within 56 mi (90 km) of the shoreline; however, they have been observed as far as 87 mi (140 km) offshore. These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the eastern U.S. coast to their calving grounds in the waters of the southeastern United States (Kenney and Vigness-Raposa 2010). The Lease Area is located within the NARW migration BIA (Figure 4.7-4). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008). Migrating NARWs have been detected acoustically north of the Lease Area in the New York Bight from February to May and then again in August through December (Biedron et al. 2009).

Historically, there have been several documented sightings of NARW off the coast of New Jersey and surrounding waters (CETAP 1982, Knowlton and Kraus 2001, Biedron et al. 2009). These waters are important migratory routes for NARW as this species travels to their feeding areas near the Gulf of Maine/Georges Bank regions and their breeding/calving grounds off the southeastern U.S. (DoC 2016). Satellite-monitored radio tags on a NARW cow and calf documented the migratory route of this pair from the Bay of Fundy to New Jersey and back during a six-week period (Knowlton et al. 2002). A few NARW sightings were documented south of the Lease Area near the Delaware Bay in October, December, May, and July (Knowlton et al. 2002). Other visual recordings of NARW were found in New Jersey waters during the spring and fall seasons (CETAP 1982). An entanglement mortality event of a NARW was recorded off the coast of New Jersey in October (Knowlton et al. 2002).

It has been noted, however, that NARW sightings in several traditional feeding habitats have been declining, causing speculation that a shift in NARW habitat usage may be occurring (Pettis et al. 2017).

Geo-Marine (2010) observed NARWs offshore of New Jersey during all seasons; except for summer. Three sightings of this species were documented in November, December, and January (Geo-Marine 2010). NARWs exhibit notable seasonal variability, with maximum occurrence in winter (December to February) and minimum occurrence in spring and summer. These sightings were likely to be migrant movements towards breeding and calving grounds located north and south of the Lease Area (Winn et al. 1986, Cole et al. 2009). NARWs detected in the Geo-Marine (2010) study area off the coast of New Jersey were seen as single animals or pairs. These sightings occurred within water depths from 56 to 85 ft (17 to 26 m) with distances from shore ranging from 10.7 to 17.2 nm (19.9 to 31.9 km). A January 2009 sighting documented two adult males offshore of Barnegat Light in the northernmost portion of the Geo-Marine (2010) study area. In May 2008, a cow-calf pair were documented in waters (56 ft [17 m] isobath) southeast of Atlantic City (Geo-Marine 2010; M. Zani, New England Aquarium, pers. comm. 6 January 2020).

Abundance

The population of the western Atlantic NARW stock has been in decline since 2011, with a minimum population estimate of 338 (Hayes et al. 2023). Population growth rates remain low (2.5%), as average calves born per year between 1990 and 2019 was 15 and ranged from one to thirty-nine per year (Hayes et al. 2021). In more recent years, female production has fallen, likely a result of lower female survival rate. The most significant causes of anthropogenic mortality to NARW include incidental fishery entanglement, which takes an estimated six right whales per year, and vessel strikes, which take an estimated two whales per year (Hayes et al. 2021).

Status

The NARW was listed as a Federally endangered species in 1970 and remains critically endangered throughout its range. The NARW is also listed as endangered under the NJDEP Endangered Species Conservation Act and the NYSDEC Endangered Species Regulations. In addition to its endangered status, the high rate of annual human-related mortality classifies NARW as a strategic stock under the MMPA. An unusual mortality event (UME) was established for NARWs in June 2017. Thirty documented NARW deaths and 8 seriously injured free-swimming whales have been documented as of 2019 (NOAA Fisheries 2020e).

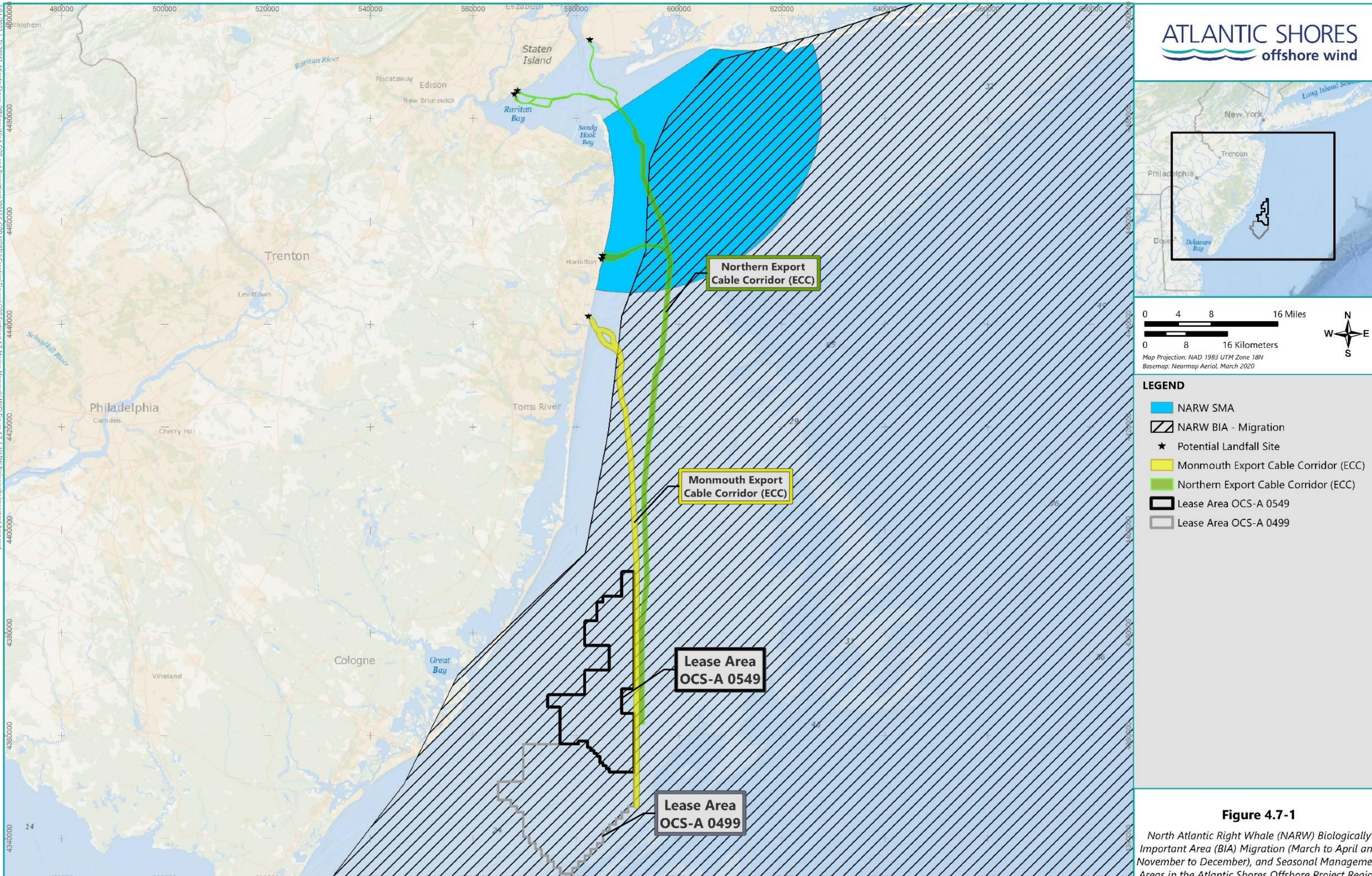



**Figure 4.7-1**

*North Atlantic Right Whale (NARW) Biologically Important Area (BIA) Migration (March to April and November to December), and Seasonal Management Areas in the Atlantic Shores Offshore Project Region*

## Sei Whales (*Balaenoptera borealis*)

Sei whales can reach lengths of about 39 to 59 ft (12 to 18 m) and have  a long, sleek body that is dark bluish-gray to black in color and pale underneath (NOAA Fisheries 2018f). Their diet is comprised primarily of plankton including krill and copepods, schooling fish, and cephalopods. Sei whales generally travel in small groups (two to five individuals), but larger groups are observed on feeding grounds (NOAA Fisheries 2018f).

Sei whales, like all baleen whales, are categorized as low-frequency cetaceans. There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly low-frequency (less than 1,000 Hz) vocalizations. Calls attributed to sei whales include pulse trains up to 3 kHz, broadband “growl” and “whoosh” sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (McDonald et al. 2005, Rankin and Barlow 2007, Baumgartner et al. 2008).

### Distribution

Sei whales are relatively widespread; the stock that occurs within the U.S. Atlantic EEZ is the Nova Scotia stock, ranges along the continental shelf waters of the northeastern U.S. to Newfoundland (Hayes et al. 2017). Sighting data suggest sei whale distribution is largely centered in the waters of New England and eastern Canada (Roberts et al. 2016a, Hayes et al. 2017) and while there appears to be a strong seasonal component to sei whale distribution, they are most abundant in adjacent waters near the continental shelf from winter to spring (Roberts et al 2016a). This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters (Hayes et al. 2017). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (1987 and 1989) and Stellwagen Bank (1986) areas (Payne and Heinemann 1990, Waring et al. 2016). An influx of sei whales into the southern Gulf of Maine occurred in summer 1986 (Schilling et al. 1992). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

There has been little detection of sei whales within New Jersey, New York, and surrounding waters (Kenney et al. 1985, Geo-Marine 2010. NYSERDA 2017). According to the New Jersey Endangered and Non-Game Species Program (ENSP), there have been no sightings of this species documented within State waters. On the shelf offshore of New Jersey, sei whales have been detected in spring. Approximately 200 sei whale vocalizations were detected in mid-September 2006 (Newhall et al. 2009); however, it is unlikely that the sei whale will be present farther nearshore by the Lease Area.

### Abundance

The best available abundance estimate for the Nova Scotia stock of sei whales from NMFS stock assessments is 6,292 individuals (Hayes et al. 2017, 2021). This estimate is considered low because the full range of the stock was not surveyed, nor did the estimate include availability-bias correction for submerged animals, or population structure errors (Hayes et al. 2017).

Status

Sei whales are listed as endangered under the ESA, the NJ Endangered Species Conservation Act, and the NYSDEC Endangered Species Regulations. The Nova Scotia stock, which is estimated at 3098, is considered strategic by NMFS under the MMPA. The maximum productivity rate for sei whales is 0.04, the default value for cetaceans. The recovery factor is 0.10 because the sei whale is listed as endangered under the ESA. Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a recovery factor and with the minimum population size. The Nova Scotia stock of the sei whale is 6.2 since the population is estimated at 3098, has a productivity rate of 0.4, and a recovery factor is 0.10 (Hayes et al. 2021). No critical habitat areas are designated for the sei whale under the ESA. A BIA for feeding for sei whales occurs north of the Lease Area in the Gulf of Maine from May through November (LaBrecque et al. 2015).

### 4.7.2.2 Toothed Whales

**Atlantic White-Sided Dolphins (*Lagenorhynchus acutus*)**

Atlantic white-sided dolphins are common in temperate waters of the western North Atlantic, have a distinctive yellowish-tan patch near their fluke and white patches below the dorsal fin and ventral sides, on both sides of their long, slender bodies. These dolphins grow up to 9 ft (2.7 m) in length and weigh between 400 and 500 pounds as adults. Like other dolphins, Atlantic white-sided dolphins communicate vocally and non-vocally through signals producing burst-pulse sounds and echolocation clicks and whistles (Popper 1980).

Distribution

Atlantic white-sided dolphins observed off the U.S. Atlantic coast are part of the Western North Atlantic Stock (Hayes et al. 2019). This stock inhabits waters from central West Greenland to North Carolina (about 35°N), primarily in continental shelf waters to the 328 ft (100 m) depth contour (Doksæter et al. 2008). Sighting data indicate seasonal shifts in distribution (Northridge et al. 1997); from January to May, low numbers of Atlantic white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire) and from June through September, larger numbers of Atlantic white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, they occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). =

No Atlantic white-sided dolphins were observed during the Geo-Marine (2010) study., The NJ ENSP noted that there is little information on the sightings of this species and that more information is needed to accurately assess the abundance of Atlantic white-sided dolphins within State waters (see CETAP 1982, Selzer and Payne 1988, Waring et al. 2007, Bowers-Altman and NJ Division of Fish and Wildlife 2009). A shallow water (~188 ft [36 m]) marine mammal survey off New Jersey found no presence of Atlantic white-sided dolphin among seasons (Kenney et al. 1985: p. 91), which further implies that it is unlikely for this species to be present within the Lease Area. Although regional surveys found very limited presence of this species near the Lease Area, data adapted from Roberts et al.

(2016b; 2017; 2018) via the MDAT (Curtice et al. 2019; MDAT 2021) indicate abundance in this region increases in the spring. Peak seasonal abundance was observed by Sadove and Cardinale (1993) between March and July in the New York Bight region (NYSERDA 2017). Therefore, Atlantic white-sided dolphins may be present in the nearshore areas (i.e., less than 230 feet [70 m; NYSERDA 2017]) of the Offshore Project Area.

Abundance

Roberts et al. (2016a, 2018) habitat-based density models provide an abundance estimate of 37,180 Atlantic white-sided dolphins within the U.S. Atlantic EEZ. There are insufficient data to determine seasonal abundance estimates of Atlantic white-sided dolphins off the U.S. Atlantic coast or their status within the U.S. Atlantic EEZ. The best available abundance estimate for the Western North Atlantic stock of Atlantic white-sided dolphins is 93,233 individuals, which is derived from data collected during a summer survey in 2016 (Hayes et al. 2021).

Status

The Atlantic white-sided dolphin is not listed as threatened or endangered under the ESA, the NJDEP Endangered Species Conservation Act, or the NYSDEC Endangered Species Regulations. The Western North Atlantic stock of Atlantic white-sided dolphins is not classified as strategic under the MMPA.

**Atlantic Spotted Dolphin (*Stenella frontalis*)**

Atlantic spotted dolphins have a robust body with a curved, tall dorsal fin and moderately long beaks (NOAA Fisheries 2022). This species can range in length from 5 to 7.5 feet (1.5 to 2.1 m) long and weigh between 220 and 315 pounds (NOAA Fisheries 2022). There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin et al. 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and one that is smaller in size with less spots (Fulling et al. 2003; Mullin and Fulling 2003, 2004; Viricel and Rosel 2014). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Its hearing is in the mid-frequency range (Southall et al. 2007).

Distribution

The Western North Atlantic stock of the Atlantic spotted dolphin can be found from southern New England to the Gulf of Mexico and Venezuela (NOAA Fisheries 2022). Though the waters off the coast of New Jersey are located within the distributional range of the Atlantic spotted dolphin, the species was not included in the Geo-Marine (2010) study. The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 33 ft to 650 ft (10 m to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep. It has been suggested that the species may move inshore seasonally during the spring, a phenomenon that has been observed during aerial surveys off the coast of New York (Caldwell and Caldwell 1966; Fritts et al. 1983, NYSERDA 2017). However, such observations off the coast of New York occurred around Montauk Point, which is 100 nm (185 km) east of the Offshore

Project Area. Given the lack of inclusion in the New Jersey ecological baseline studies and documented presence off the coast of New York occurring 100 nm (185 km) east of the Offshore Project Area, presence of the Atlantic spotted dolphin is expected to be uncommon in the Project Area. Monthly modeled distribution of Atlantic spotted dolphin also supports low densities in the Offshore Project Area (Roberts et. al 2021).

Abundance

The best population estimate for the Atlantic spotted dolphin is approximately 39,921 individuals (NOAA Fisheries 2022). Population levels of the Atlantic spotted dolphin are influenced by fishery interactions (particularly long-line fisheries) and strandings (NOAA Fisheries 2022). From 2013 to 2017, no fishery-related mortality or serious injury was reported, however 21 strandings were reported along the coastline from North Carolina to Florida (NOAA Fisheries 2022).

Status

Atlantic spotted dolphin is not listed as threatened or endangered under the ESA, the NJDEP Endangered Species Conservation Act, or the NYSDEC Endangered Species Regulations. It is also not designated as a strategic stock under the MMPA.

**Common Bottlenose Dolphins (*Tursiops truncatus*)**

Bottlenose dolphins are one of the most well-known and widely distributed species of marine mammals. These dolphins reach 7 to 13 ft (2 to 4 m) in length and are light gray to black in color (NOAA Fisheries 2018a). Bottlenose dolphins are commonly found in groups of two to 15 individuals, though aggregations in the hundreds are occasionally observed (NOAA Fisheries 2018a). They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, shrimp, and other crustaceans (Jefferson et al. 2008). Bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN 2008).

Distribution

There are multiple genetically distinct bottlenose dolphin stocks present in the Mid-Atlantic including the Western North Atlantic Offshore stock and Northern Migratory Coastal stock (Mead and Potter 1995). The Western North Atlantic Offshore stock inhabits the outer continental slope and shelf edge regions from Georges Bank to the Florida Keys (Hayes et al. 2017). Sightings of this stock of bottlenose dolphin occur from Cape Hatteras to the eastern end of Georges Bank (Kenney 1990). The Northern Migratory Coastal Stock migrates seasonally within coastal waters of the western North Atlantic. The coastal migratory stock typically inhabits nearshore waters with depths less than 80 ft (25 m) north of Cape Hatteras. During warmer months, this stock resides in waters to the 66 ft (20 m) isobath within New York, Long Island, Virginia, and Assateague (Garrison et al. 2017b). During late summer, fall, and during cooler months (January to February), the Migratory Coastal stock occupies coastal waters from Cape Lookout, North Carolina to North Carolina/Virginia border (Garrison et al. 2017b).

Off the coast of New Jersey and New York, bottlenose dolphins (likely from the Coastal Migratory stock, although there is thought to be some range overlap from the Offshore stock) can occur throughout the year (NYSERDA 2017, Geo-Marine 2010, BOEM 2012). Bottlenose dolphins were the most frequently detected species in an ecological baseline survey conducted in coastal New Jersey waters (Geo-Marine 2010, BOEM 2012). Seasonal movements north along the coast occur during the warmer months, likely directed by the presence of prey (Hayes et al. 2018b). Targeted prey species vary by area, season, and stock; however, sciaenid fishes, such as Atlantic croaker, weakfish, and squid, are common (NOAA Fisheries 2020c). The Northeast Fisheries Science Center (NEFSC) observed bottlenose dolphins during the AMAPPS surveys (NEFSC and SEFSC 2011a, 2011b, 2012, 2014a, 2014b, 2015, 2016, 2018, 2019).

Bottlenose dolphins were the most frequently observed species during the Geo-Marine (2010) study period. A total of 319 bottlenose dolphins with group sizes averaging 15.3 animals were detected offshore of New Jersey (Geo-Marine 2010). Several other monitoring efforts recorded sightings of this species during geophysical surveys in the potential windfarm sites (including the Lease Area) southeast of Atlantic City (Geo-Marine 2009a, 2009b). Bottlenose dolphins are also identified as one of the most common marine mammals in the New York Bight area based on numerous aerial surveys conducted off the coast of New York (NYSERDA 2017). Bottlenose dolphins have been present annually near and offshore of New Jersey and New York; with greater sightings during spring and summer months (Geo-Marine 2010). Given the documented presence of bottlenose dolphins off the coast of New Jersey and New York, they are expected to occur in the Offshore Project Area.

<u>Abundance</u>

The best available population estimate for the northern migratory coastal stock is 6,639 bottlenose dolphins, while the offshore stock abundance is estimated at 62,851 individuals (Hayes et al. 2018b, 2020). Current population estimates indicate there is no significant trend in abundance for either stock. Total annual human-caused mortality is unknown for both stocks. Total annual fisheries mortality and serious injury is estimated as 28 individuals for the offshore stock (from 2013 to 2017) and between 6 and 13 individuals for the coastal stock (between 2011 to 2015; Hayes et al. 2018b, 2020).

<u>Status</u>

The offshore stock of bottlenose dolphin is not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA. The northern migratory coastal stock of bottlenose dolphins is designated as a strategic stock under MMPA due to its depleted status and biased low fisheries mortality estimates (Hayes et al. 2018b). The bottlenose dolphin is listed as a species of special concern by the NJ ENSP.

#### Pilot Whales (*Globicephala spp.*)

Two species of pilot whale occur within the western North Atlantic: the long-finned pilot whale (*Globicephala melas*) and the short-finned pilot whale (*Globicephala macrorhynchus*).

These species are difficult to differentiate visually and acoustically due to similarity in appearance at the surface and vocalizations that overlap in frequency range. Consequently, the two pilot whale species cannot be reliably differentiated (Rone and Pace 2012, Hayes et al. 2019); unless otherwise stated, the descriptions below refer to both species. Pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 24 ft (7.3 m) in length (NOAA Fisheries 2018e). These whales form large, relatively stable aggregations that appear to be maternally determined (American Cetacean Society 2018). Pilot whales feed primarily on squid but also eat small to medium-sized fish and octopus when available (NOAA Fisheries 2018e, 2018i). The occurrence of long-finned and short-finned pilot whales is considered uncommon in the Lease Area.

Pilot whales are acoustic mid-frequency specialists with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Pilot whales echolocate and produce tonal calls. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about one second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al. 2014).

Distribution

Within the U.S. Atlantic EEZ, both long- and short-finned pilot whales are categorized into Western North Atlantic stocks. In U.S. Atlantic waters, pilot whales are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring ( CETAP 1982, Payne and Heinemann 1993, Abend and Smith 1999, Hamazaki 2002). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982, Payne and Heinemann 1993). Short-finned pilot whales are present within warm temperate to tropical waters and long-finned pilot whales occur in temperate and subpolar waters. Long-finned and short-finned pilot whales overlap spatially along the Mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993, Hayes et al. 2019). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have stranded as far north as Massachusetts (Hayes et al. 2017). The latitudinal ranges of the two species therefore remain uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42° N, most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2021).

Long-finned and short-finned pilot whales have been known to occur offshore of New Jersey and New York (Abend and Smith 1999, Tyler 2008, Hayes et al. 2017, NYSERDA 2017). Both species likely overlap along the shelf break between New Jersey and Georges Bank, however, there is limited information on the spatial and temporal distribution of both species in the Offshore Project Area (Hayes et al. 2017). For instance, pilot whales were not detected during the Geo-Marine (2010) study. Pilot whales have been detected in waters of the New York Bight; however, such observations occurred in waters close to the continental slope which is located far beyond the Offshore Project Area (NYSERDA 2017). The limited information of pilot whale presence within the Offshore Project Area is likely based on the habitat preference and overall distribution of pilot whales (Hayes et al. 2017).

Further, the consensus from the NJ ENSP determined that pilot whales are primarily pelagic and have a rare presence in New Jersey waters (Bowers-Altman and NJ Division of Fish and Wildlife 2009). Given their habitat preferences and lack of documented observations in the vicinity of the Offshore Project Area, they are not expected to occur in the Offshore Project Area.

Abundance

The best available estimate for long-finned and short-finned pilot whale abundance are 39,215 whales and 28,924 whales, respectively as of surveys conducted through 2016 (Lawson and Gosselin 2018, Hayes et al. 2021). Estimates of population trend or net productivity rates have not been calculated for long-finned pilot whales as abundance estimates remain highly uncertain due to long survey intervals. From 2015 to 2019, total annual observed fishery-related mortality or serious injury was nine long-finned pilot whales (Hayes et al. 2021). In addition, to direct human-induced mortality, mass strandings of long-finned pilot whales have occurred throughout their range. Between 2015 and 2019, seven long-finned pilot whales were found stranded between Maine and Florida (Hayes et al. 2021).

Status

Neither the long-finned or short-finned pilot whale species is listed as threatened or endangered under the ESA, the NJDEP Endangered Species Conservation Act, or the NYSDEC Endangered Species Regulations. The Western North Atlantic stock is not considered strategic under the MMPA.

**Risso's Dolphins (*Grampus griseus*)**

Risso's dolphins occur worldwide in both tropical and temperate waters (Jefferson et al. 2008, Jefferson et al. 2014). This species of dolphin attains a body length of approximately 9 to 13 ft (2.6 to 4 m) (NOAA Fisheries 2018k), a narrow tailstock, and a whitish or gray body. Risso's dolphins form groups ranging from 10 to 30 individuals (NOAA Fisheries 2018k). They feed primarily on squid as well as fish, such as anchovies, krill, and other cephalopods (NOAA Fisheries 2018k). Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations range from 400 Hz to 65 kHz (DoN 2008).

Distribution

Risso's dolphins within the U.S. Atlantic EEZ are part of the Western North Atlantic stock. The Western North Atlantic stock of Risso's dolphins inhabits waters from Florida to eastern Newfoundland (Leatherwood et al. 1976, Baird and Stacey 1991). During spring, summer, and fall, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank (CeTAP 1982, Payne et al. 1984). In winter, the distribution extends outward into oceanic waters (Payne et al. 1984) within the Mid-Atlantic Bight, however, very little is known about movement and migration patterns, and they are infrequently observed in shelf waters. The stock may contain multiple demographically independent populations that should themselves be considered stocks because the current stock spans multiple eco-regions (Longhurst 1998, Spalding et al. 2007).

There is limited data regarding Risso's dolphin observations offshore of New Jersey. Increased strandings of this species were recorded from 2003 to 2004 on New York, New Jersey, and Delaware coasts (DiGiovanni et al. 2005a).

Other than strandings, this species has been primarily documented on the shelf break off of New Jersey and New York (DiGiovanni et al. 2005b; NYSERDA 2017). There were no Risso's dolphins documented during the Geo-Marine (2010) study. Off the coast of New York, Risso's dolphins are typically found in waters deeper than 164 ft (50 m), with occasional sightings occurring in shallower Long Island Sound and bays (NYSERDA 2017). However, one Risso's dolphin observation was recorded during Atlantic Shores' 2020 geophysical campaign. Therefore, Risso's dolphins could occur in the Offshore Project Area.

<u>Abundance</u>

The best abundance estimate for Risso's dolphins is 35,215 individuals, calculated from 2016 surveys conducted by Northeast Fisheries Science Center (NEFSC) and Department of Fisheries and Oceans Canada (DFO) (Hayes et al. 2021). Estimates of population trend or net productivity rates have not been calculated for Risso's dolphins. Annual average estimated human-caused mortality or serious injury from 2015 to 2019 was 34 dolphins, most of which was likely due to interactions with fisheries (Hayes et al. 2021).

<u>Status</u>

Risso's dolphins are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA. They are also not listed as threatened or endangered under the NJDEP Endangered Species Conservation Act or the NYSDEC Endangered Species Regulations.

### Short-Beaked Common Dolphins (*Delphinus delphis*)

Short-beaked common dolphins (*Delphinus delphis*) are one of the most widely distributed cetaceans and occur in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked common dolphins can reach 9 ft (2.7 m) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NOAA Fisheries 2018h). This species feeds on schooling fish and squid found near the surface at night (NOAA Fisheries 2018h). Short-beaked common dolphins are in the mid-frequency functional hearing group. Their vocalizations range from 300 Hz to 44 kHz (Southall et al. 2007).

<u>Distribution</u>

Short-beaked common dolphins within the U.S. Atlantic EEZ belong to the Western North Atlantic stock, generally occurring from Cape Hatteras to the Scotian Shelf (Hayes et al. 2018b). Short-beaked common dolphins are a highly seasonal, migratory species. Within the U.S. Atlantic EEZ, this species is distributed along the continental shelf and is associated with Gulf Stream features (CeTAP 1982, Selzer and Payne 1988, Hamazaki 2002, Hayes et al. 2019). Short-beaked common dolphins occur from Cape Hatteras northeast to Georges Bank (35° to 42°N) during mid-January to

May and move as far north as the Scotian Shelf from mid-summer to fall (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 51.8°Fahrenheit (11°Celsius) (Sergeant et al. 1970, Gowans and Whitehead 1995). Breeding usually takes place between June and September, with females estimated to have a calving interval of two to three years (Hayes et al. 2019).

There have been numerous sightings of short-beaked common dolphins throughout the New Jersey coastline (Ulmer 1981, Hamazaki 2002). Generally, this species has been documented 20 nm (>37 km) near the shelf break within the months of February, May, and July, however, they have been sighted throughout the year (Geo-Marine 2010). Short-beaked common dolphins are most common at the surface and are regularly observed in large groups consisting of hundreds of animals (NOAA Fisheries 2020a). Multiple strandings of the short-beaked common dolphins have occurred along the New Jersey and New York coasts (NOAA/NMFS 2004; NOAA Fisheries 2017). Geo-Marine (2010) recorded a total of 32 short-short beaked common dolphin sightings off the coast of New Jersey. The observed species were documented in waters ranging from 33 to 102 ft (10 to 21 m) (Geo-Marine 2010). Approximately 26% of the shipboard sightings were calves during the Geo-Marine (2010) study. In waters off the coast of New York, sightings of short-beaked common dolphin typically occur near the shelf break and slope in the spring and summer and dispersed across the shelf in the fall and winter (NYSERDA 2017). Given their habitat preference, short-beaked common dolphin could occur in the offshore extents of the Offshore Project Area.

Abundance

The best abundance estimate for the western north Atlantic stock of short-beaked common dolphins is 172,947 individuals based on 2016 survey results. Average annual estimated human-caused mortality and serious injury for short-beaked common dolphins between 2015 to 2019 was 390.49 animals (Hayes et al. 2021).

Status

Short-beaked common dolphins are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA. They are also not listed as threatened or endangered under the NJDEP Endangered Species Conservation Act or the NYSDEC Endangered Species Regulations.

**Sperm Whales (*Physeter macrocephalus*)**

Sperm whales are the largest of the toothed whales and characterized by their large, bulbous heads. Adults can achieve 15 tons (females) to 45 tons (males). They mainly reside in deep-water habitats on the OCS, along the shelf edge, and in mid-ocean regions (NOAA Fisheries 2010). However, this species has also been observed in relatively high numbers in shallow continental shelf areas off the coast of southern New England (Scott and Sadove 1997). Sperm whale vocalizations include directional clicks, from less than 100 Hz to 30 kHz with most of the clicks in the 5 to 25 kHz range. Sperm whales use echolocation and produce repeated patterns of clicks or codas, which are used to attract females, compete for mates, display aggression, and maintain group cohesion (Wahlberg 2002). Foraging sperm whales make regularly spaced clicks interrupted by "creaks" and very rapid clicking for locating and capturing prey (Wahlberg 2002; Richardson et al. 1995).

Distribution

Sperm whale migratory patterns are not well-defined, and no obvious migration patterns have been observed in certain tropical and temperate areas. However, general trends suggest that most populations move poleward during summer (Waring et al. 2015). Within U.S. Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CETAP 1982, Scott and Sadove 1997). During winter, sperm whales are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the Mid-Atlantic Bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the Mid-Atlantic region. In fall, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the Mid-Atlantic Bight.

There were no sperm whale sightings during the Geo-Marine (2010) study; however, approximately nine individuals were observed offshore of New Jersey near the OCS during shipboard surveys in summer 2011 (Palka 2012). There is substantial information on sperm whale occurrence offshore of New Jersey, but they are exclusively in deeper waters near the OCS (CETAP, 1982 Waring et al. 2007) and are unlikely to be present within the Lease Area. Similar to the waters off of New Jersey, waters off the coast of New York provide habitat for sperm whale primarily in the deep waters of the continental shelf break and slope; however, sightings have occurred in New York waters inshore of the 328-ft (100-m) depth contour (NYSERDA 2017). Due to the rare occurrence of sperm whales within New Jersey waters, the NJ ENSP recommends that the species should be removed from the New Jersey list of species (Bowers-Altman and NJ Division of Fish and Wildlife 2009). Given the observations of sperm whales documented in shipboard surveys, and their known presence off the coast of New Jersey and New York, sperm whales could occur in the Offshore Project Area.

Abundance

Though there is currently no reliable estimate of total sperm whale abundance in the entire western North Atlantic, the most recent and best available population estimate for the U.S. Atlantic EEZ is 4,439 (Hayes et al. 2020).

Status

Sperm whales are listed as endangered under the ESA, the NJDEP Endangered Species Conservation Act, and the NYSDEC Endangered Species Regulations. The North Atlantic stock is considered strategic by NMFS under the MMPA.

### Harbor Porpoises (*Phocoena phocoena*)

The harbor porpoise is abundant throughout the coastal waters of the Northern hemisphere and the only porpoise species found in the Atlantic Ocean. This species is the smallest cetacean, with a blunt, short-beaked head, dark gray back, and white underside (NOAA Fisheries 2018c). Harbor porpoises reach a maximum length of 6 ft (1.8 m) and feed on a wide variety of small fish and cephalopods (Reeves and Read 2003, Kenney and Vigness-Raposa 2010). Most harbor porpoise groups are small, usually between five and six individuals, although they aggregate into large groups for feeding or migration (Jefferson et al. 2008). Harbor porpoises are considered high-frequency cetaceans. The dominant component of harbor porpoise echolocation signals are narrowband, high-frequency clicks within 130 to 142 kHz (Villadsgaard et al. 2007).

Distribution

The harbor porpoise occupies both coastal and deep waters from off the coast of North Carolina to Greenland. They are commonly found in bays, estuaries, harbors, and fjords less than 656 ft (200 m) deep (NOAA Fisheries 2018c). Hayes et al. (2019) report that harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during summer (July to September). During fall (October to December) and spring (April to June), they are more widely dispersed from New Jersey to Maine. In winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina with lower densities found in waters off New York to New Brunswick, Canada (Hayes et al. 2019).

There are four distinct populations of harbor porpoise in the western Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Hayes et al. 2019). Harbor porpoises observed within the U.S. Atlantic EEZ are considered part of the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises are a frequently sighted cetacean offshore of New Jersey (Geo-Marine 2010). During the Geo-Marine (2010) study, 51 harbor porpoise sightings were documented approximately 0.8 to 19.8 nm (1.5 to 36.6 km) from shore (mean = 10.5 nm/19.5 km). These sightings were primarily during winter months (February to March). Off the coast of New York, harbor porpoises have been sighted year-round in both offshore and nearshore environments; however, their presence decreases during summer months (NYSERDA 2017, NYSDEC 2013). This marine mammal will likely be present within the Offshore Project Area.

Abundance

According to data collected in 2016 by Northeast Fisheries Science Center (NEFSC) and DFO, the best abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoises is 95,543 individuals (Hayes et al. 2021). The total annual estimated average human-caused mortality and serious injury is 163 harbor porpoises per year based on fisheries observer data (Hayes et al. 2020).

Status

Harbor porpoises are not listed as threatened or endangered under the ESA or designated as a strategic stock under the MMPA. Harbor porpoises are listed as a species of special concern by the NJ ENSP and the NYSDEC Endangered Species Program.

### 4.7.2.3 Pinnipeds

**Gray Seals (*Halichoerus grypus*)**

Gray seals are large, reaching 7 to 10 ft (2 to 3 m) in length, and have a silver-gray coat with scattered dark spots (NOAA Fisheries 2018l). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, gray seals can dive to depths of 984 ft (300 m) and frequently forage on the OCS (Lesage and Hammill 2001, Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner 1971, Reeves 1992, Jefferson et al. 2008). They often co-occur with harbor seals because their habitat and feeding preferences overlap (NOAA Fisheries 2018l). Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DoN 2008).

Distribution

Gray seals are the second most common pinniped along the U.S. Atlantic coast (Jefferson et al. 2008). This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). Gray seals range from Canada to New Jersey; however, stranding records as far south as Cape Hatteras (Gilbert et al. 2005) have been recorded. The eastern Canadian population of gray seals ranges from New Jersey to Labrador and is centered at Sable Island, Nova Scotia (Davies 1957, Mansfield 1966, Richardson and Rough 1993, Lesage and Hammill 2001). There are three breeding concentrations in eastern Canada: Sable Island, Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In U.S. waters, gray seals primarily pup at four established colonies: Muskeget and Monomoy islands in Massachusetts, and Green and Seal Islands in Maine. Since 2010, pupping has also been observed at Noman's Island in Massachusetts and Wooden Ball and Matinicus Rock in Maine (Hayes et al. 2019). Although white-coated pups have been stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. Following the breeding season, gray seals may spend several weeks ashore in late spring and early summer while undergoing a yearly molt.

The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2003). For this reason, studies such as the Geo-Marine (2010) did not observe gray seals offshore of New Jersey. However, the Marine Mammal Stranding Center (2020) documented 25 gray seal strandings in 2019. Other reported sightings of gray seal in waters off of New Jersey were found as bycatch in gillnets (Hatch and Orphanides 2017, Orphanides 2019). Gray seal strandings have also been documented along the shores of New York between 2011 and 2015 (NOAA Fisheries 2020f). Gray seals are less likely than harbor seals to occur around the offshore ECC routes or the Lease Area (Hayes et al. 2019).

Abundance

The gray seal is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and Baltic Sea (Haug et al. 2013). The Western North Atlantic stock is equivalent to the Northwest Atlantic population, and ranges from New Jersey to Labrador (Mansfield 1966, Scott et al. 1990, Katona et al. 1993, Lesage and Hammill 2001). In U.S. waters alone, Hayes et al. (2021) estimated an abundance of 27,300. PBR for gray seals (1,389) was calculated based on the most recent stock assessment reports (Hayes et al. 2021).

Status

Gray seals are not listed as threatened or endangered under the ESA, the NJDEP Endangered Species Conservation Act, or the NYSDEC Endangered Species Regulations. They are also not considered strategic under the MMPA.

### Harbor Seals (*Phoca vitulina*)

Adult harbor seals are not sexually dimorphic and both males and females are light gray to dark brown in color and typically reach 4.9 ft (1.5 m) and 220 pounds (100 Kg) in size with a 35-year lifespan (NOAA Fisheries Service 2017). Harbor seals forage in both shallow coastal waters and deeper offshore waters, diving to target prey within the water column or on the seafloor (Tollit et al. 1997). Primary food sources vary with seasonal abundances of fish and crustaceans in the north and Mid-Atlantic coastal region, with the most numerous prey species including sandlance, silver hake, Atlantic Herring, and redfish (NOAA Fisheries Service 2007).

Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories. These calls are comprised of “growls” or “roars” with peak energy at 200 Hz (Sabinsky et al. 2017). Captive studies have shown that harbor seals have good (greater than 50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al. 2009).

Distribution

Harbor seals are found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30° N and is the most abundant pinniped within the U.S. Atlantic EEZ (Hayes et al. 2019). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Richardson and Rough 1993) and occur seasonally from southern New England to New Jersey coasts between September and late May (Schneider and Payne 1983, Barlas 1999, Schroeder 2000). The western North Atlantic stock may occupy southern waters of the Mid-Atlantic Bight during seasonal migrations from the Bay of Fundy in the late autumn and winter (NMFS 2009; (Palka et al. 2017)). In addition to coastal waters, harbor seals utilize terrestrial habitat as haul-out sites throughout the year, but primarily during the pupping and molting periods, which occur from late spring to late summer in the northern portion of their range.

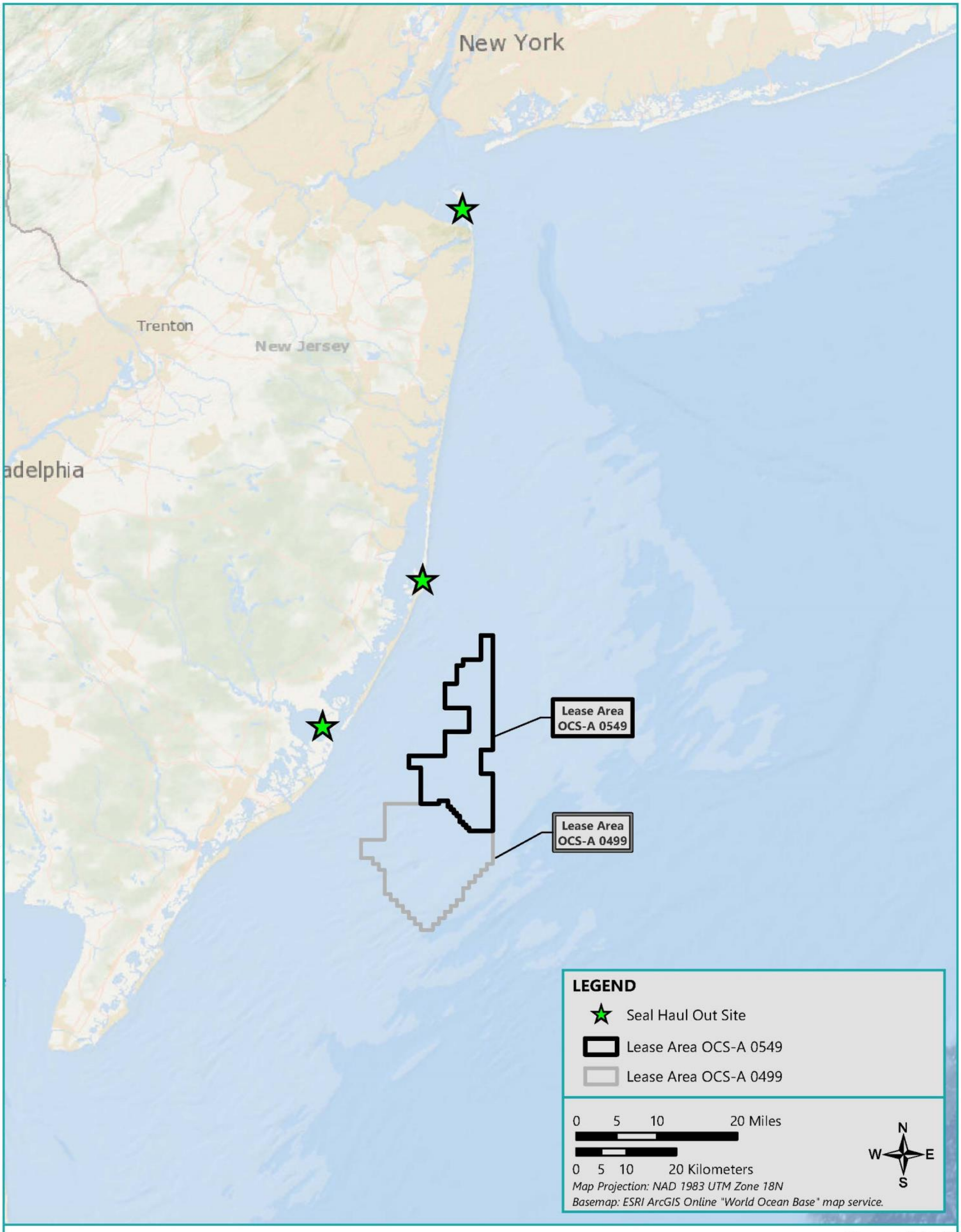
There are three major haul-out sites along the New Jersey coast, located in Great Bay, Sandy Hook, and Barnegay Inlet (Figure 4.7-2: CWFNY 2015). A general southward movement from the Bay of Fundy to southern New England occurs in fall and early winter (Rosenfeld et al. 1988, Whitman and Payne 1990, Barlas 1999, Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada takes place prior to the pupping season, which occurs from mid-May through June along the Maine coast (Richardson 1976, Wilson 1978, Whitman and Payne 1990, Kenney 1994). Geo-Marine (2010) observed one harbor seal offshore of New Jersey during their survey effort. Harbor seal presence in New York is seasonal, with peak numbers occurring from October to March (NYSDERDA 2017). Given the known seasonal presence of harbor seals off the coast of New Jersey and New York and documentation in the Geo-Marine (2010) study, they could occur in the Offshore Project Area.

Abundance

The best current abundance estimate for harbor seals is 61,336 individuals, estimated from survey results and analysis of abundance treads from 1993 to 2018, (Hayes et al. 2021). Annual average estimated human-caused mortality and serious injury to harbor seals (from 2015 to 2019) is 339 seals (Hayes et al. 2021), with death due to fisheries interactions accounting for most of the mortality events. Harbor seal mortality through bycatch is highest in the Northeast Sink Gillnet fishery between Boston, Massachusetts, and Maine. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989, Rough 1995, Barlas 1999, Hoover et al. 1999, Slocum et al. 1999, deHart 2002).

Status

Harbor seals are not listed as threatened or endangered under the ESA, the NJDEP Endangered Species Conservation Act, or the NYSDEC Endangered Species Regulations. In addition, the Western North Atlantic Stock of harbor seals is not considered strategic under the MMPA (Hayes et al. 2020).



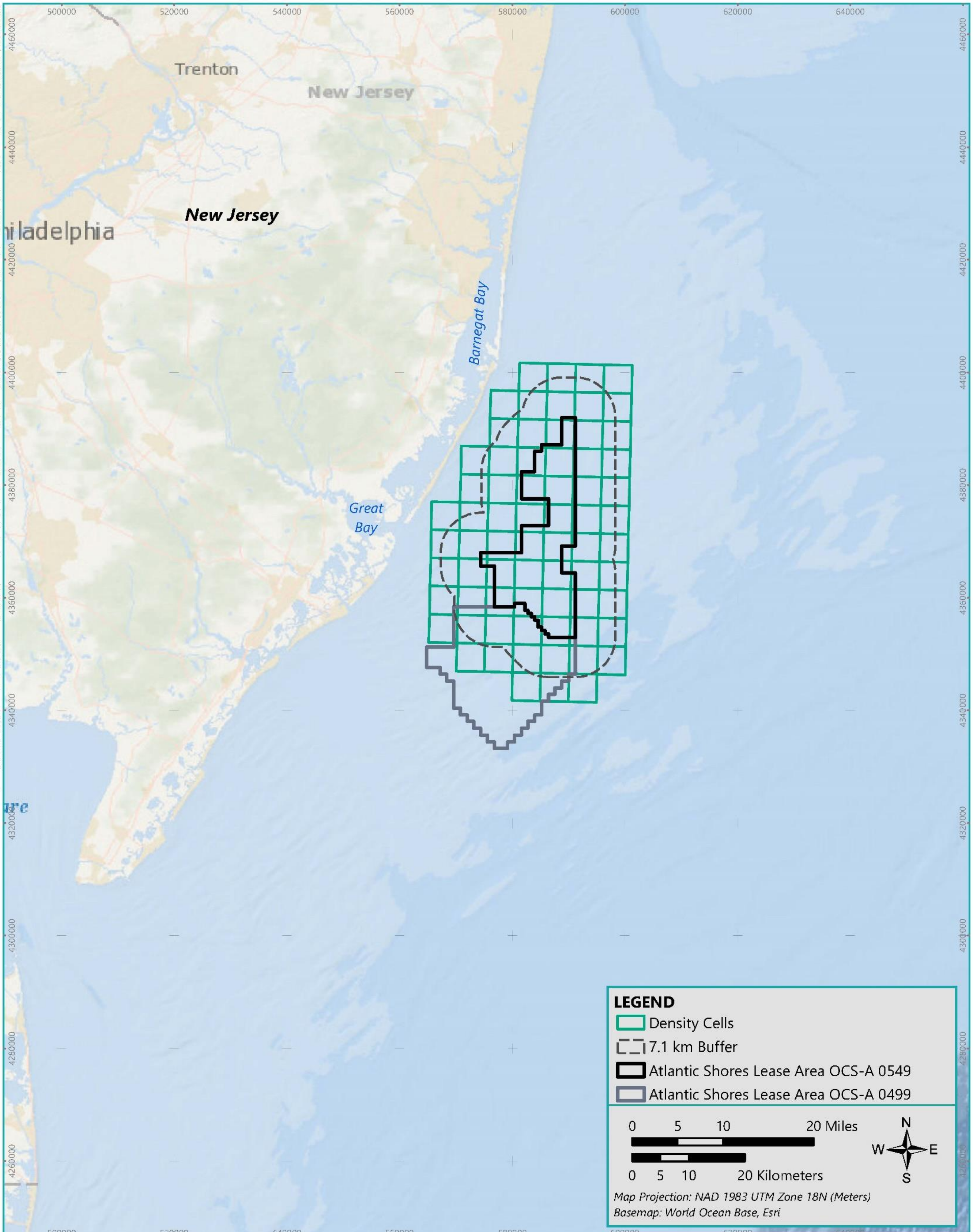

ATLANTIC SHORES offshore wind

**Figure 4.7-2**
*Major Seal Haul-Outs and Pupping Locations Near the Lease Area and ECC*

### 4.7.2.4 Mean Monthly Marine Mammal Density Estimates

As the basis for assessing marine mammal exposure to Project-related activities, the mean monthly marine mammal densities were estimated to understand what species, and at what density, occur in the vicinity of the Lease Area and ECCs. Densities (see Appendix II-L) were calculated within a 7.1 km buffered polygon around the OCS-A 0549 lease area perimeter. The buffer size was selected as the largest 10 dB-attenuated exposure range over all species, scenarios, and threshold criteria, with the exception of the Wood et al. (2012) thresholds. Wood et al. (2012) exposure ranges were not considered in this estimate since they include a small subset of very long ranges for migrating mysticetes and harbor porpoise. Figure 4.7-3 provides a spatial representation of the model used. Additional information regarding the model design and thresholds is provided in Appendix II-L.

The mean species density for each month was determined by calculating the unweighted mean of all grid cells (5 × 5 km for NARW) partially or fully within the buffered polygon. Densities were computed monthly, annually, and for the May–December period to coincide with proposed pile driving activities. For long- and short-finned pilot whales (*Globicephala melas* and *Globicephala macrorhynchus*, respectively), monthly densities are unavailable from Roberts et al. (2016a, 2016b, 2017), so annual mean densities were used. Additionally, Roberts et al. (2016a, 2016b, 2017) provide density for pilot whales as a guild that includes both species. To obtain density estimates for long-finned and short-finned pilot whales, the guild density from Roberts et al. (2016a, 2016b, 2017) was scaled by the relative stock sizes based on the best available abundance estimate from NOAA Fisheries SARs (NOAA Fisheries 2021a). Table 4.7-2 through Table 4.7-5 show the monthly marine mammal density estimates for each species evaluated in the acoustic analysis presented in Appendix II-L.




ATLANTIC SHORES offshore wind

**Figure 4.7-3**

*MGEL (2022) Grid Cells to Calculate Marine Mammal Densities in the Offshore Project Area*

### Table 4.7-2. Potentially Occurring Marine Mammals and Their Respective Monthly (or Annual) Mean Densities (Marine Geospatial Ecology Laboratory, 2022) in the 7.1 km Buffered Lease Area 0549 During the Annual Construction Period (May Through December) for the ASOW North Project; Some Species Were Modeled as a Group

| Marine Mammal Species | | Model Group | Monthly Density (animals/km$^2$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | May | June | July | August | September | October | November | December |
| ***Mysticetes*** | | | | | | | | | | |
| Common minke whale (*Balaenoptera acutorostrata*) | | | 0.00774 | 0.00157 | 0.00034 | 0.00015 | 0.00012 | 0.00066 | 0.00015 | 0.00035 |
| Fin whale (*Balaenoptera physalus physalus*) | | | 0.00075 | 0.00069 | 0.00036 | 0.00022 | 0.00022 | 0.00037 | 0.00041 | 0.00146 |
| Humpback whale (*Megaptera novaeangliae*) | | | 0.00083 | 0.00060 | 0.00013 | 0.00008 | 0.00023 | 0.00076 | 0.00117 | 0.00141 |
| North Atlantic right whale (*Eubalaena glacialis*) | | | 0.00009 | 0.00003 | 0.00001 | 0.00001 | 0.00002 | 0.00003 | 0.00012 | 0.00042 |
| Sei whale (*Balaenoptera borealis*) | | | 0.00022 | 0.00006 | 0.00001 | 0.00001 | 0.00002 | 0.00007 | 0.00030 | 0.00048 |
| ***Odontocetes*** | | | | | | | | | | |
| Atlantic spotted dolphin (*Stenella frontalis*) | | | 0.00002 | 0.00008 | 0.00019 | 0.00062 | 0.00042 | 0.00044 | 0.00029 | 0.00002 |
| Atlantic white-sided dolphin (*Lagenorhynchus acutus*) | | | 0.00482 | 0.00375 | 0.00012 | 0.00004 | 0.00041 | 0.00386 | 0.00506 | 0.00489 |
| Common bottlenose dolphin (*Tursiops truncatus*) | Western North Atlantic Northern Migratory Coastal stock | | 0.23816 | 0.32765 | 0.32684 | 0.34785 | 0.36630 | 0.34530 | 0.33514 | 0.19006 |
| | Western North Atlantic Offshore stock) | | 0.06055 | 0.08442 | 0.08747 | 0.08734 | 0.08235 | 0.08193 | 0.08977 | 0.05813 |

| Marine Mammal Species | Model Group | Monthly Density (animals/km²) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | May | June | July | August | September | October | November | December |
| Harbor porpoise (*Phocoena phocoena*) | | 0.00943 | 0.00039 | 0.00030 | 0.00012 | 0.00002 | 0.00010 | 0.00045 | 0.03064 |
| Long-finned pilot whale[1] (*Globicephala melas*) | Pilot Whale | 0.00006 | | | | | | | |
| Risso's dolphin (*Grampus griseus*) | | 0.00012 | 0.00004 | 0.00002 | 0.00002 | 0.00002 | 0.00007 | 0.00045 | 0.00068 |
| Short-beaked common dolphin (*Delphinus delphis*) | | 0.02101 | 0.00712 | 0.00302 | 0.00151 | 0.00019 | 0.00747 | 0.04034 | 0.03821 |
| Short-finned pilot whale[1] (*Globicephala macrorhynchus)* | Pilot Whale | 0.00005 | | | | | | | |
| Sperm whale (*Physeter macrocephalus*) | | 0.00012 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00005 | 0.00005 |
| ***Pinnipeds*** | | | | | | | | | |
| Gray seal[1] (*Halichoerus grypus*) | Seal | 0.04869 | 0.00958 | 0.00109 | 0.00079 | 0.00162 | 0.00901 | 0.02426 | 0.04794 |
| Harbor seal[1] (*Phoca vitulina vitulina*) | Seal | 0.10939 | 0.02153 | 0.00245 | 0.00176 | 0.00365 | 0.02023 | 0.05449 | 0.10770 |

1 Densities in the MGEL 2022 database are only available for the Pilot Whale and Seal guilds and not for the individual species so these densities were scaled by the ratio of their abundances; additionally, densities for the Pilot Whale guild are only available annually and not monthly

## Table 4.7-3. Potentially Occurring Marine Mammals and Their Respective Monthly (or Annual) Mean Densities (Marine Geospatial Ecology Laboratory, 2022) in the Wolfe's Pond (WP), NY and Monmouth (Mon), NJ Buffered Cofferdam Model Areas Used in the Vibratory Pile Driving Modeling for the Atlantic Shores North Project

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km$^2$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| ***Mysticetes*** | | | | | | | | | | | | | |
| Common minke whale | WP | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00021 |
| | Mon | 0.00013 | 0.00013 | 0.00021 | 0.00319 | 0.00248 | 0.00046 | 0.00021 | 0.00021 | 0.00021 | 0.00021 | 0.00021 | 0.00021 |
| Fin whale | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| | Mon | 0.00035 | 0.00011 | 0.00024 | 0.00030 | 0.00009 | 0.00011 | 0.00005 | 0.00004 | 0.00007 | 0.00009 | 0.00010 | 0.00034 |
| Humpback whale | WP | 0.00042 | 0.00027 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 | 0.00001 |
| | Mon | 0.00076 | 0.00049 | 0.00037 | 0.00001 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00002 | 0.00079 |
| North Atlantic right whale | WP | 0.00016 | 0.00018 | 0.00008 | 0.00005 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00003 | 0.00010 |
| | Mon | 0.00017 | 0.00019 | 0.00021 | 0.00011 | 0.00003 | 0.00001 | 0.00000 | 0.00000 | 0.00001 | 0.00001 | 0.00002 | 0.00010 |
| Sei whale | WP | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00001 |
| | Mon | 0.00020 | 0.00013 | 0.00016 | 0.00020 | 0.00013 | 0.00007 | 0.00002 | 0.00001 | 0.00002 | 0.00005 | 0.00018 | 0.00042 |
| ***Odontocetes*** | | | | | | | | | | | | | |
| Atlantic spotted dolphin | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00002 | 0.00017 | 0.00033 | 0.00020 | 0.00007 | 0.00000 | 0.00000 |
| Atlantic white-sided dolphin | WP | 0.00002 | 0.00001 | 0.00002 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00006 | 0.00005 |
| | Mon | 0.00047 | 0.00030 | 0.00046 | 0.00124 | 0.00052 | 0.00024 | 0.00001 | 0.00001 | 0.00004 | 0.00043 | 0.00105 | 0.00103 |
| Common bottlenose dolphin—Northern Coastal Migratory stock | WP | 0.00172 | 0.00057 | 0.00118 | 0.00797 | 0.01676 | 0.01943 | 0.01716 | 0.01550 | 0.01744 | 0.01908 | 0.01464 | 0.00905 |
| | Mon | 0.03661 | 0.01246 | 0.01631 | 0.06915 | 0.17419 | 0.28310 | 0.22517 | 0.16424 | 0.22768 | 0.29993 | 0.25955 | 0.18494 |
| Harbor porpoise | WP | 0.00170 | 0.00186 | 0.00228 | 0.00304 | 0.00045 | 0.00003 | 0.00001 | 0.00000 | 0.00000 | 0.00002 | 0.00004 | 0.00168 |
| | Mon | 0.01469 | 0.01254 | 0.01607 | 0.01941 | 0.00368 | 0.00024 | 0.00007 | 0.00002 | 0.00001 | 0.00008 | 0.00031 | 0.01563 |
| Long-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |
| Risso's dolphin | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km²) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| Risso's dolphin | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00002 | 0.00008 |
| Short-beaked common dolphin | WP | 0.00046 | 0.00026 | 0.00059 | 0.00222 | 0.00210 | 0.00032 | 0.00001 | 0.00000 | 0.00001 | 0.00034 | 0.00223 | 0.00143 |
| | Mon | 0.00316 | 0.00133 | 0.00201 | 0.00488 | 0.00316 | 0.00059 | 0.00003 | 0.00001 | 0.00002 | 0.00244 | 0.01359 | 0.00974 |
| Short-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |
| Sperm whale | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| | Mon | 0.00001 | 0.00001 | 0.00001 | 0.00003 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00007 | 0.00005 |
| ***Pinnipeds*** | | | | | | | | | | | | | |
| Gray seal* | WP | 0.03959 | 0.03496 | 0.06499 | 0.06373 | 0.01688 | 0.07216 | 0.00961 | 0.00424 | 0.01069 | 0.13527 | 0.05165 | 0.03429 |
| | Mon | 0.02334 | 0.02334 | 0.03255 | 0.03440 | 0.02573 | 0.07851 | 0.00560 | 0.00315 | 0.00727 | 0.05789 | 0.03122 | 0.03866 |
| Harbor seal* | WP | 0.08895 | 0.07855 | 0.14601 | 0.14320 | 0.03792 | 0.16212 | 0.02159 | 0.00952 | 0.02402 | 0.30392 | 0.11604 | 0.07705 |
| | Mon | 0.07808 | 0.05243 | 0.07313 | 0.07729 | 0.05780 | 0.17638 | 0.01258 | 0.00707 | 0.01633 | 0.13005 | 0.07015 | 0.08687 |

*Densities in the MGEL 2022 database are only available for Pilot Whale and Seal guilds/groups and not for the individual species, so these densities were scaled by the ratio of their abundances to derive individual densities for both species of pilot whales and the seals; additionally, densities for the Pilot Whale guild are only available annually and not monthly

## Table 4.7-4. Potentially Occurring Marine Mammals and Their Respective Monthly (or Annual) Mean Densities (Marine Geospatial Ecology Laboratory, 2022) in the Wolfe's Pond (WP), NY and Monmouth (Mon), NJ Buffered Conductor Barrel Model Areas Used in the Impact Pile Driving Modeling for the Atlantic Shores North Project

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km$^2$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| ***Mysticetes*** | | | | | | | | | | | | | |
| Common minke whale | WP | 0.00001 | 0.00001 | 0.00001 | 0.00011 | 0.00008 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00000 | 0.00000 |
| | Mon | 0.00013 | 0.00013 | 0.00021 | 0.00319 | 0.00248 | 0.00046 | 0.00004 | 0.00002 | 0.00004 | 0.00030 | 0.00006 | 0.00011 |
| Fin whale | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| | Mon | 0.00035 | 0.00011 | 0.00024 | 0.00030 | 0.00009 | 0.00011 | 0.00005 | 0.00004 | 0.00007 | 0.00009 | 0.00010 | 0.00034 |
| Humpback whale | WP | 0.00043 | 0.00028 | 0.00037 | 0.00002 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00003 | 0.00079 |
| | Mon | 0.00001 | 0.00000 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00001 |
| North Atlantic right whale | WP | 0.00017 | 0.00019 | 0.00009 | 0.00006 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00003 | 0.00011 |
| | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| Sei whale | WP | 0.00001 | 0.00000 | 0.00000 | 0.00001 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00001 |
| | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| ***Odontocetes*** | | | | | | | | | | | | | |
| Atlantic spotted dolphin | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00002 | 0.00017 | 0.00033 | 0.00020 | 0.00007 | 0.00000 | 0.00000 |
| Atlantic white-sided dolphin | WP | 0.00002 | 0.00002 | 0.00003 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00006 | 0.00005 |
| | Mon | 0.00047 | 0.00030 | 0.00046 | 0.00124 | 0.00052 | 0.00024 | 0.00001 | 0.00001 | 0.00004 | 0.00043 | 0.00105 | 0.00103 |
| Common bottlenose dolphin—Northern Coastal Migratory stock | WP | 0.00197 | 0.00065 | 0.00130 | 0.00836 | 0.01717 | 0.01982 | 0.01813 | 0.01733 | 0.01947 | 0.01985 | 0.01519 | 0.01002 |
| | Mon | 0.03661 | 0.01246 | 0.01631 | 0.06915 | 0.17419 | 0.28310 | 0.22517 | 0.16424 | 0.22768 | 0.29993 | 0.25955 | 0.18494 |
| Harbor porpoise | WP | 0.00190 | 0.00208 | 0.00257 | 0.00347 | 0.00053 | 0.00004 | 0.00001 | 0.00000 | 0.00000 | 0.00002 | 0.00004 | 0.00188 |
| | Mon | 0.00015 | 0.00013 | 0.00016 | 0.00019 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00016 |
| Long-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km$^2$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| Risso's dolphin | WP | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| Risso's dolphin | Mon | 0.00000 | 0.00000 | 0.00000 | 0.00001 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00002 | 0.00008 |
| Short-beaked common dolphin | WP | 0.00062 | 0.00033 | 0.00063 | 0.00180 | 0.00149 | 0.00026 | 0.00001 | 0.00000 | 0.00001 | 0.00048 | 0.00301 | 0.00199 |
| | Mon | 0.00316 | 0.00133 | 0.00201 | 0.00488 | 0.00316 | 0.00059 | 0.00003 | 0.00001 | 0.00002 | 0.00244 | 0.01359 | 0.00974 |
| Short-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |
| Sperm whale | WP | 0.00062 | 0.00033 | 0.00063 | 0.00180 | 0.00149 | 0.00026 | 0.00001 | 0.00000 | 0.00001 | 0.00048 | 0.00301 | 0.00199 |
| | Mon | 0.00001 | 0.00001 | 0.00001 | 0.00003 | 0.00004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00007 | 0.00005 |
| ***Pinnipeds*** | | | | | | | | | | | | | |
| Gray seal* | WP | 0.02918 | 0.02583 | 0.04860 | 0.04724 | 0.01348 | 0.04679 | 0.00828 | 0.00398 | 0.01000 | 0.12665 | 0.03821 | 0.02549 |
| | Mon | 0.00035 | 0.00023 | 0.00033 | 0.00034 | 0.00026 | 0.00079 | 0.00006 | 0.00003 | 0.00007 | 0.00058 | 0.00031 | 0.00039 |
| Harbor seal* | WP | 0.06557 | 0.0582 | 0.10920 | 0.10613 | 0.03028 | 0.10514 | 0.01860 | 0.00895 | 0.02246 | 0.28455 | 0.08585 | 0.05726 |
| | Mon | 0.07808 | 0.05243 | 0.07313 | 0.07729 | 0.05780 | 0.17638 | 0.01258 | 0.00707 | 0.01633 | 0.13005 | 0.07015 | 0.08687 |

*Densities in the MGEL 2022 database are only available for Pilot Whale and Seal guilds/groups and not for the individual species, so these densities were scaled by the ratio of their abundances to derive individual densities for both species of pilot whales and the seals; additionally, densities for the Pilot Whale guild are only available annually and not monthly

## Table 4.7-5. Potentially Occurring Marine Mammals and Their Respective Monthly (or Annual) Mean Densities (Marine Geospatial Ecology Laboratory, 2022) in the Wolfe's Pond (WP), NY and Monmouth (Mon), NJ Buffered Goal Post Model Areas Used in the Vibratory Pile Driving Modeling for the Atlantic Shores North Project

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km$^2$) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| ***Mysticetes*** | | | | | | | | | | | | | |
| Common minke whale | WP | 0.00001 | 0.00001 | 0.00001 | 0.00011 | 0.00008 | 0.00001 | 0 | 0 | 0 | 0.00001 | 0 | 0 |
| | Mon | 0.0002 | 0.0002 | 0.00032 | 0.00496 | 0.00428 | 0.00086 | 0.00009 | 0.00004 | 0.00006 | 0.00042 | 0.0001 | 0.00017 |
| Fin whale | WP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Mon | 0.00102 | 0.00036 | 0.00063 | 0.00078 | 0.0003 | 0.0003 | 0.00018 | 0.00014 | 0.0002 | 0.00023 | 0.0002 | 0.00104 |
| Humpback whale | WP | 0.00043 | 0.00028 | 0.00037 | 0.00002 | 0.00001 | 0.00001 | 0 | 0 | 0 | 0.00001 | 0.00003 | 0.00079 |
| | Mon | 0.00082 | 0.00053 | 0.00083 | 0.00061 | 0.00034 | 0.00032 | 0.0001 | 0.00008 | 0.00015 | 0.00036 | 0.00096 | 0.00131 |
| North Atlantic right whale | WP | 0.00025 | 0.00027 | 0.00011 | 0.00009 | 0.00001 | 0 | 0 | 0 | 0 | 0.00001 | 0.00005 | 0.00017 |
| | Mon | 0.00031 | 0.00034 | 0.00033 | 0.00022 | 0.00005 | 0.00002 | 0.00001 | 0.00001 | 0.00001 | 0.00002 | 0.00005 | 0.0002 |
| Sei whale | WP | 0.00001 | 0 | 0 | 0.00001 | 0.00001 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00001 |
| | Mon | 0.00023 | 0.00015 | 0.0002 | 0.00025 | 0.00016 | 0.00007 | 0.00002 | 0.00001 | 0.00002 | 0.00006 | 0.00022 | 0.00046 |
| ***Odontocetes*** | | | | | | | | | | | | | |
| Atlantic spotted dolphin | WP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Mon | 0 | 0 | 0 | 0 | 0 | 0.00006 | 0.00034 | 0.00064 | 0.00031 | 0.00013 | 0.00001 | 0 |
| Atlantic white-sided dolphin | WP | 0.00002 | 0.00002 | 0.00003 | 0.00003 | 0 | 0 | 0 | 0 | 0 | 0.00001 | 0.00006 | 0.00005 |
| | Mon | 0.00086 | 0.00052 | 0.0008 | 0.00196 | 0.00104 | 0.00045 | 0.00003 | 0.00002 | 0.00011 | 0.00085 | 0.00181 | 0.00184 |
| Common bottlenose dolphin—Northern Coastal Migratory stock | WP | 0.00197 | 0.00065 | 0.0013 | 0.00836 | 0.01717 | 0.01982 | 0.01813 | 0.01733 | 0.01947 | 0.01985 | 0.01519 | 0.01002 |
| | Mon | 0.03629 | 0.01222 | 0.01518 | 0.06307 | 0.161 | 0.26198 | 0.21233 | 0.15753 | 0.20011 | 0.27269 | 0.24134 | 0.17548 |
| Harbor porpoise | WP | 0.0019 | 0.00208 | 0.00257 | 0.00347 | 0.00053 | 0.00004 | 0.00001 | 0 | 0 | 0.00002 | 0.00004 | 0.00188 |
| | Mon | 0.01877 | 0.0163 | 0.02142 | 0.02674 | 0.00519 | 0.00036 | 0.00015 | 0.00004 | 0.00001 | 0.0001 | 0.00038 | 0.0187 |

| Marine Mammal Species | Wolfe's Pond (WP)/ Monmouth (Mon) | Monthly Density (animals/km²) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Marc | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| Long-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |
| Risso's dolphin | WP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Mon | 0.00001 | 0 | 0 | 0.00001 | 0.00001 | 0.00001 | 0 | 0 | 0 | 0 | 0.00004 | 0.00018 |
| Short-beaked common dolphin | WP | 0.00062 | 0.00033 | 0.00063 | 0.0018 | 0.00149 | 0.00026 | 0.00001 | 0 | 0.00001 | 0.00048 | 0.00301 | 0.00199 |
| | Mon | 0.00597 | 0.00234 | 0.00311 | 0.00727 | 0.00529 | 0.00132 | 0.00013 | 0.00005 | 0.00005 | 0.00354 | 0.02004 | 0.01643 |
| Short-finned pilot whale* | WP | 0.00000 | | | | | | | | | | | |
| | Mon | 0.00000 | | | | | | | | | | | |
| Sperm whale | WP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Mon | 0.00001 | 0.00001 | 0.00001 | 0.00004 | 0.00006 | 0 | 0 | 0 | 0 | 0 | 0.00008 | 0.00004 |
| ***Pinnipeds*** | | | | | | | | | | | | | |
| Gray seal* | WP | 0.02918 | 0.02583 | 0.04861 | 0.04724 | 0.01348 | 0.04679 | 0.00828 | 0.00398 | 0.01000 | 0.12665 | 0.03821 | 0.02549 |
| | Mon | 0.04051 | 0.02678 | 0.03408 | 0.03949 | 0.03070 | 0.06438 | 0.00449 | 0.00259 | 0.00574 | 0.04529 | 0.03158 | 0.04051 |
| Harbor seal* | WP | 0.06557 | 0.05802 | 0.10920 | 0.10613 | 0.03028 | 0.10514 | 0.01861 | 0.00895 | 0.02246 | 0.28456 | 0.08585 | 0.05726 |
| | Mon | 0.09103 | 0.06017 | 0.07656 | 0.08873 | 0.06896 | 0.14465 | 0.01008 | 0.00582 | 0.01291 | 0.10176 | 0.07094 | 0.09103 |

*Densities in the MGEL 2022 database are only available for Pilot Whale and Seal guilds/groups and not for the individual species, so these densities were scaled by the ratio of their abundances to derive individual densities for both species of pilot whales and the seals; additionally, densities for the Pilot Whale guild are only available annually and not monthly

### 4.7.2.5 Potential Impacts and Proposed Environmental Protection Measures

The potential Impact Producing Factors (IPFs) that may affect marine mammals during Project construction, O&M, and decommissioning are presented in Table 4.7-6. Marine mammals may also be affected by discharges from vessels and accidental releases; these potential impacts are considered to have a low likelihood of occurrence and are discussed in Section 9.2.3.

**Table 4.7-6. Impact Producing Factors for Marine Mammals**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel movements | ● | ● | ● |
| Noise | ● | ● | ● |
| Installation of new structures and cables | ● | ● | ● |
| Electromagnetic fields | | ● | |
| Light | ● | ● | ● |
| Presences of structures and cables | | ● | ● |

The maximum PDE analyzed for IPFs to marine mammals is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I). Risk of impacts to marine mammals from Project activities can be significantly reduced, if not avoided, with the implementation of monitoring measures designed to detect marine mammals prior to exposure and/or mitigation techniques to lessen the potential for effects. Atlantic Shores is committed to a comprehensive mitigation program, summarized at the end of this section, to avoid and minimize impacts to marine mammals. To date, Atlantic Shores has demonstrated during the completion of its preconstruction surveys that adverse effects to marine mammals can be avoided.

For the purposes of the IPF assessment, potential effects on marine mammals have been categorized as either very low, low, moderate, or high based on the relative risk of exposure and the vulnerability of the marine mammal species to Project-related stressors. Relative risk is determined according to marine mammal species occurrence using existing literature on marine mammal distribution and presence/use of the Lease Area, information on the potential impacts of offshore wind farm construction and operations in both the U.S and globally, and studies that provide a general understanding of hearing, vessel collision risk, response to anthropogenic sound, and other factors that influence the potential impacts of offshore wind construction, O&M, and decommissioning activities on marine mammals. For example, exposure to a species that infrequently occurs in the Lease Area or is not sensitive to a particular IPF (e.g., noise) based on scientific literature, would be categorized as very low or low relative risk of impact to Project-related sound sources. Whereas exposure for an IPF to a species listed under the Endangered Species Act may be categorized as moderate risk.

#### 4.7.2.6 Vessel Movements

Construction, O&M and decommissioning of the Project will require the support of up to 16 types of vessels throughout the lifetime of the Project (see Section 4.10, Table 4.10-1 of Volume 1). Atlantic Shores understands that vessel strikes are considered one of the primary threats to marine mammals and that presence of marine mammals within the Offshore Project Area will have to be monitored throughout all phases of Project development such that vessel interactions with these species can be avoided to the maximum extent practicable.

Studies suggest that vessel collisions pose a greater threat to baleen whales than to other marine species due to their size, mobility, and surface behavior (e.g., Kraus et al. 2005; Parks et al. 2011; Davies and Brilliant 2019). Vessel collision has also been documented as the leading cause of mortality for NARW since the 1970s (Moore et al. 2006). Research indicates that most vessel collisions with whales resulting in serious injury or death occur when a ship is traveling at speeds of over 14 knots (Schoeman et al. 2020).

The greatest potential for Project vessels to interact with marine mammals in the Offshore Project Area will be during transits to and from the Lease Area. Atlantic Shores estimates that approximately 550 to 2,050 vessel round trips to the Offshore Project Area will occur annually during Project operations, which is an average of two to six vessel trips per day. To minimize the potential for vessel interactions with marine mammals during vessel operations, Atlantic Shores will follow Federal guidelines to avoid vessel interactions with whales and adhere to all NOAA-mandated Seasonal Management Areas (SMA) or Dynamic Management Areas (DMAs). Currently, in the Mid-Atlantic, all vessels 65 ft (19.8 m) or greater operating within a SMA must travel at 10 knots or less between November 1 and April 30. For NOAA-established DMAs (which signify a grouping of three or more NARW) all vessels are encouraged to either avoid these areas or reduce speeds to 10 knots or less if transiting through.

Atlantic Shores will also monitor marine mammal activity during all Project phases to ensure that the chances for possible collisions are minimized. Specifically, Atlantic Shores will monitor NOAA notifications from the Right Whale Slow Zones Program, online or the “Whale Alert” app and the NOAA Right Whale Sighting Advisory System for NARW activity in the Offshore Project Area. Environmental training will also be provided to all vessel personnel responsible for operation, navigation, or lookout on marine mammal siting, avoidance, and reporting procedures. Atlantic Shores is also investigating the application of near real-time monitoring, autonomous underwater vehicles, and unmanned aerial systems to support the detection of marine mammals within the Offshore Project Area. With these monitoring measures and the implementation of vessel strike avoidance measures, the risk of marine mammal interactions with Project vessels is considered low to very low.

#### 4.7.2.7 Noise

Noise, as defined as unwanted or disturbing sound, may result from Project activities during all phases of the Project. However, the greatest potential for noise-generating activities will occur during the construction phase of the Project. During construction, noise will be produced by vessels, vehicles, and equipment.

Project-related noises produced during O&M activities are fairly limited to operating WTGs, infrequent surveys, and vessel traffic and are generally not considered a significant IPF for marine mammals. Atlantic Shores will implement a suite of marine mammal monitoring and mitigation measures to decrease the risk of exposures to marine mammals occurring in proximity to noise-inducing Project activities during construction.

Marine mammals use sound, either by actively producing or passively listening to sounds, for basic life functions such as communication, navigation, foraging, detecting predators, and maintaining social networks. Toothed whales (odontocetes) are known to produce echolocation sounds to image their surroundings and find prey. Additionally, marine mammals passively listen to sounds to learn about their environment by gathering information from other marine mammal species, prey species, and physical phenomena such as wind, waves, rain, and seismic activity (Richardson et al. 1995).

Marine mammals exposed to anthropogenic sound may experience impacts ranging in severity from minor disturbance to non-auditory injury (Southall et al. 2007, Wood et al. 2012, NMFS 2018, 2019). The severity of any noise-induced effect on marine mammals depends on the characteristics of received sounds (i.e., received level, frequency band, duration, rise time, duty cycle), the distance the sound travels and the biological context within which it occurs (Ellison et al. 2012, Ellison et al. 2016b, Ellison et al. 2018). The likelihood of a potential impact from an anthropogenic activity is dependent upon ambient conditions, the spatial and temporal co-occurrence of animals and the characteristics of the noise-producing activity.

Based on Project-specific modeling and pertinent findings in published scientific literature, the most likely impact on marine mammals from Project-related noise is assumed to be changes in behavior. Behavioral responses of marine mammals to sound exposure can vary widely, from subtle responses, which may be difficult to observe and have limited implication for the affected animal, to obvious responses, such as avoidance, displacement, or panic reactions (Southall et al. 2016, Russell et al. 2016).

The impact of anthropogenic sounds on marine mammal species is frequency dependent. Southall et al. (2007) assigned the extant marine mammal species to functional hearing groups based on their hearing capabilities and sound production and other biological functions. This division into broad categories was intended to provide a realistic number of categories for which individual sound exposure criteria were developed. These groups were revised by NMFS (2018) but the categorization has proven to be a scientifically justified and useful approach in developing auditory weighting functions and deriving noise exposure criteria for the different marine mammal groups (Table 4.7-7).

## Table 4.7-7. Marine Mammal Hearing Groups (NMFS 2018)

| Hearing Group | Generalized Hearing Range[1] |
|---|---|
| Low-frequency (LF) cetaceans (mysticetes or baleen whales) | 7 Hz to 35 kHz |
| Mid-frequency (MF) cetaceans (odontocetes: delphinids, beaked whales) | 150 Hz to 160 kHz |
| High-frequency (HF) cetaceans (other odontocetes) | 275 Hz to 160 kHz |
| Phocid pinnipeds underwater (PPW) | 50 Hz to 86 kHz |
| Phocid pinnipeds in air | 50 Hz to 36 kHz |

[1]The generalized hearing range is for all species within a group. Individual hearing will vary.

In 2018, NMFS issued voluntary technical guidance for assessing the effects of underwater human-made sound on marine mammals. The guidance recommends received thresholds when marine mammals are predicted to experience changes in hearing sensitivity (temporary or permanent threshold shifts [TTS or PTS] for incidental exposure to underwater man-made sound sources (NMFS 2018). The Technical Guidance document also recognizes two main types of sound sources: impulsive and non-impulsive. Impulsive sound sources generate intense and often repetitive noise (e.g., impact pile-driving). Non-impulsive sources consist of continuous or intermittent sources (e.g., propeller cavitation, sonar, vibratory hammering).

Although NMFS (2018) defined acoustic threshold levels at which PTS and TTS are predicted to occur for each marine mammal hearing group for impulsive and continuous signals, only information about the PTS injury exposure criteria for marine mammals are presented within Appendix II-L. Continuous sound signals do not have the high peak pressure with rapid rise time and decay characteristic of impulsive sounds; instead, the pressure (i.e., intensity) of continuous signals is more consistent throughout the signal. The PTS acoustic threshold levels are defined using metrics of the cumulative sound exposure level (SEL) over a 24-hr period and the peak sound pressure level. For the cumulative SEL, the appropriate frequency weighting for each hearing group is applied, which is reflected in the subscript of each threshold (e.g., the LF cetacean threshold is identified as LE, LC). The cumulative SEL metric considers both received level and duration of exposure over the duration of the activity within a 24-hr period.

The behavioral threshold for marine mammals, which is part of MMPA Level B harassment along with TTS38, is defined by NMFS as 120 dB re 1 µPa (LP) for continuous sources, such as vibratory pile driving, and 160 dB re 1 µPa (LP) for impulsive sources, such as impact pile driving (NMFS, 2005) (Table 4.7-8).

[38]NMFS considers behavioral effects to be the onset of MMPA Level B harassment while TTS is upper Level B harassment.

### Table 4.7-8. Acoustic Threshold Levels for Marine Mammal Injurious (PTS Onset) Harassment (MMPA Level A; NMFS, 2018) and Behavioral Harassment (NOAA, 2005) Associated with Impulsive and Non-Impulsive (Continuous) Sound

| Hearing Group | Impulsive Sounds* | | | Non-Impulsive Sounds | Continuous Sounds |
|---|---|---|---|---|---|
| | PTS Onset | | Behavior (dB re 1μPa) | PTS Onset | Behavior (dB re 1 μPa) |
| | SEL (dB re 1 μPa$^2$-s) | Peak (dB re 1μPa) | | SEL (dB re 1 μPa$^2$-s) | |
| Low-frequency cetaceans (LF) | 183 dB ($L_{E,LF,24h}$) | 219 dB ($L_{pk,0-pk,flat}$) | 160 dB ($L_p$) | 199 dB ($L_{E,LF,24h}$) | 120 dB ($L_p$) |
| Mid-frequency cetaceans (MF) | 185 dB ($L_{E,MF,24h}$) | 230 dB ($L_{pk,0-pk,flat}$) | | 198 dB ($L_{E,MF,24h}$) | |
| High-frequency cetaceans (HF) | 155 dB ($L_{E,HF,24h}$) | 202 dB ($L_{pk,0-pk,flat}$) | | 173 dB ($L_{E,HF,24h}$) | |
| Phocid pinnipeds underwater (PW) | 185 dB ($L_{E,PW,24h}$) | 218 dB ($L_{pk,0-pk,flat}$) | | 201 dB ($L_{E,PW,24h}$) | |

*Dual metric thresholds for impulsive sounds: The metric to be used is whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.

The following subsections address underwater sound that may be generated during activities conducted in the Offshore Project Area, including impulsive pile driving and other noise sources (e.g., HRG surveys, vessels, cable installation, vibratory pile driving, operational WTGs, operational offshore cables, and decommissioning) and assesses the potential effects noise generated from these activities may have on marine mammals. As described in the following subsections, effects to marine mammals from underwater noise will be limited to radial distances from the source where sound levels are above regulatory thresholds. Pile driving noise during construction (if a piled foundation type is chosen) is the most likely to cause potential effects; however, noise mitigating measures (e.g., noise abatement systems such as bubble curtains and hydro-dampeners, soft starts and ramp up procedures, and ramp-down procedures, if necessary) will reduce the likelihood for exposure to harmful underwater sound levels.

**Impact Pile-Driving Noise**

To evaluate the potential risks to marine mammals from impact pile-driving noise, Atlantic Shores conducted an underwater acoustic and animal exposure modeling analysis. An overview of the modeling conducted is provided in Section 8.0 In-Air Noise and Hydroacoustics. The Underwater Acoustic Assessment of Pile Driving and Related Sound-Producing Construction Activities at the Atlantic Shores Offshore Wind North Project is provided in Appendix II-L.

To support the understanding of the potential exposure of marine mammals to pile-driving noise, the underwater acoustic analysis modeled the estimated radial distances (i.e., exposure ranges) to NMFS-recommended injury and behavioral thresholds (Table 4.7-8). The model evaluated distances to NMFS thresholds based on a range of operational conditions (e.g., foundation type, hammer type, pile-driving schedule) as well as levels of potential noise attenuation (ranging from 0 to 15 dB) that could potentially be achieved through the application of industry standard noise abatement systems (NAS). For the exposure assessment on marine mammals, the 10 dB attenuation level was conservatively chosen as the minimum sound reduction achievable with the application of a single NAS, such as a bubble curtain, during pile-driving (Bellmann et al. 2020). It is worth noting, however, that Atlantic Shores is investigating NAS options including, but not limited to, evacuated sleeve systems (e.g., IHC-Noise Mitigation System [NMS]), encapsulated bubble systems, and/or Helmholtz resonators (e.g., the AdBm NMS and HydroSound Dampers [HSDs]). These technologies may be capable of meeting or exceeding 10 dB attenuation during actual pile-driving, which could further decrease the radial distances away from the source of pile-driving noise.

Appendix II-L provides the representative modeling results for pile-driving scenarios that represent the maximum potential exposure ranges (i.e., monopile and post-piled jacket foundations), inclusive of the assumed 10 dB attenuation. The 15-m monopile foundation scenario is predicted to generate the maximum exposure ranges to regulatory-defined injury thresholds for all hearing groups. The 15-m monopile foundation scenario is also predicted to generate the maximum exposure ranges to regulatory-defined behavioral threshold for all hearing groups.

The behavioral threshold (Table 4.7-8) currently used in impact assessments (NOAA 2005) are based on a SPL metric that does not account for species' frequency weighting or the duration of the exposure. However, the longer predicted distances from the pile-driving sound source to these accepted Federal behavioral response thresholds indicate that marine mammals would be exposed to levels of pile-driving noise that will induce changes in behavior before they are exposed to noise levels that could cause injury.

To estimate the number of marine mammals that could be exposed to noise levels above Federal injury and behavior thresholds, important factors such as animal movement and marine mammal density estimates within the greater Lease Area were considered.39 Forecasted animal movements (e.g., diving, foraging, surfacing) were included in the exposure modeling to account for real-life movements when

[39] For modeling purposes, marine mammal densities were calculated within a 31.1 mi (50) km buffered polygon around the Lease Area and OCS-A 0499 Lease Area perimeter including the Monmouth ECC.

estimating exposures by individual marine mammals. Species' distribution and densities were also accounted for because they play a significant role in the number of marine mammal exposures to pile-driving sounds. To account for these factors, the exposure model scales the number of potentially exposed species by their corresponding densities in the Lease Area (Roberts et al. 2016a, 2017, 2020, 2022). For example, habitat for harbor porpoises extends well beyond the Lease Area, and cetacean density estimates indicate that numbers of baleen whales are lower in the Lease Area relative to preferred foraging habitats outside the area thus reducing the likelihood these species will be exposed to pile-driving noises in the Lease Area (LaBrecque et al. 2015).

Results of the marine mammal animal movement and exposure model based on the two most conservative pile-driving scenarios (OSS post-piled jacket and WTG/meteorological [met] tower monopile) with 10 dB attenuation are provided in Appendix II-L. For endangered NARWs, modeled results suggest that, with minimal mitigation, small numbers of injurious level exposures are predicted during construction. Model estimates include the possibility that up to 0. 90NARWs may be exposed to acoustic thresholds for injury with 10 dB noise attenuation mitigation. Sei whales are not anticipated to incur any injurious or behavioral exposures. Fin whales are the other endangered species known to occur in the Lease Area. The model predicted that with 10 dB noise attenuation up to approximately 8.3 individuals could be exposed to acoustic threshold levels of sound for injury from impact pile-driving.

The animal movement model also predicts behavioral level exposures for marine mammals expected to occur in the Lease Area. The probability of exposure to behavioral threshold levels of sound is highest for individuals of species that are considered common or regular, varying by month or season. The two most vulnerable species are NARWs and harbor porpoises for the reasons described above. Density models suggest that both species are seasonal in the Lease Area and predicted to occur in higher densities outside of the Lease Area, indicating suitable habitat is available for any displaced individuals. The model results predicted that fewer than two individual NARWs would be exposed to sound levels that could elicit a behavioral response with 10dB sound attenuation.

As further explained in the Acoustic Modeling and Exposure Report (see Appendix II-L), the modeled results should be interpreted with caution and not as absolute impact numbers because they are conservative and over-estimate both underwater sound propagation distances and the number of marine mammals exposed to potentially injurious or disruptive noises. The reasons for this conservatism are that the model does not account for environmental factors (e.g., ambient noise levels, physical variation of the marine environment), species-specific factors (e.g., animal aversion), and marine mammal monitoring and mitigation measures. The following factors are expected to decrease the level of risk to marine mammals from impact pile-driving noise, as explained below:

- Ambient sound levels, mainly from other anthropogenic activities in the ocean, may mask Project-related noise and decrease the chance of exposure to marine mammals (Kraus et al. 2016; Hatch et al. 2012).
- Animal aversion is an important behavioral and mitigating factor likely decreasing the risk of marine mammal exposure from pile-driving and other construction sounds because received

sound level generally decreases with distance. Moving away from sounds, or aversion, is a common response of animals to sound, particularly at higher sound exposure levels (Ellison et al. 2012). Some level of aversion for all species is expected during construction. As shown in Section 2.8.1 and Table B-1 of Appendix II-L, an estimation of the effect of aversion on exposure estimates for two representative species, harbor porpoise and NARW, indicates that when aversion is accounted for by the model, few numbers of porpoises and whales are exposed to noises above injury and behavior thresholds.

- Monitoring marine mammal encroachment throughout construction activity is designed to detect marine mammals prior to pile-driving exposure to potentially injurious or disruptive sounds;

- Passive acoustic monitors will be deployed in combination with visual observations, performed by NOAA approved Protected Species Observers (PSOs). Current passive acoustic monitoring technologies that may be deployed during project activities include towed hydrophone arrays, stationary autonomous buoys, and autonomous underwater vehicles and gliders.

- Marine mammal protection zones will be maintained during pile-driving and operational controls will be implemented to modify or halt potentially harmful activities when marine mammals are detected.

- Equipment operating procedures (e.g., Pre-start clearances, soft starts, ramp-ups, operational shutdowns and delay) to control the noise generated by pile-driving or survey equipment will be implemented to prevent exposure of harmful sound levels to protected marine life.

- During nighttime activities and/or periods of inclement weather the use of night vision devices such as night vision binoculars and/or infrared cameras will be implemented.

For all species, impacts resulting from sound exposure may affect individuals but have only a very low to low risk of negatively impacting marine mammal stocks or populations. The potential negative impact on the population will depend on the effect on the individual, the size of the species' population and the localized activity. For species that may be present within and adjacent to the Lease Area, the potential exists for small numbers of marine mammals to experience sound level conditions at regulatory-defined injury and behavioral thresholds for impact pile-driving activities.

As with individual exposure estimates, Atlantic Shores modeled the number of injurious exposures predicted to occur as a percentage of species' abundance, the results of which confirmed that predicted injurious exposures are very low or low for all marine mammal species, with or without attenuation (see Tables 39 through 41 within Appendix II-L).

Behavioral responses for marine mammal species are likely limited to short-term disruption of behavior or displacement related to pile-driving noise. The estimated exposures to most species' stocks are expected to be significant overestimates of the actual proportion of the stock potentially affected by pile-driving activities. That is because estimates of exposure do not account for animal aversion or the implementation of mitigation measures other than bubble curtains (e.g., clearance and shutdown zones, additional NAS, pile-driving shutdown). Some marine mammals are well known for their aversive responses to anthropogenic sound (e.g., harbor porpoises). Other species in an area of exposure may move location depending on their acoustic sensitivity, life stage, and acclimation (Wood et al. 2012) and may or may not demonstrate behavioral responses.

**Other Noise Sources**

There are several other potential anthropogenic sound sources associated with offshore Project construction, O&M, and decommissioning. These sources were not quantitatively modeled because the potential acoustic impact of these noise sources is expected to be much less than impulsive pile driving. A qualitative assessment of possible impacts to marine mammals from other noise sources generated by Project activities, including high-resolution geophysical (HRG) surveys, vessels, cable installation, vibratory pile driving (if needed), operational WTGs, operational offshore cables, and decommissioning is summarized in this section.

<u>High Resolution Geophysical (HRG) Surveys</u>

As detailed in Section 2.1 of Volume II, HRG surveys may be conducted to support pre-construction site clearance activities as well as post construction facilities surveys. HRG surveys use sound sources that output acoustic signals with frequency bandwidths and amplitudes best suited for the desired survey product. The acoustic signals often are impulsive, tonal, or chirp pulses (short duration signals that sweep through many frequencies). HRG sources can be grouped into three categories: (1) impulsive signals (e.g., boomers and sparkers) that are broadband with most energy at low frequencies; (2) chirp sonars, which are high-frequency sweeps with most energy at high frequencies; and (3) sonars (e.g., side-scan, multibeam), which are high-frequency tones or chirp signals (Halvorsen and Heaney 2018). The source level, beamwidth, pulse duration, and pulse repetition rate of such sources are typically adjustable.

While low, the potential exists for small numbers of marine mammals to be exposed to underwater sound associated with HRG survey activities at levels correlated with behavioral responses. These sound levels may affect individuals but have only negligible effects on marine mammal stocks based on their seasonal density and distribution and their known reactions to exposure to impulsive, intermittent sound sources. A previous analysis by BOEM (2014) on the potential effects of sound associated with HRG surveys on marine mammals in the Mid- and South-Atlantic Planning Areas concluded that impacts are expected to be minor with the implementation of mitigation measures for sources operating at or below 200 Hz.

On June 29, 2021, NMFS issued a Letter of Concurrence (LoC) covering site characterization activities including HRG surveys. As a result, the mitigation, monitoring and reporting conditions for these activities were revised with respect to threatened and endangered species. Atlantic Shores has implemented the best management practices outlined within the LoC for HRG surveys conducted subsequent to issuance of the LoC and will continue to do so for future HRG surveys that may be conducted within the Lease Area.

Atlantic Shores has completed several years of HRG surveys to date and successfully demonstrated that monitoring and mitigation during HRG surveys decreases the potential impacts to marine mammals. Many of the monitoring and mitigation strategies described for pile-driving are similar to those employed during HRG surveys. Standard mitigation employed during HRG surveys includes the use of PSOs, protective zones, ramp-up of active sound sources and shut down of sources should marine mammals enter the established shutdown zones. Because of the intermittent and short-term nature of HRG surveys, and the implementation of monitoring and mitigation measures, the effects of HRG noise on marine mammals are expected to be low.

Cofferdam Installation

The installation and removal of cofferdams with vibratory pile driving of sheet piles will generate noise that will radiate into the marine environment. Vibratory pile driving generates non-impulsive or continuous sound that has a lower threshold for behavioral effects to marine mammals than for impact pile driving. Cofferdams will be installed at nearshore landing sites off the coast of New Jersey and New York. The potential exists for small numbers of marine mammals to be exposed to noise from vibratory pile driving to install or remove cofferdams that may cause behavioral responses in a limited number of species, but no injurious effects on marine mammals are predicted from cofferdam installation nor removal.

**Conductor Barrel / Goal Post Installation and Extraction**

ASOW is planning on installing 1.54 m diameter steel pipes as part of the conductor barrel at four potential locations between New Jersey and New York (Figure 2). The conductor barrel will be comprised of five 6.1 m sections of pipe to result in a total length of 30.5 m. The 1.54 m pipes will be installed at an angle of approximately 12° to the seafloor using a Grundoram Taurus pneumatic hammer. The conductor barrel is supported by a goal post structure comprised of two 0.3 m steel pipes installed vertically into the seafloor and an I-beam welded horizontally between the two vertical piles. The goal post 0.3 m steel pipes will be installed via vibratory pile driving using an APE 200T hammer.

Two representative modeling locations have been selected for modeling of the conductor barrel and goal post installation, one per state, to capture the range of water depths and habitats at the potential installation locations, with one model site selected per state. The Monmouth location was modeled as the representative New Jersey location and the Lemon Creek/Wolfe's Pond location was modeled as the representative New York location.

The number of seasonal, unmitigated acoustic exposure estimates of marine mammals for impact pile driving at each of the two representative model sites have been estimated for the installation or extraction of a single conductor barrel (See Appendix II-L). The overall acoustic exposures for the installation and extraction of all 11 conductor barrels (eight in New Jersey and three in New York) have also been estimated. Although all seasons were modeled for conductor barrel installation/extraction, the calculation of the overall acoustic exposures assumed that installation would occur in winter and extraction would occur in spring. These seasons were chosen for installation and extraction to allow for maximum flexibility in the installation and extraction since these seasons generally have the highest acoustic exposures. Acoustic exposures associated with impact pile driving for conductor barrel installation or removal have been reported herein to two decimal places, so that it appears that most species have 0.00 acoustic exposures or no exposures whereas the actual exposures are typically very, very small and would only be represented if exposures were reported to the fifth or sixth decimal place.

The number of seasonal, unmitigated acoustic exposure estimates of marine mammals for vibratory pile driving at each of the two representative model sites have been estimated for the installation or extraction of a single goal post (See Appendix II-L). The overall acoustic exposures for the installation and extraction of all 11 goal posts (eight in NJ and three in NY) have also been estimated. Although all seasons were modeled for goal post installation/extraction, the calculation of the overall acoustic exposures assumed that installation would occur in winter and extraction would occur in spring. These seasons were chosen for installation and extraction to allow for maximum flexibility in the installation and extraction since these seasons generally have the highest acoustic exposures. Acoustic exposures associated with vibratory pile driving for goal post installation or removal have been reported herein to two decimal places, so that it appears that most species have 0.00 acoustic exposures or no exposures whereas the actual exposures are typically very, very small and would only be represented if exposures were reported to the fifth or sixth decimal place.

<u>Vessel Sounds</u>

As discussed previously, Project vessel traffic will originate from one or more port facilities and arrive at the Offshore Project Area during construction, O&M, and decommissioning (see Sections 4.10.3 and 5.5 of Volume I). Ship engines, propellers, thrusters, and vessel hulls emit broadband, non-impulsive sound, which overlaps with the assumed or known hearing frequency ranges for all marine mammals. Presently, marine mammals occurring off of New Jersey and New York are subjected to commercial shipping traffic and other vessel noise and could potentially be habituated to vessel noise (BOEM 2014). Because noise from Project-vessel traffic is likely to be the same, or similar to, background vessel traffic noise, the potential risk of impacts from vessel noise to marine mammals is expected to be low relative to the risk of impact from pile-driving sound.

<u>Vibratory Pile-driving</u>

Vibratory pile-driving may be used for the installation of WTG foundations in the Lease Area, as discussed in Section 4.2.1 of Volume I, as well as vibratory pile-driving of goal posts near landfall of the cables. Although studies of vibratory pile-driving measured sound source levels above injury and behavior thresholds, these Project-related noises are not expected to impact marine mammals (Hart Crowser and Illingworth and Rodkin 2009, Houghton et al. 2010). The monitoring and mitigation measures to be implemented during impact pile-driving are expected to greatly reduce the risk of exposure to marine mammals from vibratory pile-driving in the Lease Area should it be implemented.

Cable Installation and Cable Operation

As described in Section 4.5 of Volume I, cable installation activities generate non-impulsive, intermittent sounds when using mechanical or water jetting equipment. However, the dominant sound sources during cable installation are the thrusters on the dynamically positioned vessels that will be used. As discussed above regarding vessel noise, the impacts of noise exposure associated with this cable installation activity are expected to be low because noise from cable laying equipment activities is likely to be less than background vessel traffic noise.

High-voltage alternating current (HVAC) offshore cables are expected to produce non-impulsive low-frequency tonal vibration sound in the water. High voltage direct current (HVDC) cables do not produce a similar tonal sound because the current is not alternating. As previously explained in Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat, the anticipated sound pressure level arising from the vibration of high voltage alternating current (HVAC) cables during operation are likely undetectable in the ambient soundscape of the Lease Area (Meibner et al. 2006). No effects on marine mammals are expected from low-frequency tonal vibration sound emitted during cable operations.

Aircraft

The Project is likely to rely on aircraft for a variety of specific missions during construction, O&M, and decommissioning. Helicopters may be used for crew transfer or for visual inspection of equipment during installation activities. Atlantic Shores may also use fixed-wing aircraft to support monitoring and mitigation for protected marine species. Aircraft noise may be perceived by marine mammals at the ocean surface and cause temporary changes in behavior and localized displacement to the few individuals in the area (Richardson et al. 1985a, Richardson and Würsig 1997, Nowacek et al. 2007). In general, marine mammals may react to aircraft noise more often when the aircraft is lower in altitude, closer in lateral distance, and flying over shallow water (Richardson et al. 1985b, Patenaude et al. 2002). These reactions include short surfacing, hasty dives, aversion from the aircraft, or dispersal from the incoming aircraft (Bel'kovich 1960, Kleĭnenberg et al. 1964, Richardson et al. 1985a, Richardson et al. 1985b, Luksenburg and Parsons 2009). The response of marine mammals to aircraft noise largely depends on the species as well as the animals' behavioral state at the time of exposure (e.g., migrating, resting, foraging, socializing) (Würsig et al. 1998).

Helicopter and fixed-wing aircraft used during the Project construction phase will be in operation intermittently and maintain safe altitudes (usually 500 to 1000 ft [150 to 300 m]) above sea level. At these heights, aircraft noise may elicit short-term behavioral response in marine mammals. However, the risks of Project aircraft inducing adverse effects on marine mammals are considered low.

Wind Turbine Generators

Wind turbine generators (WTGs) produce sound in the nacelle that is transmitted from the topside to the foundation and then radiated into the water. Current literature indicates noise generated from the operation of wind farms is minor and does not cause injury or lead to permanent avoidance at distances greater than 0.5 nm (1 km) for the species studied (e.g., harbor porpoise, seals, and fish)

(Wahlberg and Westerberg 2005, Stenberg et al. 2015), with potential to have minimal effects at much closer distances up to within a few meters of the WTG (Bergström et al. 2013). This operational noise from WTGs is generally low with sound pressure levels of around 151 dB [re 1 μPa] and frequency ranges of 60 to 300 Hz (Dow Piniak et al. 2012). Underwater noise level is related to WTG power and wind speed, with increased wind speeds creating increased underwater sound (Wahlberg and Westerberg 2005). Ambient noise within the 71 to 224 Hz frequency band in the MA WEA and RI/MA WEA was measured to be between 96 dB [re 1 μPa] and 103 dB [re 1 μPa] 50% of the time with greater sound levels 10% of the time (Kraus et al. 2016). Measurements at the Block Island Wind Farm determined that sound would likely decline to ambient levels at a distance of 0.5 nm (1 km) from the WTGs and average sound level was recorded to be between 112 to 120 dB [re 1 μPa] when wind speed was 6.5 to 39.4 feet per second (ft/s) (2 to 12 meters per second [m/s]) (HDR 2019).

Given the low level of sound generated by WTGs in relation to ambient sounds, no injury to marine mammals is reasonably expected.

#### 4.7.2.8 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new foundation structures and offshore cables includes installation of associated scour and cable protection. These activities may have limited effect on marine mammals through direct seafloor disturbance and temporary increases in suspended sediment and deposition because the area of disturbance will be small relative to the total area of surrounding habitat (see Section 3.2 Water Quality). Moreover, as evident from environmental assessments and surveys performed in the Offshore Project Area, this area is dynamic in nature and experiences regular disturbance from natural (e.g., waves, storms, mobile sediment) and anthropogenic (e.g., fishing and vessel activity) sources. For example, previous marine mammal impact studies from dredging operations reported dredge-related plumes were localized and did not result in widespread or excessive turbidity that would impact marine mammals (Todd et al. 2015).

Electromagnetic Fields

This section addresses electromagnetic fields (EMF) generated during operation of the Project and the localized effects on marine mammals. EMFs are invisible areas of electric and magnetic energy that occur both naturally and anthropogenically in the marine environment. Atlantic Shores conducted an EMF study to predict EMF levels from the Project's submarine electrical system operation which includes a combination of HVDC and HVAC cables and OSSs (see Appendix II-I). The modeling results show that EMF levels are predicted to decrease exponentially with increasing distance from the cables and therefore do not pose a risk to marine mammals. Several studies have determined that cetaceans would likely not be affected by subsea cable EMFs, as the area of influence would be too small to alter their behavior (Normandeau Associates et al. 2011, Gill et al. 2014, Copping et al. 2016).

Potential EMF effects on marine mammal prey species (e.g., finfish, invertebrates) were evaluated in Section 4.6.2.4. Magnetic fields will be generated by the offshore cable system and multiple theories have been proposed for finfish detection of magnetic fields. Magnetosensitive fish species potentially occurring in the Offshore Project Area (e.g., sharks, rays and eels) may use magnetic fields for migration, navigation, and to locate food, habitat, and spawning grounds. Other finfish and pelagic invertebrate species of commercial or recreational value in the Offshore Project Area (e.g., flounder species, longfin squid, spot, scup, bluefish, hake species, black sea bass) likely lack the physiological components necessary to detect electric and magnetic fields and therefore are not expected to be adversely affected by EMF outputs from Project HVAC and HVDC export cables, HVAC inter-link cables, and HVAC inter-array cables. Most preferred marine mammal prey species fall into the latter category and are not expected to experience adverse effects from EMF.

#### 4.7.2.9 Light

During construction, and O&M, vessels working or transiting during periods of darkness and fog will utilize lighting. During operations, Project structures will be lighted in compliance with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines for lighting and marking as described in Section 5.3 of Volume I. WTG aviation lights will likely be too high above sea level to penetrate the water surface. Navigation lighting on structures along the perimeter of the Lease Area will have lights close to sea level and could penetrate the water. As discussed in Section 4.6.2.5, the artificial light from navigation lighting can attract or deter certain prey species of marine mammals (e.g., finfish, invertebrates). However, the amount of artificial Project lighting from vessels and structures that would penetrate the sea surface is expected to be localized and minimal and not likely to cause adverse effects to marine mammals or their prey species (Marangoni et al. 2022).

#### 4.7.2.10 Presence of Structures and Cables

Within the Offshore Project Area, the installation and presence of foundations, towers, cable protection, and scour protection are likely to result in the creation of hard-substrate habitat in what is currently, predominantly flat, sandy habitat. These changes may lead to temporary and localized shifts in limited areas of marine mammal habitat and changes to prey abundance, hydrodynamics, suspended sediment and deposition rates, and both invasive and non-invasive species attraction. Potential benthic and pelagic habitat effects from the presence of structures was previously discussed in Section 4.6.2.6. The overall negative impact of habitat alteration and prey availability is anticipated to be very low to low especially considering relatively large ranges of marine mammals and availability of habitat in other areas.

Although the presence of foundations and cable and scour protection could result in shifts to prey habitats and availability over time during the O&M phase of the Project; foundations and cable and scour protection are expected to produce ecologically beneficial effects that could outweigh the risk of introducing hard structure to a small area of the vast flat, sandy habitat found in the Mid-Atlantic Bight. Once the Project is decommissioned, the local environmental and ecological features of the area are expected to revert to pre-construction conditions. Potential impacts from decommissioning include the loss of Project-related hard structures, which are expected to be colonized at the time of decommissioning. Reef or structure-oriented marine mammal prey species (i.e., finfish, crustaceans) will be displaced during decommissioning as the foundations and scour protection are removed.

The presence of structures is not expected to impede marine mammal movements in an adverse way. During the O&M phase of the Project, WTGs and OSSs will be positioned with sufficient distance between them (i.e., WTGs will be positioned in a grid with rows spaced 0.6 and 1 nm [1.1 and 1.9 km] apart, while the up to 8 OSSs will be placed on the same grid or between WTGs along the 1 nm [1.9 km] rows), so that marine mammals will not be impeded from natural use of the habitat, including migration and feeding.

#### 4.7.2.11 Summary of Proposed Environmental Protection Measures

Atlantic Shores is committed to avoiding and minimizing Project-related impacts to marine mammals during all phases of the Project. Atlantic Shores is developing a Marine Mammal Monitoring Plan in conjunction with key Federal, State and eNGO stakeholders that will inform Project activities and decision-making. In addition, Atlantic Shores will also be implementing a comprehensive program of best management practices (BMPs) to minimize and avoid Project impacts, while exploring new, innovative minimization/avoidance approaches. After mitigation measures are implemented, the residual risk of impacts to marine mammals is expected to be significantly reduced.

Throughout all phases of the Project (pre-construction, construction, O&M, decommissioning) Atlantic Shores is committed to the implementation of the following key mitigation and monitoring strategies to reduce the risk of Project-related impacts to marine mammals. Vessel strike avoidance procedures will be implemented that reduce the potential risk of Project-related vessel collisions with marine mammals, including the following actions:

- Adhere to marine wildlife viewing and safe boating guidelines (GARFO 2021) to the maximum extent practicable.
- Train Project personnel in marine mammal spotting and identification, observation reporting protocols and vessel strike avoidance procedures, as applicable.
- Adhere to applicable NOAA-established Seasonal Management Area and Dynamic Management Area speed restrictions for the NARW, which are currently 10 knots or less for vessels 65 ft [20 m] or greater during reported periods of high density.
- Monitor marine mammal activity during all Project phases to ensure that the chances for possible marine mammal strikes are minimized. Specifically, Atlantic Shores will monitor NOAA notifications from the Right Whale Slow Zones Program, online or the "Whale Alert", Mysticetus, or WhaleMap apps and the NOAA Right Whale Sighting Advisory System for NARW activity in the Offshore Project Area.
- Establish a communication network amongst all project vessels for situational awareness of sightings and detections of protected species.

Marine debris caught on offshore Project structures will be removed, when safe and practicable, to reduce the risk of marine mammal entanglement.

Atlantic Shores will take additional precautions during activities that could generate underwater noises above regulatory-defined injury and behavior thresholds (e.g., impact pile-driving, HRG surveys), as follows:

- Marine mammal protection zones will be established and monitored to create sufficient opportunity to modify or halt Project activities potentially harmful to protected species, such as:
    - Shutdown Zones around activities that have the potential to harm marine mammals.
    - Clearance Zone (larger than a Shutdown Zone) around activities that have the potential to result in the harassment of marine mammals.
- Visual monitoring of Shutdown and Clearance Zones by NOAA Fisheries-approved PSOs will be conducted to alert the Project's survey and/or marine construction teams to the presence of protected species, including:
    - Vessel-based and/or aerial monitoring of large Shutdown and Clearance Zones.
    - Use of night vision devices such as night vision binoculars and/or infrared cameras, during nighttime activities and/or periods of inclement weather.
- Atlantic Shores will commit to and implement passive acoustic monitoring to support the detection of vocalizing marine mammals during periods of inclement weather, low visibility and/or at night. Passive acoustic monitors will be deployed in combination with visual observations. Current passive acoustic monitoring technologies under consideration include towed hydrophone arrays, stationary autonomous buoys, and autonomous underwater vehicles and gliders.
- Pile-driving will only be conducted between May through December to minimize risk to NARW.
- Equipment operating procedures will be implemented, as appropriate, to control the noise generated by pile-driving or survey equipment to prevent exposure of harmful sound levels to protected marine life.
    - NAS will be implemented during impact pile-driving to decrease the propagation of potentially harmful underwater noises.
    - Pre-start Clearances, and Soft starts will be considered for activities such as impact pile-driving.
    - Ramp-up procedures whereby the sound source level is increased gradually before full use of power will be used.

- A ramp-down, and if necessary, a shut-down of activities such as pile-driving and/or HRG survey equipment that has the potential to cause harm or harassment to marine mammals will occur if an animal is seen approaching or entering a Clearance Zone or Shutdown Zone. Shutdowns will not be implemented for dolphins that voluntarily approach the survey vessel.

Atlantic Shores is also evaluating additional innovative technologies and methods to improve the monitoring of marine mammals within the Offshore Project Area and to further inform regional efforts to understand cumulative impacts to these species. Through partnerships with universities, governmental agencies and environmental non-governmental organizations, Atlantic Shores is working with marine mammal experts to identify key knowledge gaps and to plan studies to advance the general understanding of marine mammals in the Mid-Atlantic Bight. Other innovations Atlantic Shores is currently investigating to further minimize impacts to marine mammal include:

- Near Real-Time Monitoring – Various acoustic technologies (e.g., passive underwater acoustic monitors, cable hydrophones) provide advantages for real-time monitoring of marine mammal vocalizations indicating species presence in an area.

- Autonomous Underwater Vehicles – Autonomous Underwater Vehicle technologies allow for remotely controlled data collection of the underwater environment without divers or intrusive methods to detect marine life and changing environmental conditions during certain Project activities (e.g., construction).

- Unmanned Aerial Systems – This effort will build on earlier trials conducted by RPS, AUV Flight Services and Advanced Aircraft Company, for which Federal regulatory agency approval was obtained. Atlantic Shores will conduct a field trial during an offshore wind survey using drone technology to monitor for protected species. The Unmanned Aerial Systems would be mounted with a high definition stabilized infrared camera system specifically designed for small, unmanned vehicles. A trial would be configured whereby a PSO team would monitor high-definition drone camera footage in real time on shore, while another PSO team would simultaneously monitor visually from a selected platform.

## 4.8 Sea Turtles

This section describes sea turtles that may be present within the Offshore Project Area, which includes the Lease Area, Monmouth Export Cable Corridor (ECC), and the Northern ECC. This section also assesses Project-related impact producing factors (IPFs) and anticipated environmental protection measures to avoid, minimize, or mitigate potential impacts to sea turtles during construction, operations, and maintenance (O&M), and decommissioning. Sea turtles fill important roles in marine ecosystems by maintaining healthy seagrass beds, thus providing habitat for other marine life, balancing marine food webs, and facilitating nutrient cycling from sea to shore (Wilson et al. 2010). Sea turtles also provide a concentrated source of nutrients from their unhatched eggs on their nesting beaches and have been identified as important species for promoting vegetation growth and dune stabilization (Bouchard and Bjorndal 2000, Hannan et al. 2007). As discussed in this section, there are no documented seagrass beds or sea turtle nesting beaches in the Offshore Project Area or along the shoreline near the ECCs; however, sea turtles are generally known to occupy the Mid-Atlantic Bight with varying concentrations throughout the year (Greene et al. 2010).

To protect sea turtles that may occur in the Offshore Project Area, Atlantic Shores is implementing an assessment that considers how Project activities may affect sea turtles in the Offshore Project Area based on documented sea turtle distributions in the larger context of the Mid-Atlantic Bight. Atlantic Shores' assessment of sea turtles builds upon and fills data gaps from previously completed Federally and State funded research efforts. Relevant studies, both completed and ongoing, inform which species occupy the Offshore Project Area, and include state-of-the-art aerial digital surveys and underwater acoustic modeling coupled with animal movement and exposure modeling. In 2021, Atlantic Shores affixed two *Innovasea Vemco VR2W* receivers on separate metocean buoys installed in the Lease Area OCS-A 0499, which collect data on tagged sea turtles and highly migratory fish species that pass within the range of the receivers. When the buoys are brought to shore either opportunistically or to complete scheduled maintenance the data are collected from the buoys. Atlantic Shores also implemented Bureau of Ocean Energy Management (BOEM) and National Oceanic and Atmospheric Association (NOAA) approved mitigation measures during 2019 and 2020 pre-construction surveys to avoid vessel strikes and noise impacts on sea turtles. These efforts will help inform Atlantic Shores Project design and construction planning efforts to support the minimization and/or avoidance of Project-related impacts to sea turtles.

### 4.8.1 Affected Environment

Sea turtles that may occur in the Offshore Project Area during construction, O&M, and decommissioning may experience limited effects from certain Project activities. Descriptions, distributions, and abundances of sea turtles in the Offshore Project Area are based on reviews of existing technical reports, academic publications, and public reports (e.g., press releases). A number of aerial and shipboard studies in the region have recorded sea turtle observations and were included in this baseline characterization: Northwest Atlantic Marine Ecoregional Assessment (Greene et al. 2010), Northeast Fisheries Science Center (NEFSC) aerial surveys, NEFSC shipboard surveys, the North Atlantic Right Whale (NARW) Consortium database, and a multi-year series of seasonal aerial surveys conducted by Normandeau Associates for the New York State Energy Research and Development

Authority (NYSERDA) (NYSERDA; Normandeau Associates Inc. and APEM Inc. 2018, 2019b, 2019a, 2019c, 2020).

In support of this COP and ongoing consultations with BOEM and NOAA regarding Federally protected species, Atlantic Shores has completed an underwater acoustic and animal exposure modeling analysis for impact pile-driving noise and other Project-related sound sources based on hydroacoustic modeling analysis for the maximum Project Design Envelope (PDE) for the Lease Area (see Appendix II-L). The relevant results of this analysis pertaining to potential Project-related noise impacts on sea turtles are discussed in Section 4.8.2.2.

Of the seven extant sea turtle species, six may occur within U.S. waters. All six of these species are listed as threatened or endangered under the Endangered Species Act (ESA). While all six species of sea turtles may migrate through the Offshore Project Area and the Mid-Atlantic Bight for feeding opportunities during the summer and fall (Shoop and Kenney 1992, Shaver et al. 2005, McMichael et al. 2006, Rostal 2007, NMFS and USFWS 2014), the four species most likely to occur in the Offshore Project Area are loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles. Sightings of these sea turtles are less likely to occur in the Offshore Project Area when water temperatures are low during the winter and spring (Greene et al., 2010; BOEM 2012a).

Table 4.8-1 identifies the sea turtle species likely to occur in the Offshore Project Area including pertinent population characteristics derived from NOAA's periodic status reviews and other recent literature. Table 4.8-1 also indicates protection status, occurrence, and estimated abundance and categorizes species as common, regular, uncommon, and rare, based on their expected occurrence in the Offshore Project Area:

- Common – Occurring consistently in moderate to large numbers
- Regular – Occurring in low to moderate numbers on a regular basis or seasonally
- Uncommon – Occurring in low numbers or on an irregular basis.
- Rare – There are limited species records for some years; range includes the Lease Area but due to habitat preferences and distribution information, species are not expected to occur in the Lease Area. Records may exist for adjacent waters.

The following subsections provide information on the biology, distribution, habitat use, and abundance of the sea turtle species considered common, regular, and uncommon to the Offshore Project Area. The species categorized as rare, hawksbill and olive ridley, are not discussed in this section.

## Table 4.8-1. Sea Turtles Species in the Western North Atlantic Ocean

| Species | Scientific Name | Overlapping Distinct Population Segments (DPS) | Best Dps Abundance Estimate | Status of Species or DPS[1] Under Endangered Species Act (ESA) | Occurrence In Offshore Project Area[2] |
|---|---|---|---|---|---|
| Leatherback | *Dermochelys coriacea* | n/a - not listed with DPS[3] | 34,000 to 94,000 adults (2006)[4] | Endangered | Common |
| Loggerhead | *Caretta caretta* | Northwest Atlantic[5] | 68,000 to 90,000 nests per year in U.S.[5] | Threatened | Common |
| Green | *Chelonia mydas* | North Atlantic[6] | 167,424 nesting females[6] | Threatened | Uncommon |
| Kemp's ridley | *Lepidochelys kempii* | n/a - not listed with DPS[8] | 248,307 adults (2012)[9] | Endangered | Uncommon |
| Hawksbill | *Eretmochelys imbricata* | n/a - not listed with DPS[10] | 3,600-= to 6,100 Atlantic nesting females[10] | Endangered | Rare |
| Olive ridley | *Lepidochelys olivacea* | Non-Mexican (Pacific Coast)[11] | 2,606 nests (2002-2003) Western Atlantic ocean[12] | Threatened | No documented sightings |

Notes:
[1]DPS – Distinct Population Segment
[2]From BOEM (2012a) EA using TNC NAM ERA (Greene et al. 2010) compiled data.
[3]NMFS and USFWS (2015).
[4]Turtle Expert Working Group (2007).
[5]Conant et al. (2009).
[6]NOAA Fisheries (2020).
[7]NMFS (2015).
[8]NMFS and USFWS (2015).
[9]Gallaway et al. (2013).
[10]NMFS and USFWS (2013).
[11]NMFS and USFWS (2014).
[12]da Silva et al. (2007).

**Leatherback Sea Turtles**

Leatherback sea turtles can grow to a maximum size of 8 feet (ft) (2.4 meters [m]) and 2,000 pounds (900 kilograms [kg]) and are distributed circumglobally between 47° south and 71° north latitude with nesting occurring on sandy beaches between 34° south and 38° north latitude (Eckert et al. 2012, USFWS 2018). U.S. nesting sites are not found north of Florida (Bräutigam and Eckert 2006); therefore, no nesting sites occur in the vicinity of the Project Area. Leatherbacks are the most pelagic of the sea turtles, with migration patterns that vary by region. Atlantic leatherbacks tend not to cross the equator with Northern Atlantic individuals migrating between nesting sites and fertile feeding grounds in the Gulf of Maine, Gulf of Mexico, Canada, Europe, and West Africa, all north of the equator, where they consume mainly jellyfish but also feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (Eckert et al. 2012, USFWS 2018). Juvenile leatherback sea turtles move offshore where they are believed to remain in warmer subtropical waters for a few years (Eckert 2002). Review of three years of aerial and shipboard surveys determined that between 100 and 900 leatherbacks utilize the Northwest Atlantic (Shoop and Kenney 1992). Leatherback turtle occurrence in the Offshore Project Area is more common in the summer and fall but is possible all year (Geo-Marine 2010, BOEM 2012a, Meyers &Ottensmeyer 2005).

**Loggerhead Sea Turtles**

Loggerhead sea turtles can grow to a maximum size of 9.2 ft (2.8 m) and 1,000 pounds (450 kg) and occur throughout the temperate and tropical waters in the Atlantic, Pacific, and Indian Oceans (Dodd 1988). Loggerheads typically consume invertebrates and fish but are known to consume vegetation as well (Plotkin et al. 1993; (Bjorndal 1997)). Estimates of the age at first maturity vary. One estimate based on individuals in the Mediterranean Sea found maturity was reached between ages 25 to 29 years (Baldi et al. 2023) while another study on loggerhead turtles stranded in Georgia found that maturity was reached between ages 20 to 63 years (Casale et al. 2011). Nesting within the U.S. occurs on sandy beaches as far north as North Carolina (Conant et al. 2009); therefore, no nesting sites occur in the vicinity of the Project Area. Recently hatched juveniles move offshore where they associate with sargassum habitats and other areas where debris and vegetation collect and provide food and shelter (Witherington 1997). Older juveniles and adults inhabit neritic waters, especially within large bays and other protected waters as far north as Cape Cod Bay along the east coast of the U.S. (Conant et al. 2009). Adults generally inhabit less protected neritic waters and are known to inhabit Mid-Atlantic shelf waters during summer months (Hawkes et al. 2007, Winton et al. 2018). A review of three years of aerial and shipboard surveys determined that between 2,200 and 11,000 loggerheads utilize the Northwest Atlantic (Shoop and Kenney 1992). Their occurrence in the Offshore Project Area is more common in the summer and fall but is possible all year (McNeill et al. 2020, Geo-Marine 2010, BOEM 2012).

**Green Sea Turtles**

Green sea turtles can grow to a maximum size of 3.3 ft (1 m) in carapace length and weigh 441 pounds (200 kg) occurring throughout tropical, subtropical, and less frequently in temperate waters throughout the globe with nesting sites in more than 80 countries (Groombridge and Luxmoore 1989).

On the east coast of the U.S., green sea turtle nesting occurs in Florida, Georgia, and the Carolinas (NOAA 2022). No nesting sites occur in the vicinity of the Project Area. Most juveniles spend their time in offshore pelagic habitats, specifically in and around sargassum mats (Mansfield et al. 2021), while adult turtles spend most of their lives in shallow coastal waters primarily consuming marine algae and seagrass with some populations consuming mainly invertebrates (Carballo et al. 2002). Estimates of age at sexual maturity range from 12 to 20 years up to 50 years with females nesting roughly three to 11 seasons throughout their life (Bell et al. 2005). Although uncommon, individual green turtles can be found in New Jersey and New York waters in the summer and fall when water temperatures are highest (NYSERDA 2017). Most return to warmer waters during the winter or can succumb to cold-stunning (McMichael et al. 2006).

**Kemp's Ridley Sea Turtles**

Kemp's ridley sea turtles can grow to a maximum size of 2.5 ft (0.75 m) and weigh a maximum of 110 pounds (50 kg) and are found primarily in the Gulf of Mexico with sightings as far north as the Grand Banks off Newfoundland and sporadic sightings off of the Azores and in the Mediterranean Sea (Conant 1975; Watson et al. 2004; Witt et al. 2007; Insacco and Spadola 2010). Adults typically remain in shallow waters consuming various organisms including mollusks, natural and synthetic debris, sea horses, cownose rays, jellyfish, fishes, and tunicates with seasonal migrations to nesting sites in the spring (Shaver et al. 2005, Rostal 2007, NMFS and USFWS 2014). Juveniles can spend the first two years of their life as pelagic individuals associated with sargassum before moving to neritic waters (Epperly et al. 2013). Neritic juveniles typically migrate to warmer waters during the winter (Lyn et al. 2012). Estimates of the age to maturity range from five to 12 years (Bjorndal et al. 2014) to 10 to18 years (Shaver and Wibbels 2007). In their northern range, which includes waters offshore of New Jersey and New York, Kemp's ridley sea turtles primarily utilize nearshore coastal habitats in the summer and fall when water temperatures are warmest. Nesting is limited almost entirely to the Western Gulf of Mexico and does not occur in the vicinity of the Project Area.

### 4.8.2 Seasonal Sea Turtle Density Estimates

The best available sea turtle densities for the Project area are available from Duke University's MGEL, (DiMatteo et al. 2023) (Table 4.8-2), which were prepared for the U.S. Navy for the Atlantic U.S. waters. The densities were available in 10 x10 kilometer grid cells, the resolution of which aligned with the environmental covariates used in the density modeling. The sea turtle density estimates in each grid cell represent the monthly mean, averaged for the period from 2003 to 2019, except for the green turtle, which covered the period from 2010 to 2019. Densities were estimated using a density surface model that correlated local abundances observed during systematic line transect surveys with environmental conditions observed at that same location and time. For unsurveyed areas and times, densities were estimated by extrapolation.

**Table 4.8-2. Modeled Sea Turtle Species and their Respective Seasonal Mean Densities (DiMatteo et al. 2023) ) in the Buffered (7.1-km) Lease Area 0549 During the Annual Construction Period of the ASOW North Project; All Sea Turtle Species Modeled as a Representative Group.**

| Sea Turtle Species | Monthly Density (animals/km$^2$)* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | May | June | July | August | September | October | November | December |
| Green turtle (*Chelonia mydas*) | 0.0000 | 0.3746 | 0.4554 | 0.3268 | 0.4814 | 0.2676 | 0.0253 | 0.0000 |
| Kemp's ridley turtle (*Lepidochelys kempii*) | 0.0000 | 0.02814 | 0.0309 | 0.03077 | 0.01781 | 0.01907 | 0.003945 | 0.0000 |
| Leatherback turtle (*Dermochelys coriacea*) | 0.04848 | 0.22700 | 0.55460 | 0.87080 | 0.96160 | 0.69350 | 0.10140 | 0.00385 |
| Loggerhead turtle (*Caretta caretta*) | 0.1771 | 0.4163 | 0.313 | 0.2767 | 0.2889 | 0.5197 | 0.2788 | 0.0622 |

### 4.8.3 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs that may affect sea turtles during Project construction, O&M, or decommissioning are presented in Table 4.8-3. Sea turtles may also be affected by discharges from vessels and accidental releases; these potential impacts are considered to have a low likelihood of occurrence and are discussed in Section 9.2.3.

**Table 4.8-3. Impact Producing Factors for Sea Turtles**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel movements | ● | ● | ● |
| Noise | ● | ● | ● |
| Installation of new structures and cables | ● | ● | ● |
| Electromagnetic fields | | ● | |
| Light | ● | ● | ● |
| Presences of structures and cables | | ● | ● |

The maximum PDE analyzed for potential impacts to sea turtles is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I). Risk of impacts to sea turtles from Project activities can be significantly reduced, if not avoided, with the implementation of monitoring measures designed to detect sea turtles before they are impacted and mitigation techniques to lessen the potential for effects. Atlantic Shores is committed to a comprehensive mitigation program, summarized at the end of this section, to avoid and minimize impacts to sea turtles. To date, Atlantic Shores has demonstrated during the completion of its preconstruction surveys that adverse effects to sea turtles can be avoided.

For the purposes of the IPF assessment, potential effects on sea turtles have been categorized as either very low, low, moderate, or high based on the relative risk of exposure and the vulnerability of the sea turtle species to Project-related stressors. Relative risk is determined according to sea turtle species occurrence using existing scientific literature values for distribution and presence/use of the Offshore Project Area, information on the potential impacts of offshore wind farm construction and operations in both the U.S and globally, and studies that provide a general understanding of hearing, vessel collision risk, response to anthropogenic sound, and other factors that influence the potential impacts of offshore wind construction, O&M, and decommissioning activities on sea turtles. For example, exposure to a species that infrequently occurs in the Lease Area (e.g., green turtle) or is not sensitive to a particular IPF (e.g., noise) based on scientific literature, would be categorized as having a low relative risk of impact to Project-related sound sources.

#### 4.8.3.1 Vessel Movements

Construction, O&M and decommissioning of the Project will require the support of up to 16 types of vessels throughout the lifetime of the Project (see Section 4.10, Table 4.10-1 of Volume 1). Atlantic Shores understands that vessel strikes are considered a threat to sea turtles and that presence of sea turtles within the Offshore Project Area will have to be monitored throughout all phases of Project development such that vessel interactions with these species can be avoided to the maximum extent practicable.

The greatest potential for Project vessels to interact with sea turtles in the Offshore Project Area will be during transits to and from the Lease Area. Atlantic Shores estimates that approximately 550 to 2,050 vessel round trips to the Offshore Project Area will occur annually during Project operations, which is an average of two to six vessel trips per day. As discussed in Section 4.7 Marine Mammals, Atlantic Shores will adhere to NOAA marine mammal requirements regarding vessel speed as well as guidance on vessel strike avoidance throughout all Project activities. These measures will also support efforts to minimize potential interactions with sea turtles.

Environmental training will also be provided to all vessel personnel responsible for operation, navigation, or lookout on sea turtles sighting, avoidance, and reporting procedures. The combination of these mitigation and monitoring measures reduces the risk of sea turtle interactions with Project vessels.

#### 4.8.3.2 Noise

Like other marine species, sea turtles have the potential to experience effects from increased levels of underwater sound. The following subsections address underwater noise that may be generated during Project construction, O&M, and decommissioning along with their potential effects on sea turtles. These activities include impact pile-driving and other noise sources (e.g., HRG surveys, vessels, cable installation, vibratory pile driving, operational WTGs, operational offshore cables, and decommissioning). The Project construction phase will result in the most noise-generating activities. However, Atlantic Shores will be implementing mitigation and monitoring techniques (e.g., soft starts and ramp ups during impact pile-driving, protected species observers [PSOs], and noise abatement systems [NAS]) to decrease sea-turtle risk of exposures to noise-generating Project activities.

**Impact Pile-driving Noise**

To evaluate the potential risks to sea turtles from impact pile-driving noise, Atlantic Shores conducted an underwater acoustic and animal exposure modeling analysis. This hydroacoustic assessment considered the proposed development within the Lease Area. An overview of the modeling conducted is provided in Section 8.0 In-Air Noise and Hydroacoustics. The complete Underwater Acoustic Assessment of Pile Driving and Related Sound-Producing Construction Activities at the Atlantic Shores Offshore Wind North Project Lease Area (Modeling Report) is provided as Appendix II-L.

The effects of anthropogenic sound from Project activities on sea turtles were assessed against the NOAA and BOEM accepted injury and behavioral acoustic thresholds criteria for impulsive and non-impulsive sounds. These threshold criteria are summarized in Table 4.8-4. Please note that injury and behavioral thresholds for sea turtles were developed for use by the US Navy (Finneran et al. 2017) based on exposure studies (e.g., McCauley et al. 2000a) and include dual acoustic thresholds (PK and SEL) for permanent threshold shift (PTS) and temporary threshold shift (TTS).

## Table 4.8-4. Interim Sea Turtle Injury and Behavioral Acoustic Thresholds Currently used by NOAA NMFS Greater Atlantic Regional Field Office (GARFO) and BOEM for Impulsive and Non-impulsive Sounds

| Species Group | Impulsive Signals | | Non-Impulsive Signals | Behavior ($L_{prms}$ dB re 1µPa (Unweighted) |
|---|---|---|---|---|
| | Injury | | Injury | |
| | SEL (dB re 1µPa$^2$-s) (Weighted) | Peak (dB re 1µPa) (Unweighted) | SEL (dB re 1µPa$^2$-s) (Weighted) | |
| Sea turtles (TU) | 204 ($L_{E,TU, 24h}$) | 232 ($L_{pk,0\text{-}pk,flat}$) | 220 ($L_{E, TU,24h}$) | 175 |

The hydroacoustic model estimated radial distances to regulatory-defined threshold levels based on a range of operational conditions (e.g., foundation type, hammer type, pile-driving schedule) as well as levels of potential noise attenuation (ranging from 0 to 15 decibels [dB]) that could potentially be achieved through the application of industry standard noise abatement systems (NAS). For the exposure assessment on sea turtles, the 10 dB attenuation level was conservatively chosen as the minimum sound reduction achievable. The Project will use a NAS for all impact piling events. The Project is committed to achieving ranges associated with at least 10 dB of noise attenuation. The type and number of NAS to be used during construction have not yet been determined. Based on prior measurements, this combination of NAS is reasonably expected to achieve greater than 10 dB broadband attenuation of impact pile driving sounds. It is also worth noting, that Atlantic Shores is investigating NAS options including, but not limited to, evacuated sleeve systems (e.g., IHC-Noise Mitigation System [NMS]), encapsulated bubble systems, and/or Helmholtz resonators (e.g., the AdBm NMS and HydroSound Dampers [HSDs]). These technologies may be capable of meeting or exceeding 10 dB attenuation during actual pile-driving, which could further decrease the radial distances away from the source of pile-driving noise.

Appendix II-L provides a summary of the representative modeling results to regulatory-defined sea turtle injury and behavioral thresholds for the monopile foundation pile-driving scenario. Of the pile-driving scenarios modeled, the monopile represents the maximum potential exposure ranges, inclusive of the assumed 10 dB attenuation. The full modeling results for all three foundation scenarios (i.e., monopile, pre-piled jacket, post-piled jacket) are provided in Appendix II-L, Tables 39 through 41. When assuming impact pile-driving of a monopile (with 10 dB noise attenuation), the predicted maximum exposure radial distances for injury and behavior are less than 1 mi (1.6 km) from the source. No sea turtles are expected to be exposed to $L_{PK}$ (peak sound pressure) exceeding the injury criteria threshold.

To estimate the number of sea turtles that could be exposed to noise levels above regulatory injury and behavior thresholds, important factors such as animal movement and sea turtle density estimates within the greater Lease Area, were considered.[40] Forecasted animal movements (e.g., diving, foraging, surfacing) were included in the exposure modeling to account for real-life movements when estimating exposures to individual sea turtles. Species' distribution and densities were also accounted for because they play a significant role in the number of sea turtles predicted to be exposed to pile-driving sounds. To account for sea turtle occurrence in the Lease Area, the exposure model scales the number of potentially exposed species by their corresponding densities in the area (Table 4.8-2; Denes et al. 2021).

Results of the sea turtle movement and exposure model based on the most conservative pile-driving scenario (15m monopile installation) with 10 dB attenuation are provided Table 4.8-5. The modeling analysis predicts that over the two-year construction period less than two sea turtles would be exposed to sound exposure levels ($L_E$) above the regulatory-defined threshold for injury and no sea turtles are expected to be exposed to peak sound pressure levels ($P_K$) exceeding the injury criteria threshold. In fact, these results are consistent across all foundation types (see Tables 39 through 41 of Appendix II-L). Potential sea turtle exposure to noise levels above the regulatory-defined behavior threshold with 10 dB attenuation under the maximum exposure scenario (i.e., 15-m monopile installation) would not exceed a total of 23 Kemp's ridley, 15 leatherback, and one green sea turtles over the 2-year construction period. Potential exposures to loggerhead sea turtles are predicted to be greater than other sea turtle species due to its higher seasonal presence in the Lease Area during the summer months (Table 4.8-2).

[40] For modeling purposes, sea turtle densities were calculated within a 31 mi (50) km buffered polygon around the Lease Area perimeter including the Monmouth ECC.

### Table 4.8-5. Overall Acoustic Exposure Estimates of Sea Turtles for the Atlantic Shores North Project Based on Installation Schedule 1 (15 m Monopiles and OSS Jackets, Which Includes Four Post-Piled Pin Piles)

| Marine Animal Hearing Group | Marine Animal Species | Injury | | | | | | | | Behavior | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Peak ($L_{pk}$) | | | | SEL ($L_E$) | | | | SPL ($L_p$) | | | |
| | | Sound Attenuation Level (dB) | | | | | | | | Sound Attenuation Level Attenuation (dB) | | | |
| | | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 | 0 | 6 | 10 | 15 |
| Turtles (TU) | Green turtle | 0.0 | 0.0 | 0.0 | 0.0 | 1212.3 | 398.0 | 46.8 | 0.0 | 3394.8 | 1614.4 | 1212.0 | 888.3 |
| | Kemp's ridley turtle | 0.0 | 0.0 | 0.0 | 0.0 | 86.2 | 28.1 | 3.4 | 0.0 | 242.7 | 115.8 | 86.3 | 63.0 |
| | Leatherback turtle | 0.0 | 0.0 | 0.0 | 0.0 | 2001.0 | 663.8 | 74.1 | 0.0 | 5549.1 | 2622.1 | 1990.5 | 1471.4 |
| | Loggerhead turtle | 0.0 | 0.0 | 0.0 | 0.0 | 1392.9 | 457.0 | 51.5 | 0.0 | 3868.4 | 1839.6 | 1390.7 | 1021.1 |

As evidenced by the modeling assessments, the potential impacts on sea turtles associated with exposure to sound levels above regulatory defined thresholds are expected to be low and limited to the seasons when sea turtles are present (i.e., primarily summer and fall). Because of their rigid external anatomy, it is possible that sea turtles are highly protected from impulsive sound effects such as pile-driving (Popper et al. 2014), and studies suggest that pile-driving activities are unlikely to result in long-term behavioral modification.

These factors are expected to decrease the level of risk to sea turtles from impact pile-driving noise, as explained in the following list:

- Ambient sound levels, mainly from other anthropogenic activities in the ocean, may mask Project-related noise and decrease the chance of exposure to sea turtles (Kraus et al. 2016).
- Animal aversion is an important behavioral and mitigating factor likely decreasing the risk of sea turtle exposure from pile-driving and other construction sounds because received sound level generally decreases with distance. Moving away from sounds, or aversion, is a common response of animals to sound, particularly at higher sound exposure levels (McCauley et al., 2000a, Popper et al., 2014). Some level of aversion for all species is expected during construction.
- Monitoring throughout construction activity is designed to detect sea turtles before they approach impact pile-driving close enough to be exposed to potentially injurious or disruptive sounds.
- Visual observations will be performed by NOAA-approved Protected Species Observers (PSOs) throughout pile-driving activities.
- Protection zones will be maintained during pile-driving and operational controls will be implemented to modify or halt potentially harmful activities when sea turtles are detected.
- Equipment operating procedures (e.g., soft starts, ramp-ups) to control the noise generated by pile-driving or survey equipment will be implemented to prevent exposure of harmful sound levels to protected marine life.
- Beginning impact pile-driving during low visibility/low conditions will be prohibited when sea turtles cannot be detected to decrease the overall risk of exposure. During nighttime activities and/or periods of inclement weather use of night vision devices, such as night vision binoculars and/or infrared cameras, will be implemented.

For all species, impacts resulting from sound exposure may affect individuals but have only a very low to low risk of impact on sea turtle populations. The potential impact on the population will depend on the effect on the individual, the size of the species' population, and the localized activity. There are four sea turtle species that may be present in the vicinity of the Lease Area during construction, O&M, and decommissioning.

The likelihood of any sea turtle species occurring in the Lease Area is dependent on season and may vary from year-to-year (Normandeau Associates and APEM 2018, 2019a, 2019b, 2019, 2020).

**Other Noise Sources**

There are several other potential anthropogenic sound sources associated with offshore Project construction, O&M, and decommissioning. With the exception of coffer dam installation, conductor barrel impact pile driving and goal post installation / extraction, these sources were not quantitatively modeled because the potential acoustic impact of these noise sources is expected to be much less than impact pile-driving. A qualitative assessment of possible impacts on sea turtles from other noise sources generated by Project activities, including high-resolution geophysical (HRG) surveys, cofferdam installation, vessels, cable installation, vibratory pile driving (if needed), operational WTGs, operational offshore cables, and decommissioning is summarized in this section.

**High-Resolution Geophysical (HRG) Surveys**

As detailed in Sections 4.5.3 and 4.5.9 of Volume I, HRG surveys may be conducted to support pre-construction site clearance activities as well as post construction facilities surveys. HRG surveys use sound sources that output acoustic signals with frequency bandwidths and amplitudes best suited for the desired survey product. The acoustic signals often are impulsive, tonal, or chirp pulses (short duration signals that sweep through many frequencies). HRG sources can be grouped into three categories: (1) impulsive signals (e.g., boomers and sparkers) that are broadband with most energy at low frequencies; (2) chirp sonars, which are high-frequency sweeps with most energy at high frequencies; and (3) sonars (e.g., side-scan, multibeam), which are high-frequency tones or chirp signals. The source level, beamwidth, pulse duration, and pulse repetition rate of such sources are typically adjustable.

A previous analysis by BOEM (2014) on the effects of HRG survey noise on sea turtles in the Mid- and South-Atlantic Planning Areas concluded that impacts are expected to be minor with the implementation of mitigation measures for sources operating at or below 200 Hz. Modeled acoustic ranges to injury thresholds for active acoustic sources used in HRG surveys are generally within a small distance from the source. Sea turtles in the vicinity of an HRG survey are not expected to be exposed to sound levels that could cause hearing damage (BOEM 2014). HRG equipment may produce sound levels associated with behavioral response in sea turtles such as avoidance of the sound source, disorientation, and change in normal behaviors such as feeding (BOEM 2014).

On June 29, 2021, NMFS issued a Letter of Concurrence (LoC) covering site characterization activities including HRG surveys. As a result, the mitigation, monitoring and reporting conditions for these activities were revised with respect to threatened and endangered species. Atlantic Shores has implemented the best management practices outlined within the LoC for HRG surveys conducted subsequent to issuance of the LoC and will continue to do so for future HRG surveys that may be conducted within the Lease Area.

Atlantic Shores has conducted several months of HRG surveys to date and have successfully demonstrated that monitoring and mitigation during HRG surveys decreases the potential impacts on sea turtles. Many of the monitoring and mitigation strategies described for pile-driving are like those employed during HRG surveys. Standard mitigation employed during HRG surveys includes the use of PSOs, protective zones, ramp-up of active sound sources, and shut down of sources should sea turtles enter the established exclusion zones. Because of the intermittent and short-term nature of HRG surveys, and the implementation of monitoring and mitigation measures, the effects of HRG noise on sea turtles are expected to be low.

**Coffer Dam Installation**

ASOW is planning on installing ZZ46-700 sheet piles (width of 700 millimeters (mm) and varying lengths (14.3 m or 24.2 m)) at five potential cofferdam locations between New York and New Jersey with vibratory pile driving using an APE 200T hammer (Figure 4.8-1). Two representative modeling locations have been selected for cofferdam installation and removal to capture the range of water depths and habitats at the potential installation locations, with one model site selected per state. The Monmouth location was modeled as the representative New Jersey location and the Wolfe's Pond/Lemon Creek, Staten Island location was modeled at the representative New York location. Up to six cofferdams will be installed and extracted, with up to four at a New Jersey nearshore location and two at a New York nearshore location. The installation of the cofferdams was modeled in the winter and extraction of the cofferdams was modeled in the spring, which resulted in 12 days of vibratory piling in both winter and spring.

Acoustic exposures for sea turtles due to vibratory pile-driving for cofferdams were not calculated as sea turtle species are not reasonably expected to be present in the cofferdam model areas during the modeled seasons of winter and spring. As cold-blooded animals, sea turtles depend upon the temperature of their surrounding environment to maintain their body temperatures. Winter and spring water temperatures off New Jersey and New York are too cold for sea turtle survival, so sea turtles migrate southward into warmer ocean environments during these seasons, only returning northward as the ocean temperatures begin warming.

**Conductor Barrel / Goal Post Installation and Extraction**

ASOW is planning on installing 1.54-m diameter steel pipes as part of the conductor barrel at four potential locations between New Jersey and New York (Figure 2). The conductor barrel will be comprised of five 6.1-m sections of pipe to result in a total length of 30.5 m. The 1.54-m pipes will be installed at an angle of approximately 12° to the seafloor using a Grundoram Taurus pneumatic hammer. The conductor barrel is supported by a goal post structure comprised of two 0.3-m steel pipes installed vertically into the seafloor and an I-beam welded horizontally between the two vertical piles. The goal post 0.3-m steel pipes will be installed via vibratory pile driving using an APE 200T hammer.

Two representative modeling locations have been selected for modeling of the conductor barrel and goal post installation, one per state, to capture the range of water depths and habitats at the potential installation locations, with one model site selected per state. The Monmouth location was modeled as the representative New Jersey location and the Lemon Creek/Wolfe's Pond location was modeled at the representative New York location.

Acoustic exposures for sea turtles due to impact pile driving for conductor barrels and installation / extraction of goal posts were not calculated as sea turtle species are not reasonably expected to be present in the model areas during the modeled seasons of winter and spring. As cold-blooded animals, sea turtles depend upon the temperature of their surrounding environment to maintain their body temperatures.

**Vessel Sounds**

As discussed previously, Project vessel traffic will originate from one or more port facilities and arrive at the Offshore Project Area during construction, O&M, and decommissioning (see Sections 4.10.3 and 5.5 of Volume I). Ship engines, propellers, thrusters, and vessel hulls emit broadband, non-impulsive sound, which overlaps with the assumed or known hearing frequency ranges for sea turtles (Piniak 2012), Piniak et. al, 2012). Presently, sea turtles occurring off of New Jersey and New York are subjected to commercial shipping traffic and other vessel noise and could potentially be habituated to vessel noise (BOEM 2014). Because noise from Project-vessel traffic is likely to be the same, or similar to, background vessel traffic noise, the potential risk of impacts from vessel noise to sea turtles is expected to be low relative to the risk of impact from pile-driving sound.

As with impulsive sound from pile-driving, the most likely effect of vessel noise on sea turtles is behavioral response. Given the low model-predicted estimates of exposure to pile-driving sound for sea turtles and the lower sound levels associated with vessel transit and operation, the risk to sea turtles from Project vessel operation is assessed as very low to low.

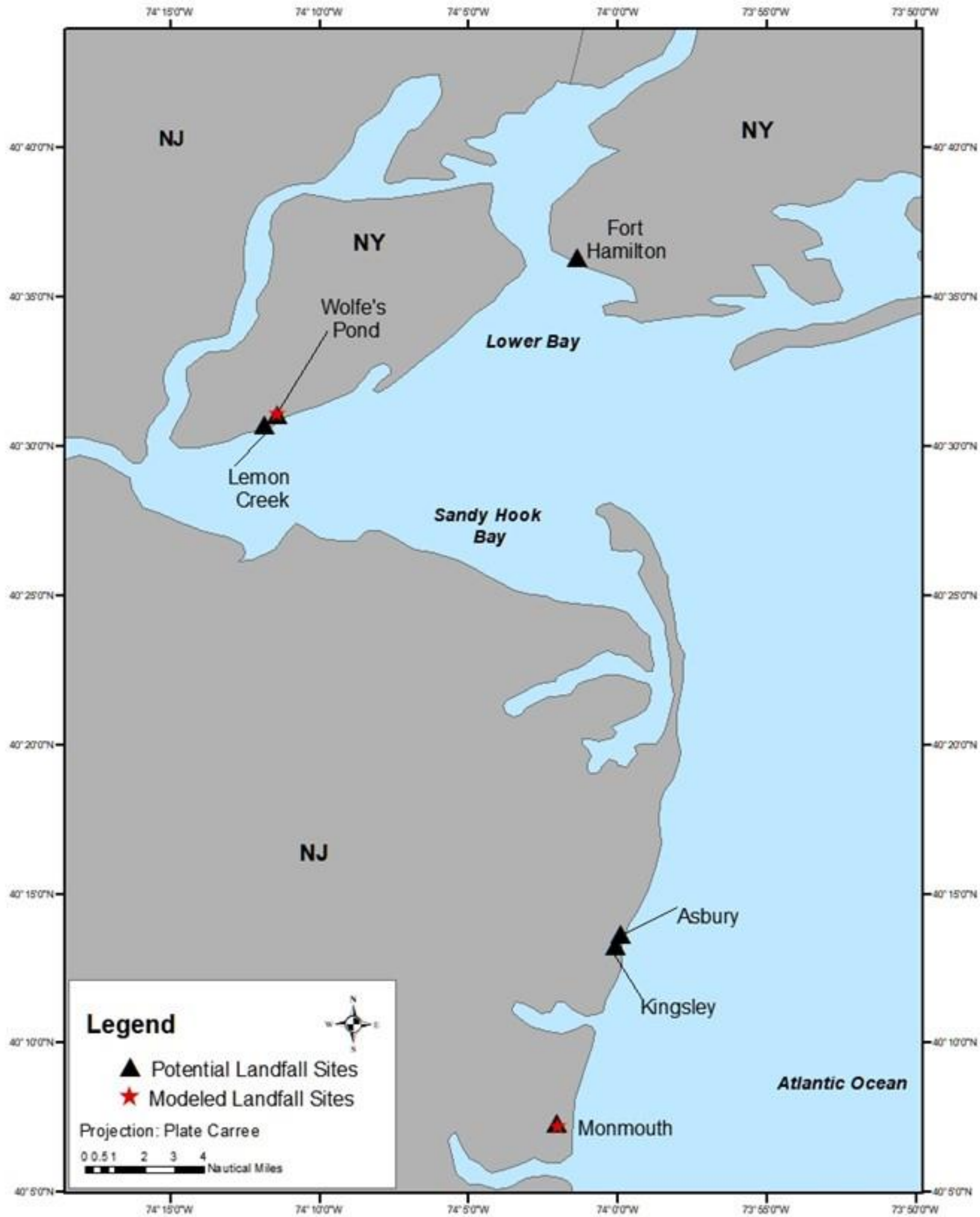





**Figure 4.8-1**

*Potential Cofferdam, Conductor Barrel, and Goal Post Locations for the Atlantic Shores North Project Near Shore in New Jersey and New York States*

**Vibratory Pile-driving**

Vibratory pile-driving may be used for the installation of WTG foundations in the Lease Area, as discussed in Section 4.2.1 of Volume I. The monitoring and mitigation measures to be implemented during impact pile-driving are expected to greatly reduce the risk of exposure to sea turtles from vibratory pile-driving in the Lease Area.

**Cable Installation and Cable Operation**

As described in Section 4.5 of Volume I, cable installation activities generate non-impulsive, intermittent sounds when using mechanical or water jetting equipment. However, the dominant sound sources during cable installation are the thrusters on the dynamically positioned vessels that will be used. Published impact studies for various cable projects have concluded that sound related to subsea cable installation was not a significant issue as recorded sound levels were highly variable, ranging from 123 dB to 178 dB SPL at the source, which is below the non-impulsive acoustic thresholds for injury in sea turtles (Nedwell et al. 2003). As described above for vessel noise, the potential impacts of noise exposure on sea turtles associated with this cable installation activity are expected to be very low and dependent on season. Noises from cable-laying equipment activities are also likely to be less than background vessel traffic noise.

High-voltage alternating current (HVAC) offshore cables are expected to produce non-impulsive low-frequency tonal vibration sound in the water. High voltage direct current (HVDC) cables do not produce a similar tonal sound because the current is not alternating. As previously explained in Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat, the anticipated sound pressure level arising from the vibration of high voltage alternating current (HVAC) cables during operation are likely undetectable in the ambient soundscape of the Lease Area (Meißner et al. 2006). No effects on sea turtles are expected from low-frequency tonal vibration sound emitted during cable operations.

**Aircraft**

The Project is likely to rely on aircraft for a variety of specific missions during construction, O&M, and decommissioning. Helicopters are sometimes used for crew transfer operations and may also be used for visual inspection of equipment while vessels continue with installation activities. Atlantic Shores may also use fixed-wing aircraft to support monitoring and mitigation for protected marine species.

Helicopter and fixed-wing aircraft used during the Project's construction phase will be in operation intermittently and maintain safe altitudes (usually 500 to 1000 ft [150 to 300 m]) above sea level. At these heights, aircraft noise is unlikely to elicit behavioral response in sea turtles based on acoustic thresholds (Piniak et al. 2016). The risk of potential effects is considered low.

**Wind Turbine Generators**

A review of the sound characteristics of WTG noise on marine wildlife was presented in Section 4.7.2.2. The anticipated WTG underwater sound levels are well below both non-impulsive injury and behavioral response thresholds for sea turtles (see Table 4.8-4). Effects of noise from wind turbines on sea turtles are expected to be very low.

### 4.8.3.3 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new foundation structures and offshore cables includes installation of associated scour and cable protection. These activities result in localized seafloor disturbances and temporary increases in suspended sediment and deposition that may alter limited areas of sea turtle habitat and cause short-term changes in sea turtle prey abundance. Few sea turtles are expected to be affected by these activities because the area of disturbance will be small relative to the total area of surrounding habitat (see Section 3.2 Water Quality). Moreover, as evident from environmental assessments and surveys performed in the Offshore Project Area, the affected area is dynamic in nature and experiences regular disturbance from natural (e.g., waves, storms, mobile sediment) and anthropogenic (e.g., fishing and vessel activity) sources. Temporary loss of prey species for foraging sea turtles is likely limited to the period of active construction with prey species expected to return when these activities cease (USCG 2006). Similarly, sea turtles are likely to avoid areas close to installation and maintenance activities, where sea floor disturbances and temporarily suspended sediments may occur.

### 4.8.3.4 Electromagnetic Fields

EMFs are invisible areas of electric and magnetic energy that occur both naturally and anthropogenically in the marine environment. Atlantic Shores conducted an EMF study to predict EMF levels from Project submarine electrical system operation which includes a combination of HVDC and HVAC cables and OSSs (see Appendix II-I). The modeling results show that EMF levels are predicted to decrease exponentially with increasing distance from the cables and are therefore expected to cause minimal risk to sea turtles. Furthermore, the New Jersey Baseline Ecological Studies (Geo-Marine 2010) did not identify sea turtles as marine fauna that might be impacted by EMF (Lohmann et al. 1999, Lohmann et al. 2001, Bochert and Zettler 2006).

Based on modeled EMF levels, sheathing and burial of cables, and limited time spent on the seafloor in proximity to cables, the risk of effects on sea turtles from EMFs is expected to be low. While sea turtles do forage on benthic species in the neritic zone, sea turtles spend most of their time near the sea surface (Smolowitz et al. 2015)(Burke et al. 1993).

### 4.8.3.5 Light

During construction, and O&M, vessels working or transiting during periods of darkness and fog will utilize lighting. During operations, Project structures will be lit in compliance with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines for lighting and marking as described in Section 5.3 of Volume I. WTG aviation lights will likely be too high above sea level to penetrate the water surface. Navigation lighting on structures along the perimeter of the Lease Area will have lights close to sea level and could penetrate the water. As discussed in Section 4.6.2.5, the artificial light from navigation lighting can attract or deter certain prey species of sea turtles (e.g., finfish, invertebrates). However, the amount of artificial Project lighting from vessels and structures that would penetrate the sea surface is expected to be localized and minimal and not likely to cause adverse effects to sea turtles or their prey species. The risk of impact to sea turtles from Project-related artificial lighting on offshore structures is expected to be very low.

#### 4.8.3.6 Presence of Structures and Cables

Within the Offshore Project Area, the installation and presence of foundations, towers, cable protection, and scour protection are likely to result in the creation of hard-substrate habitat in what is currently, predominantly flat, sandy habitat. These changes may lead to temporary and localized shifts in limited areas of sea turtle habitat and changes to prey abundance, hydrodynamics, suspended sediment, and deposition rates, and both invasive and non-invasive species attraction. Potential benthic and pelagic habitat effects from the presence of structures was previously discussed in Section 4.6.2.6. The overall negative impact of habitat alteration and declining prey availability is anticipated to be very low to low especially considering relatively large ranges of sea turtles, availability of habitat in other areas, and relatively low seasonal abundance of sea turtles in the Offshore Project Area.

During Project O&M, WTG and OSS foundations will be positioned with sufficient distance between them so that sea turtles will not be impeded from natural use of the habitat. Submerged foundations can create a "reef effect", providing additional habitat for marine species (Broadbent et al. 2020, Petersen and Malm 2006, Friedlander et al. 2014, Sammarco et al. 2014). Sea turtles are known to be attracted to reefs associated with artificial structures, likely because they are a source of both shelter and foraging habitat (Stoneburner 1982, Gitschlag et al. 1997). Loggerheads are commonly observed resting in and around artificial reefs and shipwrecks (Patterson 2010, Nuttall and Wood 2012). Artificial reefs contain greater densities and biomass of fish compared to surrounding sandy areas as well as adjacent natural reefs (Bohnsack 1989, Ambrose and Anderson 1990, Bohnsack et al. 1994, Arena et al. 2007, Gallaway et al. 2009, Lowe et al. 2009, Friedlander et al. 2014). For these reasons, foundations may have a long-term, positive impact on sea turtles.

Although the presence of foundations and cable and scour protection could result in shifts to prey habitats and availability over time during the O&M phase of the Project, foundations and cable and scour protection are expected to produce ecologically beneficial effects that could outweigh the risk of introducing hard structure to a small area of the vast flat, sandy habitat found in the Mid-Atlantic Bight. Once the Project is decommissioned, the local environmental and ecological features of the area are expected to revert to pre-construction conditions. Potential impacts from decommissioning include the loss of Project-related hard structures, which are expected to be colonized at the time of decommissioning. Reef or structure-oriented sea turtle prey species (i.e., finfish, crustaceans) will be displaced during decommissioning as the foundations and scour protection are removed.

Lost fishing gear and other marine debris could possibly catch on foundations and present a secondary entanglement hazard to sea turtles (Barnette 2017). However, WTG/OSS foundations have large diameters without the protrusions on which lost fishing gear or other marine debris could become snagged, reducing the potential for gear entanglement. Regardless, Project vessels and personnel will remove any lost gear or marine debris encountered during regular inspections. Therefore, the potential for marine debris and other pollution as a direct result of the installation and presence of structures in the Offshore Project Area is considered very low and manageable.

#### 4.8.3.7 Summary of Proposed Environmental Protection Measures

Atlantic Shores is committed to avoiding and minimizing Project-related impacts to sea turtles during all phases of the Project. Atlantic Shores is developing a monitoring plan in conjunction with key Federal, State and eNGO stakeholders that will inform Project activities and decision-making to mitigate Project-related impacts on protected marine species, including sea turtles. In addition, Atlantic Shores will also be implementing a comprehensive program of best management practices (BMPs) to minimize and avoid Project impacts, while exploring new, innovative minimization/avoidance approaches. After mitigation measures are implemented, the residual risk of impacts to sea turtles is expected to be significantly reduced.

Throughout all phases of the Project (pre-construction, construction, O&M, decommissioning), Atlantic Shores is committed to the implementation of mitigation and monitoring strategies to reduce the risk of Project-related impacts on sea turtles. The environmental protection measures adopted for marine mammals (Section 4.7.2.7) will also protect sea turtles. Several of these key strategies are listed as follows:

- Vessel strike avoidance procedures will be implemented that reduce the potential risk of Project-related vessel collisions with sea turtles, including the following actions:
    - Adhere to marine wildlife viewing and safe boating guidelines (NOAA 2018) to minimize vessel interactions to the maximum extent practicable.
    - Train Project personnel in sea turtle spotting and identification, observation reporting protocols, and vessel strike avoidance procedures, as applicable.
- In accordance with the June 29, 2021 Informal Letter of Concurrence issued by NMFS, during times of the year when sea turtles are known to occur in the Offshore Project Area, vessels will avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels will slow to no greater than 4 knots while transiting through such areas.
- Marine debris caught on offshore Project structures will be removed, when safe and practicable, to reduce the risk of sea turtle entanglement.

Atlantic Shores will take additional precautions during activities that could generate underwater noises above regulatory-defined injury and behavior thresholds (e.g., impact pile-driving, HRG surveys), as follows:

- Protection zones will be established and monitored to create sufficient opportunity to modify or halt Project activities potentially harmful to protected species, such as:
    - Exclusion Zones around activities that have the potential to harm sea turtles.
    - Monitoring Zone (larger than an Exclusion Zone) around activities that have the potential to result in the harassment of sea turtles.

- Visual monitoring of Exclusion and Monitoring Zones by NOAA Fisheries-approved PSOs will be conducted to alert the Project's survey and/or marine construction teams to the presence of protected species, including:
  - Vessel-based and/or aerial monitoring of large Exclusions Zones and Monitoring Zones.
  - Use of night vision devices such as night vision binoculars and/or infrared cameras, during nighttime activities and/or periods of inclement weather.
- Pile-driving will follow a proposed schedule that avoids the completion of pile-driving after dark.
- Equipment operating procedures will be implemented, as appropriate, to control the noise generated by pile-driving or survey equipment to prevent exposure of harmful sound levels to protected marine life.
  - NAS will be implemented during impact pile-driving to decrease the propagation of potentially harmful underwater noises.
  - Soft starts will be considered for activities such as impact pile-driving.
  - Ramp-up procedures whereby the sound source level is increased gradually before use of full power.
  - A ramp-down, and if necessary, a shut-down of activities such as pile-driving and/or HRG survey equipment that has the potential to cause harm or harassment to sea turtles will occur if an animal is seen approaching or entering a Monitoring Zone or Exclusion Zone.

Atlantic Shores is also evaluating additional innovative technologies and methods to improve the monitoring of sea turtles within the Project Area and to further inform regional efforts to understand cumulative impacts to these species. Through partnerships with universities, governmental agencies and environmental non-governmental organizations, Atlantic Shores is working with sea turtle experts to identify key knowledge gaps and to plan studies to advance the general understanding of sea turtles in the Mid-Atlantic Bight. Other innovations Atlantic Shores is currently investigating to further minimize impacts to sea turtles include the use of unmanned aerial systems. This effort will build on earlier trials conducted by RPS, AUV Flight Services and Advanced Aircraft Company, for which Federal regulatory agency approval was obtained. Atlantic Shores will conduct a field trial during an offshore wind survey using drone technology to monitor for protected species. The Unmanned Aerial Systems would be mounted with a high definition stabilized infrared camera system specifically designed for small, unmanned vehicles. A trial would be configured whereby a PSO team would monitor high-definition drone camera footage in real time on shore, while another PSO team would simultaneously monitor visually from a selected platform.

## 4.9 Summary of Protected Species

This section summarizes the marine, terrestrial, and avian species listed as endangered and threatened under the Federal Endangered Species Act (ESA) the New Jersey Department of Environmental Protection (NJDEP) Endangered Species Conservation Act, and/or the New York Department of Environmental Conservation (NYSDEC) Endangered Species Regulations that could be present within or proximate to the Onshore and Offshore Project Area based on agency consultation, field studies, and/or a review of publicly available information and could potentially be impacted directly or indirectly by the Project. Table 4.9-1 lists the species, their Federal and/or State status, and the Construction and Operations Plan (COP) section/supporting appendix where potential effects to the species or its habitat are discussed.

### Table 4.9-1. Listed Species and Species of Concern with Potential Occurrence in the Project Area

| Common Name | Scientific Name | Federal Status | NJ State Status | NY State Status |
|---|---|---|---|---|
| Terrestrial Plants (COP Section 4.2, Volume II Appendices E1, E2) | | | | |
| Seabeach amaranth | *Amaranthus pumilus* | T | E | T |
| American chaffseed | *Schwalbea americana* | E | E | |
| Knieskern's beak-rush | *Rhynchospora knieskernii* | T | E | |
| Swamp pink | *Helonias bullata* | T | E | |
| Winter Grape | *Vitis vulpina* | | | E |
| Dune Sandspur | *Cenchrus tribuloides* | | | T |
| Swamp Marsh Pennywort | *Hydrocotyle ranunculoides* | | | E |
| Persimmon | *Diospyros virginiana* | | | T |
| Great Plains Flat Sedge | *Cyperus lupulinus ssp. lupulinus* | | | T |
| Virginia Hedge Hyssop | *Gratiola virginiana* | | | E |
| Minute Duckweed | *Lemna perpusill* | | | T |
| Rose Pink | *Sabatia angularis* | | | E |
| Blunt Mountain Mint | *Pycnanthemum muticum* | | | T |
| Stuve's Bush Clover | *Lespedeza stuevei* | | | T |
| Torrey's Thoroughwort | *Eupatorium torreyanum* | | | T |
| Willow Oak | *Quercus phellos* | | | E |
| Sedge Rush | *Juncus scirpoides var. scirpoides* | | | E |
| Short-leaved Pine | *Pinus echinata* | | | E |
| Virginia Pine | *Pinus virginiana* | | | |

| Common Name | Scientific Name | Federal Status | NJ State Status | NY State Status |
|---|---|---|---|---|
| Whorled Mountain Mint | *Pycnanthemum verticillatum var. verticillatum* | | | E |
| Slender Spike Grass | *Chasmanthium laxum* | | | E |
| Southern Wild Raisin Low St. John's Wort | *Viburnum nudum var. nudum Hypericum stragulum* | | | E |
| Sweetbay Magnolia | *Magnolia virginiana var. virginiana* | | | E |
| Powdery Carrion Flower | *Smilax pulverulenta* | | | E |
| Swamp Marsh Pennywort | *Hydrocotyle ranunculoides* | | | E |
| Globe Flat Sedge | *Cyperus echinatus* | | | E |
| Green Milkweed | *Asclepias viridiflora* | | | T |
| Terrestrial Reptiles (COP Section 4.2, Volume II Appendices E1, E2) | | | | |
| Eastern box turtle | *Terrapene carolina* | | SC | |
| Wood turtle | *Glyptemys insculpta* | | T | |
| Bog turtle | *Glyptemys muhlenbergii* | T | E | |
| Eastern Mud Turtle | *Kinostrenon subrubrum* | | | E |
| Fence Lizard | *Sceloporus undulatus* | | | T |
| Amphibians (COP Section 4.2, Volume II Appendices E1, E2) | | | | |
| Fowler’s toad | *Anaxyrus fowleri* | | SC | |
| Pine barrens treefrog | *Hyla andersonii* | | T | |
| Birds (COP Section 4.2, Volume II Appendices E1, E2; COP Section 4.3, Volume II Appendix F) | | | | |
| American black duck | *Anas rubripes* | | | SGCN |
| American Bittern | *Botaurus lentiginosus* | | E*, SC+ | SC |
| American kestrel | *Falco sparverius* | | T | |
| American Oystercatcher | *Haematopus palliatus* | | SC | |
| Bald eagle | *Haliaeetus leucocephalus* | | E | T |
| Barn Owl | *Tyto alba* | | SC | SGCN |
| Barred owl | *Strix varia* | | T | |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | | SC* | |
| Black-crowned night-heron | *Nycticorax nycticorax* | | T | |
| Black Rail | *Laterallus jamaicensis* | | E | E |

| Common Name | Scientific Name | Federal Status | NJ State Status | NY State Status |
|---|---|---|---|---|
| Black Skimmer | *Rynchops niger* | | E | SC |
| Blackburnian Warbler | *Setophaga fusca* | | SC* | |
| Black-throated Blue Warbler | *Setophaga caerulescens* | | SC* | |
| Black-throated Green Warbler | *Setophaga virens* | | SC* | |
| Blue-headed Vireo | *Vireo solitarius* | | SC* | |
| Bobolink | *Dolichonyx oryzivorus* | | T*, SC+ | SGCN |
| Broad-winged Hawk | *Buteo platypterus* | | SC* | |
| Brown thrasher | *Toxostoma rufum* | | SC | |
| Canada Warbler | *Cardellina canadensis* | | SC* | SGCN |
| Caspian Tern | *Hydroprogne caspia* | | SC* | |
| Cattle Egret | *Bubulcus ibis* | | T | SGCN |
| Cerulean Warbler | *Setophaga cerulea* | | SC | SC |
| Cliff Swallow | *Petrochelidon pyrrhonota* | | SC* | |
| Common loon | *Gavia immer* | | | SC |
| Common Nighthawk | *Chordeiles minor* | | SC | SC |
| Common tern | *Sterna hirundo* | | SC* | T |
| Coopers Hawk | *Accipiter cooperii* | | SC* | SC |
| Eastern Meadowlark | *Sturnella magna* | | SC | SGCN |
| Forster's Tern | *Sterna forsteri* | | | U |
| Glossy ibis | *Plegadis falcinellus* | | SC | |
| Golden Eagle | *Aquila chrysaetos* | | | E |
| Golden-winged Warbler | *Vermivora chrysoptera* | | E*, SC+ | SC |
| Gull-billed Tern | *Gelochelidon nilotica* | | | U |
| Grasshopper Sparrow | *Ammodramus savannarum* | | T* | SC |
| Gray-cheeked Thrush | *Catharus minimus* | | SC | |
| Great blue heron | *Ardea herodias* | | SC* | |
| Harlequin Duck | *Histrionicus histrionicus* | | | U |
| Henslow's Sparrow | *Centronyx henslowii* | | | T |
| Hooded warbler | *Wilsonia citrina* | | SC* | |
| Horned lark | *Eremophila alpestris* | | T*, SC+ | SC |
| Kentucky Warbler | *Geothlypis formosa* | | SC | SGCN |

| Common Name | Scientific Name | Federal Status | NJ State Status | NY State Status |
|---|---|---|---|---|
| Least Bittern | *Ixobrychus exilis* | | SC | T |
| Least Flycatcher | *Empidonax minimus* | | SC* | |
| Least tern | *Sternula antillarum* | | E | |
| Little blue heron | *Egretta caerulea* | | SC | |
| Loggerhead Shrike | *Lanius ludovicianus* | | E | E |
| Long-eared Owl | *Asio otus* | | T | |
| Nashville Warbler | *Leiothlypis ruficapilla* | | SC* | |
| Northern Goshawk | *Accipiter gentilis* | | E* | SC |
| Northern harrier | *Circus cyaneaus* | | E*, SC$^{+}$ | |
| Northern Parula | *Setophaga americana* | | SC* | |
| Osprey | *Pandion haliaetus* | | T | SC |
| Peregrine Falcon | *Falco peregrinus* | | E*, SC$^{+}$ | E |
| Pied-billed Grebe | *Podilymbus podiceps* | | T*, SC$^{+}$ | T |
| Piping plover | *Charadrius melodus* | T | E | E |
| Red-headed Woodpecker | *Melanerpes erythrocephalus* | | T | SC |
| Red knot | *Calidris canutus rufa* | T | E | T |
| Red-shouldered Hawk | *Buteo lineatus* | | T* | SC |
| Roseate tern | *Sterna dougallii* | E | E | E |
| Saltmarsh Sparrow | *Ammospiza caudacuta* | | SC* | SGCN |
| Sanderling | *Calidris alba* | | SC | |
| Savannah Sparrow | *Passerculus sandwichensis* | | T* | |
| Semipalmated Sandpiper | *Calidris pusilla* | | | SGCN |
| Sharp-shinned Hawk | *Accipiter striatus* | | | SC |
| Short-eared Owl | *Asio flammeus* | | E | E |
| Snowy egret | *Egretta thula* | | SC | |
| Spotted Sandpiper | *Actitis macularius* | | SC* | |
| Tricolor heron | *Egretta tricolor* | | SC | |
| Upland Sandpiper | *Bartramia longicauda* | | | T |
| Veery | *Catharus fuscescens* | | SC* | |
| Vesper Sparrow | *Pooecetes gramineus* | | T*, SC$^{+}$ | SC |
| Whimbrel | *Numenius phaeopus* | | SC | SGCN |
| Winter Wren | *Troglodytes hiemalis* | | SC* | |

| Common Name | Scientific Name | Federal Status | NJ State Status | NY State Status |
|---|---|---|---|---|
| Wood thrush | *Hylocichla mustelina* | | SC* | |
| Worm-eating Warbler | *Helmitheros vermivorum* | | SC* | |
| Yellow-breasted Chat | *Icteria virens* | | SC* | |
| Yellow-crowned night-heron | *Nyctanassa violacea* | | T | |
| Bats (COP Section 4.4) | | | | |
| Northern long-eared bat | *Myotis septentrionalis* | T | | |
| Fish (COP Section 4.6) | | | | |
| Atlantic sturgeon | *Acipenser oxyrhynchus* | E | E | E |
| Giant manta ray | *Manta birostris* | T | | |
| Shortnose sturgeon | *Acipenser brevirostrum* | E | E | E |
| Marine Mammals (COP Section 4.7) | | | | |
| North Atlantic right whale | *Eubalaena glacialis* | E | E | |
| Fin whale | *Balaenoptera physalus* | E | E | E |
| Sei whale | *Balaenoptera borealis* | E | E | E |
| Humpback whale | *Megaptera novaeangliae* | | E | E |
| Bottlenose dolphin | *Tursiops truncatus* | | SC | |
| Harbor porpoise | *Phocoena phocoena* | | SC | SC |
| Sperm whale | *Physeter macrocephalus* | E | E | E |
| Sea Turtles (COP Section 4.8) | | | | |
| Leatherback | *Dermochelys coriacea* | E | E | E |
| Loggerhead | *Caretta caretta* | E | E | T |
| Green | *Chelonia Mydas* | E | T | T |
| Kemp's Ridley | *Lepidochelys kempii* | E | E | E |

Notes:
E – endangered. A species "in danger of extinction throughout all or a significant portion of its range."
T – threatened. A species "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
PT – Proposed listed as "threatened".
SC – New Jersey or New York state species of special concern. In New Jersey this applies to species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. In New York this applies to any Native Species for which a welfare concern or risk of endangerment has been documented in New York State

SGCN – New York Species of Greatest Conservation Need. These species are undergoing a population decline or have identified threats that may put them at risk, and are in need of timely management intervention or they are likely to reach critical population levels in New York.
UR – under review. Species that have been petitioned for listing and for which a 90-day finding has not been published or for which a 90-day substantial has been published but a 12-month finding have not yet been published in the Federal Register.
U - Unlisted a New York State designation, while unlisted in New York State these species are considered rare and of conservation concern
* Indicates Breeding population only
+ Indicates normal population only

# 5.0 Seascape, Landscape, and Visual Impact Assessment

This section describes the potential impacts associated with the Onshore Project Area and Offshore Project Area (which includes the Lease Area) to seascape, landscape, and ocean receptors as well as the viewers within these character areas. This section also describes associated impact-producing factors (IPF), measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning of the Project.

The components of the Lease Area considered in this section include 157 wind turbine generators (WTGs) and eight offshore substations (OSS), which are the primary visible offshore components of the Project, and two onshore substations, which are the primary visible onshore components of the Project (see Volume 1, Project Information).

## 5.1 Affected Environment

The Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States (Sullivan, 2021 [SLVIA methodology]) recommends a 40-nautical mile (nm) (74-kilometer [km]) radius around the Lease Area (see Figure 5.1-1). The geographic analysis area (GAA) was determined by completing a viewshed analysis of the proposed WTGs that only considers the screening effects of the curvature of the earth (with a refraction index of 0.13) and topography with a bare-earth digital elevation model or DEM. This analysis defines the zone of theoretical visibility or the maximum area in which potential visibility of the offshore facilities may be available. Once the zone of theoretical visibility for the Lease Area was defined, a refined visibility analysis was completed to determine the geographic areas of likely visibility within those areas. This analysis considers the maximum height of the visible Project components and the screening effect of the curvature of the earth, topography, vegetation, and structures as represented by a lidar derived digital surface model or DSM within the GAA. This analysis defines what is referred to as the zone of visual influence, which represents a reasonable determination of the areas within which visual effects resulting from the Project could occur. This visibility model also helps guide the identification and selection of key observation points (KOPs) and the area of potential effects to seascape, landscape, and ocean character areas.

The onshore substations and/or converter stations are the only significant above ground facilities associated with the onshore components of the Project that could produce notable visual effects. The eight potential sites under consideration for the onshore facilities are addressed in the SLVIA report (Appendix II-M1). The GAA for each of the onshore facility locations will be defined as a 2-mile (mi) (3.2 km) radius. The zone of visual influence within each of these GAAs was then determined through a DSM viewshed analysis, similar to that described for the Lease Area.

The SLVIA includes two distinct but related studies that can be found in Appendix II-M1.

- The Seascape and Landscape Impact Assessment (SLIA) analyzes and evaluates impacts on both the physical elements and features that make up a landscape or seascape and the aesthetic, perceptual, and experiential aspects of the landscape or seascape that make it distinctive (Sullivan 2021).

- The Visual Impact Assessment (VIA) analyzes and evaluates the impacts on people of adding the proposed development to views from selected viewpoints. VIA evaluates the change to the composition of the view itself and assesses how the people who are likely to be at that viewpoint may be affected by the change to the view (Sullivan 2021).

### 5.1.1 Offshore Facilities

The zone of theoretical visibility for the Lease Area includes approximately 6,474 square miles ($mi^2$) (16,768 square kilometers [$km^2$]) of open ocean and portions of Delaware Bay, 389.3 $mi^2$ (1,008 $km^2$) of offshore seascape (mean low water to the 3 nm state line), 30.3 $mi^2$ of onshore seascape (areas above mean low water with intervisibility of ocean and land), and 2,672.7 $mi^2$ (6,922 $km^{2)}$ of landscape (including inland water bodies) which extends inland to include the majority of Ocean and Atlantic Counties and portions of Cape May, Monmouth, Burlington, Camden, Gloucester, and Cumberland Counties in New Jersey (see Figure 5.1-1). Section 5.2.1 describes the viewshed analysis methodology in greater detail and the results of all viewshed analyses are provided in Appendix II-M1.

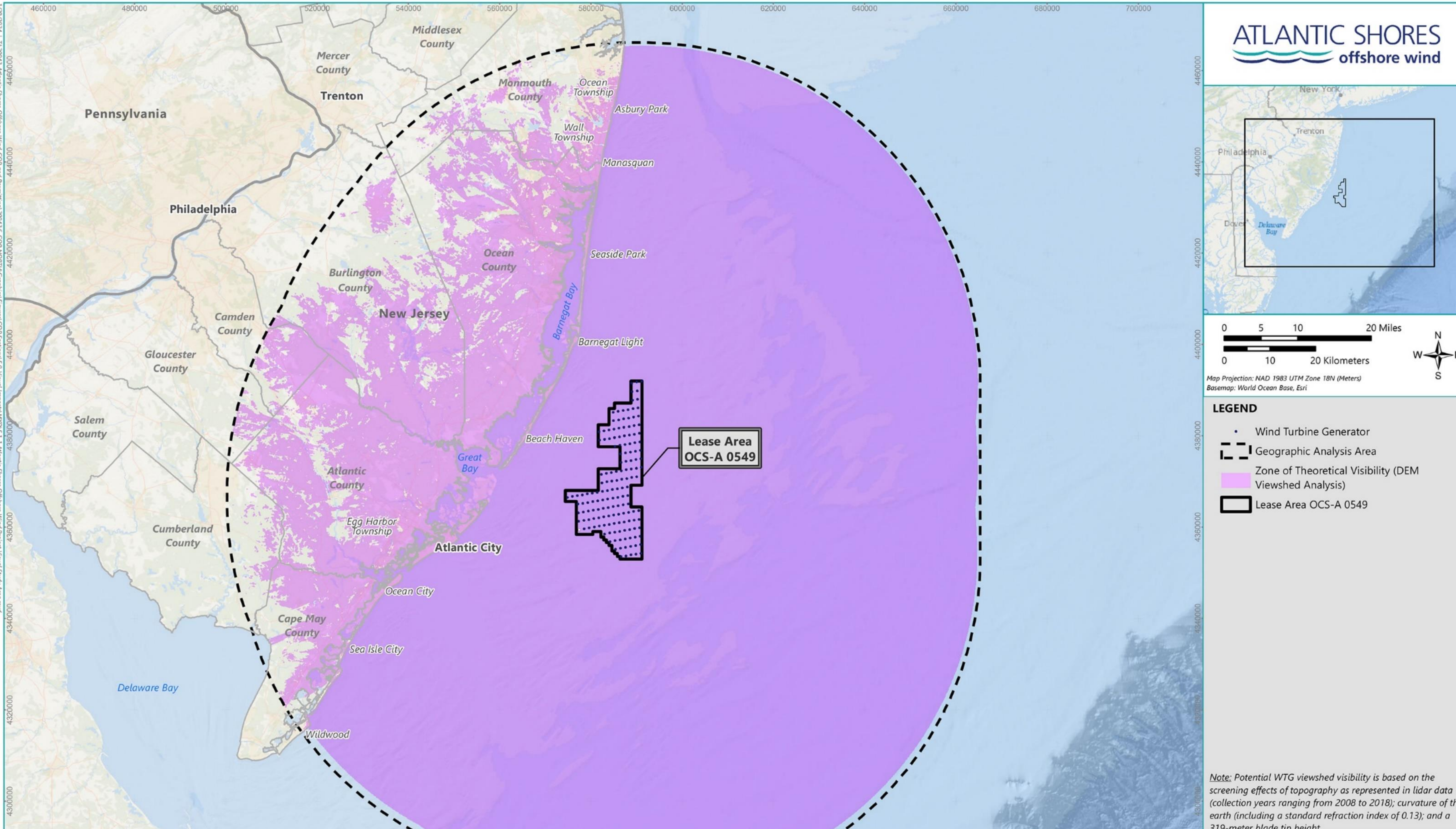



**Figure 5.1-1**

*Atlantic Shores Offshore Wind (North) Geographic Analysis Area and Zone of Theoretical Visibility*

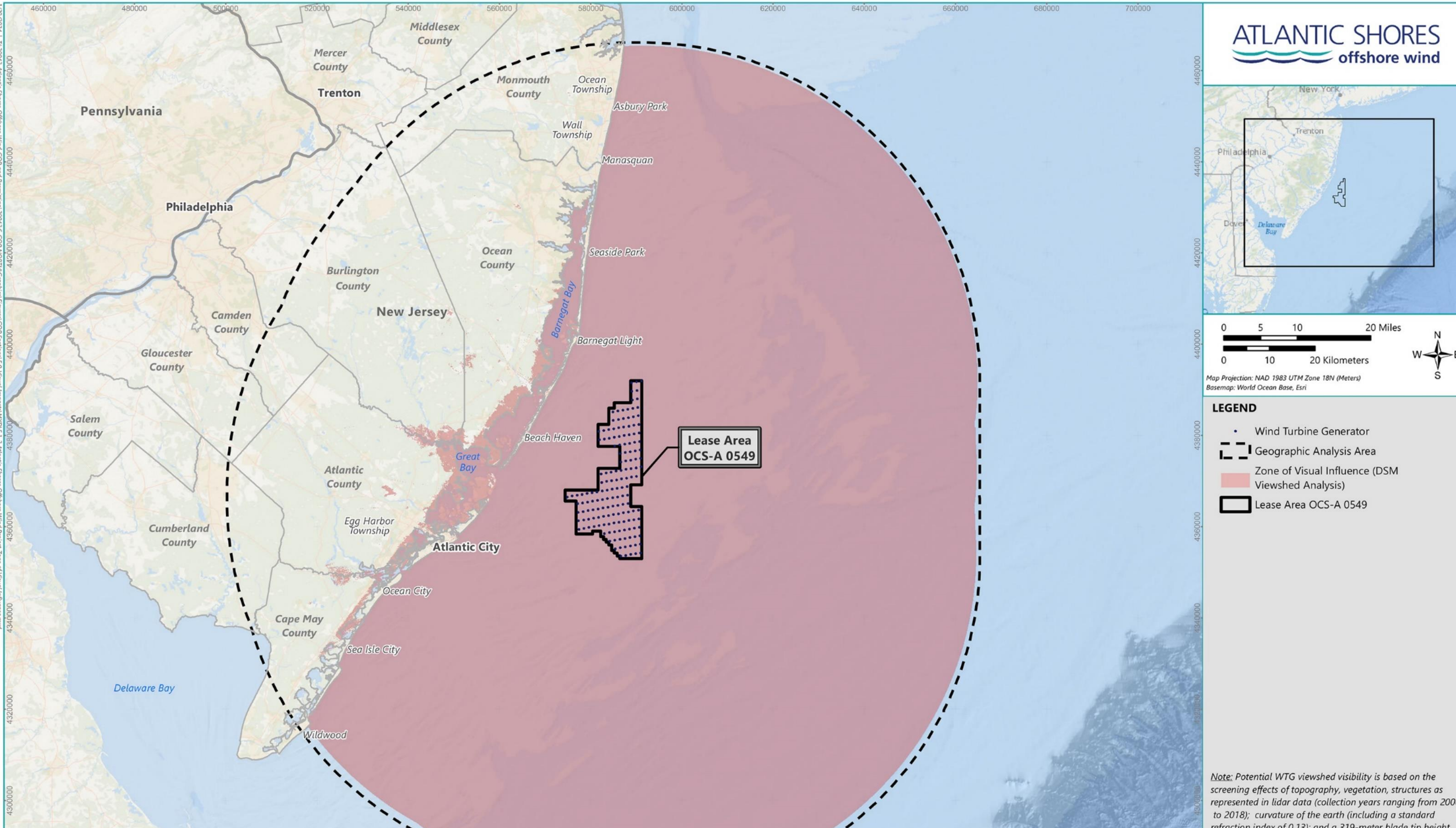



**Figure 5.1-2**

*Atlantic Shores Offshore Wind Project (North) Geographic Analysis Area and Zone of Visual Influence*

To support the characterization of the existing visual setting based on patterns of landform, vegetation, water, land use, and user activity, character area types were identified in accordance with the SLVIA methodology. Character area types defined in the SLVIA methodology include ocean character areas (OCAs), seascape character areas (SCAs), and landscape character areas (LCAs).

Specific character areas (CA) were identified through a desktop analysis of the land use/land cover designations assigned by the New Jersey Department of Environmental Protection (NJDEP) Land Use/Land Cover 2015 (as updated in 2019) Dataset. Based upon this assessment, 19 distinct character areas were identified within the zone of theoretical visibility. The defining features and boundaries of these character areas were verified, photographed, and characterized through multiple field visits. Table 5.1.1 lists the identified character areas along with a brief description of each.

### Table 5.1-1. Character Areas Identified Within the Zone of Theoretical Visibility

| Character Area | Description |
|---|---|
| Ocean | This character area makes up the largest contiguous area within the Zone of Visual Influence and includes the open water of the Atlantic Ocean off the coast of New Jersey and portions of Delaware Bay. The defining characteristic of this character area is the presence of open water as a dominant foreground element in all directions. |
| Offshore Seascape | The offshore seascape area includes the open water of the Atlantic Ocean extending from shore (mean low water) to 3 nm (3.5 mi [5.6 km]) off the coast of New Jersey and portions of Delaware Bay. |
| Undeveloped Bay | This seascape character area includes the expansive bodies of water west of the barrier islands and is characterized by an expanse of open water primarily bordered by the Salt Marsh, Dredged Lagoon, Bayfront Residential, and Forest character areas. |
| Oceanfront Residential | This seascape character area is characterized by year-round and seasonal homes, inns and hotels, and some large multi-unit buildings situated along the ocean shoreline. The defining characteristic of this zone is a broad, often elevated view (particularly from multi-story residences) of the ocean from a residential setting, with direct access to an adjacent beach. |
| Salt Marsh | This landscape character area is characterized by coastal ponds and marshes that are connected to inlets or bays with one or more relatively narrow channels allowing tidal water to periodically flood portions of the character area. This character area occurs commonly along the bay side coastlines of the mainland and barrier islands. |
| Commercial Beachfront | This seascape character area typically occurs in the major beach towns on the coast within the zone of theoretical visibility. It consists of a wooden boardwalk or walkway, ocean piers, and commercial development bordering a shoreline beach or ocean. |
| Undeveloped Beach | This seascape character area is characterized by shoreline areas with minimal development and includes rolling, vegetated dunes which lead to an open sandy beach that slopes gently to the water line. In some instances, human-made features such as break walls, or stone jetties extend from the beach out into the ocean, but the remainder of the landscape generally lacks evidence of development. |
| Atlantic City | The Atlantic City Ocean character area occurs on Absecon Island within Atlantic City, primarily east of Albany Avenue (US Route 40). This character area is defined by an eclectic mix of large casino/hotel properties, single family homes, multi-family |

| Character Area | Description |
|---|---|
| | residential complexes, large and small commercial properties, traditional mixed use downtown structures, vacant lots, boardwalk, and beach. |
| Industrial | The Industrial/Developed landscape character area includes developed landscapes defined by a variety of utilitarian functions, which are visually linked by a stark, severe aesthetic. Elements commonly found in this zone include expansive open areas, pavement, utility structures and buildings, screening or security fencing, machinery, equipment, and raw materials. Land uses include airports, military grounds, mines, power stations, industrial parks, warehouses, self-storage facilities, municipal maintenance lots, and transit stations. |
| Bayfront Residential | This landscape character area occurs in conjunction with naturally occurring bays, rivers, and coves. It is characterized by seasonal and year-round residences which are situated along the waterfront. The character area is often bordered by an adjacent Salt Marsh character area, or the waterfront at the edge of the neighborhood street grid. |
| Dredged Lagoon | This landscape character area typically occurs in conjunction with the Undeveloped Bay or Salt Marsh character areas and is characterized by residential neighborhoods with seasonal and year-round homes situated along an artificial dredged waterway. |
| Limited Access Highway | The Limited Access Highway landscape character area includes primary, high-volume vehicular travel corridors that briefly enter the Zone of Visual Influence (ZVI) and are dominated by automobiles, pavement, guardrails, and signs. |
| Recreation | The Recreation character areas occur in both the seascape and landscape within the zone of theoretical visibility. These include a range of areas intended primarily for outdoor leisure and play. On the mainland (landscape), these areas include golf courses, sports fields, athletic complexes, campgrounds, and inland beaches. On the barrier islands (seascape) these areas include community parks, small athletic complexes and their parking areas, and other developed areas within state parks. |
| Inland Open Water | This landscape character area occurs throughout the mainland portion of the zone of theoretical visibility. Its dominant visual feature is an open expanse of flat water that is enclosed by a vegetated shoreline. The shorelines are typically dominated by deciduous and coniferous trees but are occasionally interrupted by human-made features, such as homes, boat launches, bridges, and roads. |
| Commercial Strip Development | This landscape character area typically occurs inland but may be connected to the waterfront by way of the Oceanfront Commercial character area or Oceanfront Residential character area. It includes strip commercial development located along wide boulevards, and around the edges of village centers. |
| Inland Residential | The Inland Residential landscape character area includes residential development located inland of the Oceanfront and Bayfront Residential character areas. This zone is characterized by low-, medium-, and high-density residential neighborhoods which occur throughout the zone of theoretical visibility, often adjacent to Village Centers or along major throughfares. |
| Town/Village Center | The Town/Village Center landscape character area includes well-defined town/village center areas which occur in small pockets on the barrier islands and larger villages on the mainland. This zone is characterized by moderate- to high-density residential and |

| Character Area | Description |
|---|---|
| | commercial development occurring along a main street or cluster of mixed-use blocks. |
| Forest | The Forest character area contains tracts of forestland which occur sporadically throughout the ZVI. Within this character area two primary forest types are represented; the New Jersey Pine Barrens (including the Atlantic Coastal pine barrens ecosystem) and the coastal scrub (maritime) forests which typically occur in association with the Salt Marsh character area and provide a transition into the pine barrens. |
| Agriculture | This landscape character area is a minor component of the zone of theoretical visibility and is primarily found inland, outside of the zone of visual influence. These areas are characterized by open fields, farmsteads, and some minor commercial operations centers. |

User groups within these character areas broadly include local residents, seasonal residents, through travelers, tourists/vacationers, and the commercial fishing community. A more detailed description of each character area, general defining physical features, land use, viewer user groups, and types of views within the zone of visual influence is provided in Appendix II–M1.

Sensitive locations and areas within the zone of visual influence were also identified. These include resources that have been identified by national, state, or local governments, organizations, and Tribes as important sites which are afforded some level of recognition or protection. A desktop inventory of sensitive locations and areas was prepared for the entire zone of theoretical visibility and then cross referenced with the zone of visual influence to determine which of these sites could have potential views of the Lease Area. Additional resources were also identified during the field verification process. The analysis resulted in the identification of 317 sensitive locations and areas with some degree of potential visibility of the Lease Area (Table 5.1-2). The location of these sensitive locations and areas within the visual zone of visual influence are depicted in Appendix II-M1 - Attachment A .

## Table 5.1-2. Sensitive locations and Areas Within the Zone of Visual Influence

| Sensitive Location or Areas | Source | Occurrences of Resource Type within the Zone of Theoretical Visibility | Occurrences of Resource Type within the Zone of Visual Influence |
|---|---|---|---|
| National Historic Landmarks | National Park Service Public Database | 3 | 1 |
| Properties Listed on the National or State Registers of Historic Places | National Park Service Public Database | 117 | 22 |
| Properties Determined Eligible for National or State Registers of Historic Places | LUCY<br>NJ CRGIS Online Viewer | 155 | 45 |

| Sensitive Location or Areas | Source | Occurrences of Resource Type within the Zone of Theoretical Visibility | Occurrences of Resource Type within the Zone of Visual Influence |
|---|---|---|---|
| National Natural Landmarks | National Park Service Public Database | 2 | 1 |
| State/Local Designated Scenic Areas and Overlooks | NA | 7 | 0 |
| Scenic Area of Local Significance | NA | | 0 |
| State Designated Scenic Overlooks | NA | | 0 |
| National Wildlife Refuges | U.S. Fish and Wildlife Service Public Database | 2 | 1 |
| State Wildlife Management Areas | NJDEP Division of Fish & Wildlife - Wildlife Management Areas | 33 | 17 |
| National Parks | NA | 0 | 0 |
| State Parks | NJDEP Bureau of Geographic Information Systems (GIS) | 7 | 3 |
| State Nature and Historic Preserve Areas | NJDEP Bureau of GIS | 45 | 14 |
| National Forests | NA | 0 | 0 |
| State Forests | NJDEP Bureau of GIS | 6 | 3 |
| National Recreation Areas and/or Seashores | NA | 0 | 0 |
| State Beaches | NA | 0 | 0 |
| National or State Designated Wild, Scenic, or Recreational Rivers | National Wild and Scenic Rivers System | 1 | 1 |
| Highways Designated or Eligible as Scenic | NJ Scenic Byways Program | 2 | 1 |
| National Historic/Recreation/Heritage Trails | NJDEP Bureau of GIS | 1 | 1 |
| State Fishing and Boating Access Sites | NJDEP Bureau of GIS | 36 | 11 |
| Lighthouses (not NRHP-Listed or State Historic-Listed) | NJDEP Bureau of GIS | 2 | 2 |
| Public Beaches | Municipal Document Review | 71 | 54 |

| Sensitive Location or Areas | Source | Occurrences of Resource Type within the Zone of Theoretical Visibility | Occurrences of Resource Type within the Zone of Visual Influence |
|---|---|---|---|
| Environmental Justice Areas (State and Federal) | EDR EJA Analysis | 261 | 106 |
| Draft Disadvantaged Communities | — | 51 | 34 |
| Ferry Routes | NA | 0 | 0 |
| Seaports (Commercial Maritime Facilities) | NA | 0 | 0 |
| Other State Land with Public Access | NA | 7 | 0 |
| **Total** | | **812** | **317** |

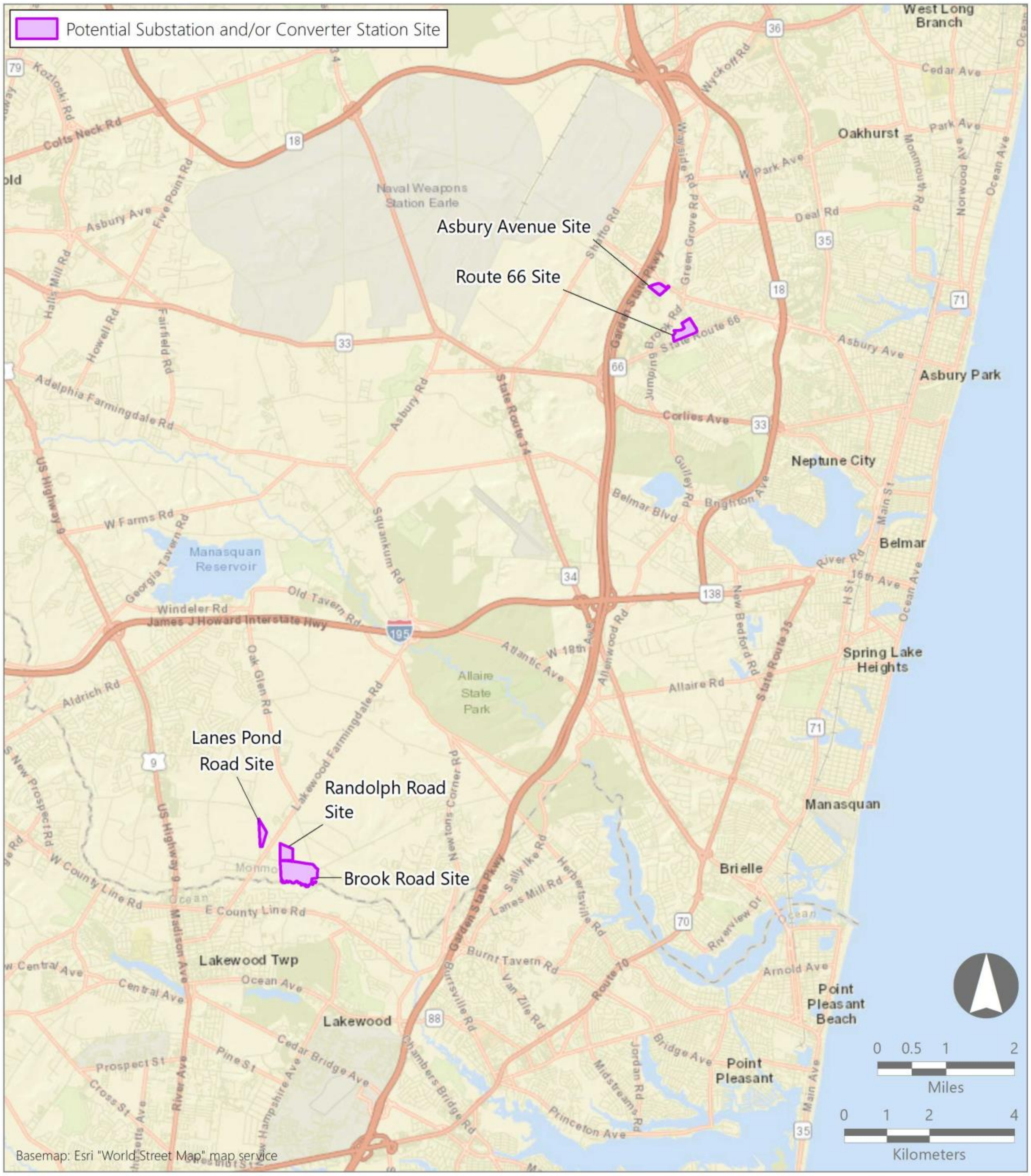
The Project is located on the Outer Continental Shelf and is therefore subject to Federal laws, regulations, and guidance including,

- Code of Federal Regulations (CFR) Title 30 of the CFR Part 585, Subpart F, Plans, and Information Requirements,
- Outer Continental Shelf Lands Act (OCSLA), Title 43, Chapter 29, Subchapter I, Section 1301 (1953),
- the Submerged Lands Act (SLA) of 1953,
- National Environmental Policy Act (NEPA),
- Clean Air Act of 1970
- Coastal Zone Management Act (CZMA) (1972),
- National Historic Preservation Act 1966,
- Inflation Reduction Act of 2022,
- Information Guidelines for a Renewable Energy Construction and Operations Plan (COP). Version 4.0. (2020), and
- US Department of the Interior, Bureau of Ocean Energy Management Office of Renewable Energy Programs Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States

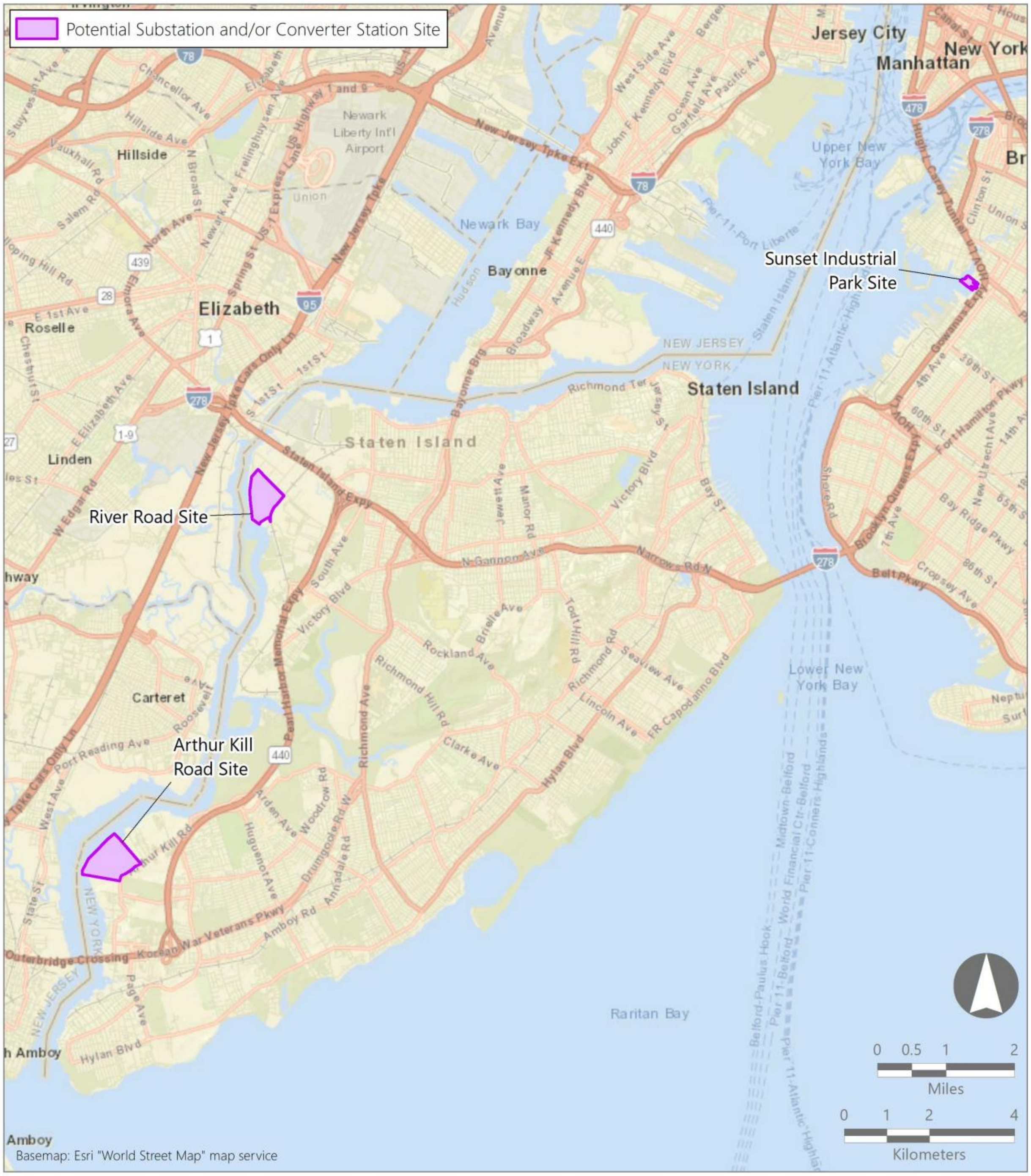
In addition, state law, local comprehensive plans, recreation and open space plans, and conservation plans may also identify important initiatives pertaining to the identification of sensitive locations or areas, the identification of coastal resiliency or climate change initiatives, and/or aesthetic standards, protections, and goals that may pertain to the proposed action. Appendix II-M1 Attachment H contains a list of federal, state, and local laws, ordinances, regulations, and statutes for each incorporated entity within the GAA.

### 5.1.2 Onshore Facilities

Atlantic Shores is considering a total of eight HVAC onshore substation and/or HVDC converter station sites in New Jersey and/or New York. This component of the Project will result in visible infrastructure during the long-term operational phase of the Project. Atlantic Shores has identified five optional locations for HVAC onshore substations and/or HVDC converter stations in New Jersey. These include Lanes Pond Road, Randolph Road, and Brooks Road in Howell Township as well as Asbury Avenue in Tinton Fall Borough and Route 66 in Neptune Township (Figure 5.1-3). Three optional locations for HVAC onshore substations and/or HVDC converter stations sites are being considered in New York. These include Arthur Kill and River Road in Staten Island and Sunset Industrial Park in Brooklyn (Figure 5.1-4). All eight locations are characterized below.




## Figure 5.1-3. New Jersey Substation/Converter Station Sites




## Figure 5.1-4. New York Substation/Converter Station Sites

Within the onshore GAAs, the DSM-based ZVI, character areas and the sensitive locations and areas were delineated for each of the eight HVAC onshore substation and/or HVDC converter station sites in New Jersey and/or New York.

### 5.1.2.1 Larrabee Alternatives

The Larrabee GAA considers three potential Sites, the Lanes Pond Road Site, the Brook Road Site, and the Randolph Road Site, and includes approximately 18.7 $mi^2$ (48.4 $km^2$). The majority of the GAA falls within Howell and Lakewood Townships, and a small portion falls within Brick Township. Table 5.1-3 includes the landscape character areas identified within the Larrabee VSA.

**Table 5.1-3. Landscape Character Areas Within the Larrabee Visual Study Area**

| Landscape Character Area | Total Area of Character Area within the GAA (acres) | Percent of Total Area[1] within GAA | Lanes Pond Road Site acres/percent | Brook Road Site acres/percent |
|---|---|---|---|---|
| Forest | 5,109 | 42.8% | 9.9/0.2 | 75.4/1.4 |
| Medium Density Residential | 2,641.1 | 22.1% | 0.6/0.02 | 0.2/0 |
| Low Density Residential | 1,130.0 | 9.5% | 15.5/1.4 | 6.3/0.6 |
| Commercial | 929.9 | 7.8% | 0.02/0 | .01/0 |
| Agriculture | 570.2 | 4.8% | 14.7/2.6 | 2.3/4 |
| High Density Residential | 559.5 | 4.7% | 0.2/0.02 | 0.5/0.1 |
| Recreation and Open Space | 449.4 | 3.8% | 0/0 | 0.3/0.1 |
| Industrial | 445.9 | 3.7% | 2.8/0.6 | 48.2/10.8 |
| Inland Water | 109.6 | 0.9% | 0.8/0.8 | 0.3/0.3 |
| Transportation | 5.0 | <0.1% | 0/0 | 0/0 |

One sensitive location or area occurs within the Lanes Pond Road Site ZVI, four occur within the Brook Road Site VSA, and five occur within the Randolph Road Site VSA. Details regarding the type of resources included in each ZVI can be found in Appendix II-M1.

### 5.1.2.2 Route 66

The Route 66 VSA includes portions of Neptune City Borough, Asbury Park City, Interlaken Borough, Wall Township, Ocean Township, Eatontown Borough, Tinton Falls Borough, Colts Neck Township, and Neptune Township. However, the ZVI is largely contained within Neptune Township, which is also the host municipality of the Route 66 site. The GAA encompasses 31.4 $mi^2$ (81.4 $km^2$) but the ZVI only includes approximately 230.5 acres or 0.4 $mi^2$ (0.9 $km^2$). Table 5.1-4 includes the landscape character areas identified within the Route 66 VSA.

### Table 5.1-4. Character Areas Within the Route 66 Visual Study Area

| Character Area | Area (Acres) | Percent of GAA | Acres of CA within ZVI | Percent of CA in ZVI |
|---|---|---|---|---|
| Agriculture | 64.6 | 0.7% | 0.0 | 0.0% |
| Commercial | 907.3 | 9.6% | 83.9 | 9.2% |
| Forest | 3,232.3 | 34.3% | 19.7 | 0.6% |
| High Density Residential | 463.1 | 4.9% | 0.2 | 0% |
| Industrial | 662.8 | 7.0% | 30.9 | 4.7% |
| Low Density Residential | 805.5 | 8.6% | 1.7 | 0.2% |
| Medium Density Residential | 2,214.5 | 23.5% | 23.4 | 1.1% |
| Open Water | 40.9 | 0.4% | 0.0 | 0.0% |
| Recreation and Open Space | 600.3 | 6.4% | 24.8 | 4.1% |
| Transportation | 420.4 | 4.5% | 1.8 | 0.4% |

Forty sensitive locations or areas occur within the Route 66 GAA. Of these, 11 occur within the Route 66 ZVI. Details regarding the type of resources occurring within the ZVI can be found in Appendix II-M1.

#### 5.1.2.3 Asbury Avenue

The Asbury Avenue GAA includes portions of Wall Township, Ocean Township, Tinton Falls Borough, Colts Neck Township, and Neptune Township. However, the ZVI is largely contained within Tinton Falls Borough, which is also the host municipality of this site. The GAA encompasses 14.0 $mi^2$ (36.2 $km^2$) but the ZVI only includes approximately 178.5 acres or 0.3 $mi^2$ (0.7 $km^2$).

### Table 5.1-5. Character Areas Within the Asbury Avenue GAA

| Character Area | Area (Acres) | Percent of VSA | Acres of CA within ZVI | Percent of CA in ZVI |
|---|---|---|---|---|
| Agriculture | 66.4 | 0.7% | 0.0 | 0.0% |
| Commercial | 748.4 | 8.4% | 38.4 | 5.1% |
| Forest | 3,246.5 | 36.3% | 27.7 | 0.9% |
| High Density Residential | 535.2 | 6.0% | 6.5 | 1.2% |
| Industrial | 964.7 | 10.8% | 83.2 | 8.6% |
| Low Density Residential | 788.2 | 8.8% | 2.9 | 0.4% |
| Medium Density Residential | 1,797.5 | 20.1% | 5 | 0.3% |
| Open Water | 38.5 | 0.4% | 0.0 | 0.0% |
| Recreation and Open Space | 378.3 | 4.2% | 1.4 | 0.4% |
| Transportation | 381.7 | 4.3% | 13.4 | 3.5% |

An inventory of sensitive locations or areas within the Asbury GAA revealed 31 resources. Of these, 10 occur within the Asbury ZVI. Details regarding the type of resources included in each ZVI can be found in Appendix II-M1.

#### 5.1.2.4 Arthur Kill

The majority of the Arthur Kill GAA falls within the borough of Staten Island, New York City, and portions of New Jersey, including Perth Amboy City, Carteret Borough, and Woodbridge Township.

However, the ZVI is largely contained within Woodbridge Township, New Jersey. The GAA encompasses 17.5 mi² (45.4 km²) and the ZVI includes approximately 3.2 mi² (8.2 km²).

### Table 5.1-6. Character Areas Within the Arthur Kill Visual Study Area

| Character Area | Area (Acres) | Percent of VSA | Acres of CA within ZVI | Percent of CA in ZVI |
|---|---|---|---|---|
| Commercial | 691.2 | 6.2% | 19.2 | 2.8% |
| Forest | 271.9 | 2.4% | 5.6 | 2.1% |
| High Density Residential | 2,452.1 | 21.8% | 13.1 | 0.5% |
| Industrial | 2,997.3 | 26.7% | 589.4 | 19.7% |
| Low Density Residential | 29.7 | 0.3% | 4.7 | 15.8% |
| Medium Density Residential | 1,331.4 | 11.9% | 49.6 | 3.7% |
| Open Water | 1,373.3 | 12.2% | 1,019.8 | 74.3% |
| Recreation and Open Space | 1,385.7 | 12.3% | 245.6 | 17.7% |
| Salt Marsh | 461.2 | 4.1% | 78.8 | 17.1% |
| Transportation | 241.2 | 2.1% | 13.7 | 5.7% |

An inventory of sensitive locations or areas within the Authur Kill GAA revealed 137 resources. Of these, 53 occur within the Authur Kill ZVI. Details regarding the type of resources included in each ZVI can be found in Appendix II-M1.

### 5.1.2.5 River Road

The majority of the River Road GAA includes the Borough of Staten Island, New York City as well as portions of New Jersey, including the Cities of Elizabeth and Linden, and Carteret Borough. However, the ZVI is mostly contained within Staten Island, New York City. The GAA encompasses 16.9 mi² (43.7 km²) and the ZVI includes approximately 3.5 mi² (9.0 km²).

### Table 5.1-7. Character Areas Within the River Road Visual Study Area

| Character Area | Area (Acres) | Percent of VSA | Acres of CA within ZVI | Percent of CA in ZVI |
|---|---|---|---|---|
| Commercial | 607.7 | 5.6% | 3.5 | 0.6% |
| Forest | 129.0 | 1.2% | 7.3 | 5.7% |
| High Density Residential | 1,379.2 | 12.8% | 1.5 | 0.1% |
| Industrial | 4,697.7 | 43.5% | 1,247.1 | 26.5% |
| Medium Density Residential | 550.6 | 5.1% | <0.1 | <0.1% |
| Open Water | 1,065.8 | 9.9% | 507.4 | 47.6% |
| Recreation and Open Space | 1,231.0 | 11.4% | 45.2 | 3.7% |
| Salt Marsh | 870.5 | 8.1% | 330.4 | 38% |
| Transportation | 268.4 | 2.5% | 91.1 | 33.9% |

An inventory of sensitive locations or areas within the River Road VSA revealed 130 resources. Of these, 49 are within the River Road ZVI. Details regarding the type of resources included in each ZVI can be found in Appendix II-M1.

#### 5.1.2.6 Sunset Industrial Park

The Sunset Industrial Park GAA occurs within the Borough of Brooklyn, New York City. The ZVI is mostly concentrated over the waters of the Upper New York Bay which is the confluence of the Hudson and East Rivers. The GAA encompasses 14.0 $mi^2$ (36.2 $km^2$) and the ZVI includes approximately 1.9 $mi^2$ (4.9 $km^2$).

**Table 5.1-8. Character Areas Within the Red Hook Visual Study Area**

| Character Area | Area (Acres) | Percent of VSA | Acres of CA within ZVI | Percent of CA in ZVI |
|---|---|---|---|---|
| Commercial | 277.2 | 3.1% | 0.0 | 0.0% |
| High Density Residential | 3,266.9 | 36.5% | 10.2 | 0.3% |
| High Rise | 67.0 | 0.7% | 0.0 | 0.0% |
| Industrial | 2,040.5 | 22.8% | 156.4 | 7.7% |
| Medium Density Residential | 11.3 | 0.1% | 0.1 | 0.9% |
| Open Water | 1,926.7 | 21.5% | 1,038.0 | 53.9% |
| Recreation and Open Space | 1,357.4 | 15.2% | 4.5 | 0.3% |

An inventory of visually sensitive resources within the Sunset Industrial Park GAA revealed 611 resources. Of these, 43 are within the Sunset Industrial Park ZVI. Details regarding the type of resources included in each ZVI can be found in Appendix II-M1.

### 5.1.3 Onshore Distance Zones

Based on the characteristics of the specific landscape being evaluated for the onshore resources, EDR defined distance zones within the GAA (as measured from the proposed onshore substations and/or HVDC converter stations) as follows:

- Near-Foreground: 0 to 0.25 mile. At this distance, a viewer is able to perceive details of an object with clarity. Surface textures, small features, and the full intensity and value of color can be seen on foreground objects.
- Foreground: 0.25 to 0.5 mile. At this distance, elements in the landscape tend to retain visual prominence, but detailed textures become less distinct. Larger scale landscape elements remain as a series of recognizable and distinguishable landscape patterns, colors, and textures.
- Middle Ground: 0.5 to 2.0 miles. The middle ground is usually the predominant distance at which landscapes are seen. At these distances, a viewer can perceive individual structures and trees but not in great detail. This is the zone where the parts of the landscape start to join together; individual hills become a range, individual trees merge into a forest, and buildings appear as simple geometric forms. Colors will be distinguishable but subdued by a bluish cast and softer tones than those in the foreground. Contrast in texture between landscape elements will also be reduced.

## 5.2 Potential Impacts and Proposed Environmental Protection Measures

The potential impact producing factors that may affect ocean, seascape, landscape resources and users during construction, O&M, or decommissioning of the Project are presented in Table 5.2-1.

### Table 5.2-1. Impact Producing Factors Associated with Seascape, Landscape, and Visual Impact Assessment

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Presence of structures and cables | | • | |
| Traffic | • | | • |
| Light | • | • | • |

To assess the potential visual effects associated with the IPFs identified in Table 5.2-1, the SLVIA methodology was applied. These analyses included the development of photosimulations (Appendix II-M1) and an evaluation of the potential impacts to viewers from important KOPs. In addition, the DSM viewshed analysis, or ZVI, and photosimulations will be used to determine the potential visual effects to the ocean, seascape, and landscape features identified in Section 5.1. The following subsections provide a summary of the methodologies used to support the seascape, landscape, and visual impact assessments used to evaluate the impacts associated with the offshore and onshore Project facilities. Sections 5.2.1 through 5.2.6 provide the results of the assessment as they pertain to the identified IPFs (presence of structures, traffic, and lighting) resulting from the construction, O&M, and decommissioning of the Project. The Project Design Envelope (PDE) analyzed for the SLVIA is the maximum onshore and offshore scope and scale of the Project as defined in Section 4.11 of Volume I.

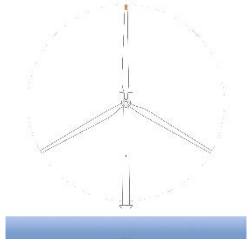
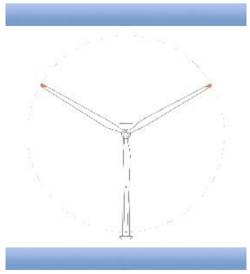
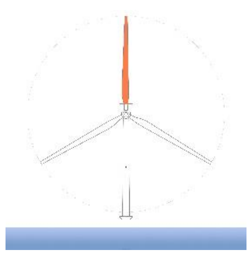
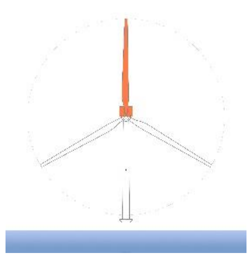
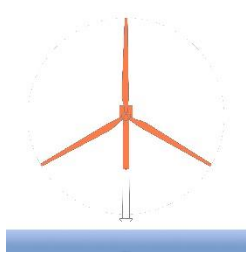
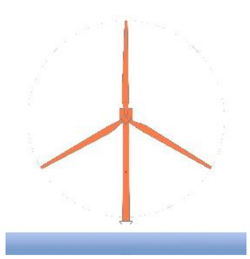
### 5.2.1 Assessment Methodology

Section 5.2.2 through 5.2.7 describe the methodologies used to determine the ZTV and ZVI through the use of digital elevation model (DEM) and digital surface model (DSM) viewshed analyses, methods for field verification, key observation point selection, photosimulation development, and the assessment of impacts to the seascape, ocean, landscape, and people within the GAA.

### 5.2.2 Viewshed Analysis

As stated in Section 5.1.1, DEM and DSM viewshed analyses were used to define the ZTV and ZVI (respectively) associated with the Lease Area. In accordance with the BOEM SLVIA guidance, this analysis was based on publicly available lidar data for the entire zone of theoretical visibility, 157 points representing the WTG locations, an assumed maximum blade tip height of 1,047 feet (ft) (319 meter [m]) above mean sea level (MSL), and an assumed viewer height of 6 ft (1.8 m). Each of these analyses considered curvature of the earth and a standard refraction value of 0.13. In addition, the major visible components of each WTG were analyzed to determine the potential degree of visibility from the ocean, seascape, and landscape character areas. These components and their heights are described in Table 5.2-2.

## Table 5.2-2. Notable Visible Features of Offshore Wind Turbines

| Component | Height (from MSL) | Illustration | Discernible Features |
|---|---|---|---|
| Blade Tip - Upright Position | 1046.6 ft (319 m) |  | A single blade in the upright position represents the greatest extent of theoretical visibility because it is the component physically occupying the greatest height. |
| Bunny Ear (Two Blades Upright) | 807.4 ft (246.1 m) |  | The bunny ear configuration (sometimes referred to as "rotor" in this report) is the maximum height represented by two blades in a simultaneous upright position (45 degrees to the water sheet) which represents a height at which viewers may be more likely to detect the motion of the rotating blades. |
| Nacelle Aviation Obstruction Warning Light (AOWL) | 615.2 ft (187.5 m) |  | The nacelle AOWL is representative of the maximum height at which nighttime visibility could occur. For the purposes of the SLVIA, this height and the resulting viewshed analysis represents the nighttime GAA. This light will be controlled by ADLS and therefore would be considered an infrequent and intermittent source of potential impacts. This height also conservatively estimates the zone of theoretical visibility of the WTG nacelle. |
| Hub (Geometric Center of the Rotor Assembly) | 562.7 ft (171.5 m) |  | The WTG hub is the point at which all three blades terminate at the approximate center of the nacelle. Not only is this representative of blade movement detectability, but it also represents the portion of the WTG with the greatest horizontal dimension, suggesting it may have a greater physical limit of visibility. |
| Mid-Tower AOWL | 301.2 ft (91.8 m) |  | The mid-tower AOWL is representative of the lowest point at which AOWLs would be mounted. This light will also be controlled by ADLS and therefore would be considered an infrequent and intermittent source of potential nighttime visual effects. This height and the resulting viewshed also represent the area from which a significant portion of the rotating WTG rotor may be visible. |
| Navigation Light | 55.8 ft (17 m) |  | The navigation lights represent the maximum height at which a consistently illuminated light source could result in visual effects. Additionally, this height and the resulting viewshed determines areas in which all substantive portions of the WTG may be visible, including the transition from the white tower and rotor to yellow foundation base. |

### 5.2.3 Field Verification

Potential visibility of the Project was evaluated in the field between July 2020 and February 2024. The purpose of this exercise was to verify the existence of direct lines of sight to the water in the direction of the proposed Project from representative KOPs and other sites with potential visibility of the Project, as indicated by viewshed analysis. Field review was also used to obtain photographs from selected KOPs and character areas for subsequent use in the development of photosimulations and to assist in character area delineation and characterization. Fieldwork was completed under a range of sky conditions (overcast to clear), but during the KOP photography visibility was recorded as being 10 mi (16 km) or greater in all instances. The visibility was recorded using the National Climatic Data Center (NCDC) current visibility recordings. These recordings extend to a maximum of 10 miles, but it is assumed that visibility extended beyond this distance. Some of the fieldwork efforts that occurred after August 2023 also used the European Centre for Medium-Range Weather Forecasts to predict potential long-range visibility. Attachment D includes a list and photolog depicting each KOP visited during field review for the Project. It should be noted that all KOPs are named utilizing the initials of the legal municipal boundary in which they occur. For example, AC04 represents the fourth KOP collected in the City of Atlantic City.

The purposes of the field investigation were as follows:

- Confirm the boundaries and document views from within the defined character areas.
- Determine the accuracy of and document views within the ZVI defined by the DSM viewshed analysis.
- Identify KOPs suitable for the development of photosimulations.

The viewshed analysis did not consider potential turbine visibility from human-made elevated positions throughout the GAA. An example would be an observation tower in the Edwin B. Forsythe NWR (KOP GT01), which offers an elevated view of the barrier islands, ocean, and surrounding landscape. Field review of this KOP, while not contradictory to the viewshed analysis results, suggests that a greater portion of the Project would be visible as a result of elevated viewer position. The same is true for heavily developed areas within the barrier islands. Particularly in Atlantic City, where several high-rise buildings offer significant views of the ocean and the Project. In these instances, it is reasonable to assume that if the viewshed indicates visibility around a tall building, visibility will also occur within or on the building. This condition is illustrated in the KOP from the Ocean Casino Resort (AC04). While the viewshed analysis suggests the Project will not be visible from ground level at this location (due to the presence of intervening screening features), field review determined that the Sky Garden on the 11th floor offered an open, elevated view of the Project. Additionally, Appendix II-M1 Attachment F analyses potential visibility from notable elevated features throughout the GAA.

Despite the anticipated limitations of the viewshed analysis, field verification confirmed that the ZVI provides a reasonable representation of the areas that could potentially be impacted by the Project. Attachment C of Appendix II-M1 contains a photographic log of all locations visited during field verification.

### 5.2.4 Key Observation Point Selection

Specific KOPs were selected prior to, and during, the field verification process as representative locations for the development of photosimulations. In addition, Atlantic Shores discussed KOP selection with various agencies and stakeholders, including the NJDEP, BOEM, and several local liaisons/stakeholders. Based on these consultations, a total of 30 unique KOP locations within the zone of visual influence were selected for the development of the photosimulations. These KOPs were selected in coordination with BOEM as a result of multiple rounds of comment and consultation meetings between August 2023 to January 2024. During this timeframe the NOI Checklist was released, which also resulted in updates to the SLVIA. Generally, the KOPs were selected based upon the following criteria:

- They were identified as KOPs by federal, state, local, or tribal officials/agencies as important visual resources, either in prior studies or through direct consultation.
- They provide clear, unobstructed views toward the Project (as determined through field verification).
- They illustrate the most open views available from historic sites, designated scenic areas, and other resources within the ZVI.
- They are representative of a larger group of candidate KOPs of the same type or in the same geographic area.
- They illustrate typical views from character areas where views of the WTGs are most likely to be available.
- They illustrate typical views of the proposed Project that will be available to representative viewer/user groups within the ZVI.
- They illustrate typical views from a variety of geographic locations and under different lighting conditions to illustrate the range of visual change that could occur with the Project in place.

Locations of the selected KOPs are shown in Figure 5.2-1. Information regarding each of these selected KOPs is summarized in Table 5.2-3.

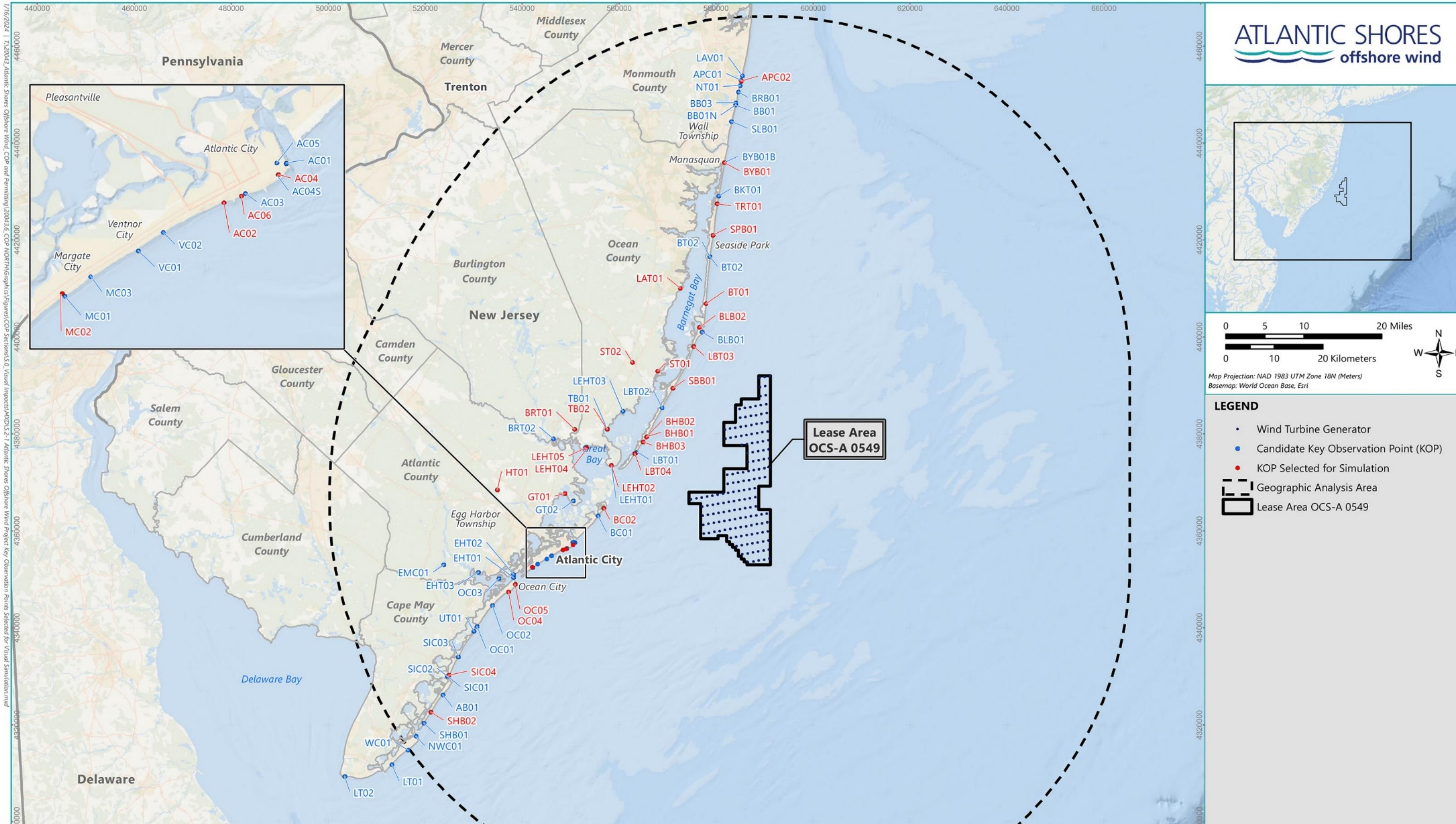



**Figure 5.2-1**

*Atlantic Shores Offshore Wind Project (North) Key Observation Points*

## Table 5.2-3. Selected Key Observation Points

| KOP Identifier | KOP Name | Location | Character Area | Distance to the Nearest WTG (mi, km) |
|---|---|---|---|---|
| APC02 | Asbury Park Convention Center (Beach) | Asbury Park City, Monmouth County, New Jersey | Residential Beachfront (SCA) | 37.98, 61.12 |
| BYB01 | Bay Head Historic District | Bay Head Borough, Ocean County, New Jersey | Residential Beachfront (SCA) | 28.0, 40.06 |
| TRT01 | Ocean Beach Historic District | Toms River Twp, Ocean County, New Jersey | Residential Beachfront (SCA) | 22.99, 36.99 |
| SPB01 | Seaside Park Borough Beach | Seaside Park Borough, Ocean County, New Jersey | Commercial Beachfront (SCA) | 19.25, 30.98 |
| LAT01 | Edwin B. Forsythe NWR at the Woodmansee Estate | Lacey Twp, Ocean County, New Jersey | Dredged Lagoon, Salt Marsh (LCA) | 15.3, 24.63 |
| BT01 | Island Beach State Park | Berkeley Twp, Ocean County, New Jersey | Undeveloped Beach (SCA) | 11.73, 18.87 |
| BLB02 | Barnegat Lighthouse State Park | Barnegat Light Borough, Ocean County, New Jersey | Recreation (SCA) | 10.07, 16.2 |
| BLB02A | Atlantic Ocean Beachfront | Barnegat Light Borough, Ocean County, New Jersey | Oceanfront Residential (SCA) | 10.7, 17.2 |
| LBT03 | Beach at Long Beach Island Foundation for the Arts and Sciences | Long Beach Twp, Ocean County, New Jersey | Residential Beachfront (SCA) | 9.35, 15.05 |
| ST02 | Barnegat Road | Stafford Township, Ocean County, New Jersey | Commercial Strip Development (LCA) | 14.6, 23.5 |
| ST01 | Manahawkin Wildlife Management Area | Stafford Township, Ocean County, New Jersey | Salt Marsh (LCA) | 11.4, 18.3 |
| SBB01 | Ship Bottom Borough Municipal Beach | Ship Bottom Borough, Ocean County, New Jersey | Residential Beachfront (SCA) | 8.52, 13.71 |
| BRT01 | Bass River State Forest | Bass River Township, Burlington County, New Jersey | Salt Marsh (LCA) | 17.4, 28.0 |
| TB02 | South Green Street Park | Tuckerton Borough, Ocean County, New Jersey | Undeveloped Beach (SCA) | 14.03, 22.58 |

| KOP Identifier | KOP Name | Location | Character Area | Distance to the Nearest WTG (mi, km) |
|---|---|---|---|---|
| BHB01 | Beach Haven Historic District. Adjacent to BHB02. | Beach Haven Borough, Ocean County, New Jersey | Residential Beachfront (SCA) | 9.85, 15.84 |
| BHB02 | Centre Street, Beach Haven (Beach Haven Historic District) Adjacent to BHB01 | Beach Haven Borough, Ocean County, New Jersey | Residential Beachfront (SCA) | 9.84, 15.84 |
| BHB03 | Holyoke Avenue, Beach Haven | Beach Haven Borough, Ocean County, New Jersey | Residential Beachfront (SCA) | 9.62, 15.48 |
| LEHT05 | Kentucky Drive | Little Egg Harbor Township, Ocean County, New Jersey | Dredged Lagoon | 15.1, 24.30 |
| LEHT04 | Osborn Island | Little Egg Harbor, Ocean County, New Jersey | Dredged Lagoon, Salt Marsh (LCA) | 14.9, 23.98 |
| LBT04 | Edwin B. Forsythe NWR, Holgate | Long Beach Twp, Ocean County, New Jersey | Undeveloped Beach (SCA) | 9.32, 15.00 |
| LEHT02 | Great Bay Boulevard Wildlife Management Area - Rutgers Field Station | Little Egg Harbor Twp, Ocean County, New Jersey | Dredged Lagoon, Salt Marsh (LCA) | 11.1, 17.86 |
| HT01 | Atlantic City Airport | Hamilton Township, Atlantic County, New Jersey | Industrial (LCA) | 24.9, 40.10 |
| GT01 | Edwin B. Forsythe NWR - Tower | Galloway Twp, Atlantic County, New Jersey | Salt Marsh (LCA) | 16.18, 26.04 |
| BC02 | North Brigantine Natural Area | Brigantine City, Atlantic County, New Jersey | Undeveloped Beach (SCA) | 11.26, 18.12 |
| AC04 | Ocean Casino Resort – Sky Garden | Atlantic City, Atlantic County, New Jersey | Atlantic City (SCA) | 16.2, 26.07 |
| AC06 | Atlantic City Beach | Atlantic City, Atlantic County, New Jersey | Commercial Beachfront (SCA) | 17.7, 28.49 |
| AC02 | Atlantic City Convention Hall | Atlantic City, Atlantic County, New Jersey | Atlantic City (SCA) | 17.67, 28.44 |
| MC02 | Lucy The Margate Elephant NHL | Margate City, Atlantic County, New Jersey | Commercial Beachfront (SCA) | 22.13, 35.61 |
| OC05 | Ocean City - East Surf Road Access | Ocean City, Cape May County, New Jersey | Residential Beachfront (SCA) | 25.0, 40.2 |

| KOP Identifier | KOP Name | Location | Character Area | Distance to the Nearest WTG (mi, km) |
|---|---|---|---|---|
| OC04 | Gillian's Wonderland Amusement Pier | Ocean City, Cape May County, New Jersey | Commercial Beachfront (SCA) | 26.11, 42.02 |
| SIC04 | Townsends Inlet Beach | Sea Isle City, Cape May County, New Jersey | Residential Beachfront (SCA) | 37.4, 60.19 |
| SHB02 | Stone Harbor Point | Stone Harbor Borough, Cape May County, New Jersey | Residential Beachfront (SCA) | 41.8, 67.3 |

### 5.2.5 Photosimulation Methodology

To show anticipated visual changes associated with the proposed Project, high-resolution photosimulations of the Lease Area components were prepared for each of the KOPs. The photosimulations were developed by constructing a three-dimensional (3D) computer model of the proposed WTG and OSS layout within the Lease Area based on design specifications and coordinates provided by Atlantic Shores. In accordance with FAA and BOEM color envelope (BOEM, 2021), the color of the WTGs is illustrated as RAL 9010 (Pure White).

Within the computer model, 3D virtual cameras were then created to match the geographic location and exact specifications of the camera used to collect the photos during field review. The virtual camera was aligned by matching field surveyed elements visible in the photograph with digital representations of these elements in the model. Once aligned, all elements in the scene (including the WTGs) are accurate to scale and position within the photograph. Each of the WTGs and OSSs were then individually positioned vertically by calculating the curvature of the earth and refraction value (Refraction Coefficient k: 0.14) for each. With the WTGs positioned in the view, a VRAY sunlight system was created to match the exact date and time of day represented in the photographs. The Project was then rendered and superimposed within the existing conditions photograph to complete the photosimulation.

To prepare nighttime simulations, EDR obtained data on the proposed AOWL from the FAA Advisory Circular 70/7460-1M (FAA, 2020), and the Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM, 2021) which set guidelines for the lighting of WTGs. Additionally, depending on the Private Aid to Navigation (PATON) status of each WTG in the array, individual WTGs were assigned a navigation light based on their designation as a Significant Peripheral Structure (SPS), Intermediate Perimeter Structure (IPS), or interior WTG. Each of these lights have variable intensity, ramp up time, on time, and ramp down time cycles. Camera alignments for the nighttime photos were conducted in the same manner described for the daytime simulations. Because the lighting systems in many 3D modeling applications are intended for close viewing, the fall-off rates and intensity metrics do not work well when the viewing conditions are measured in miles, such as is the case with offshore wind. To account for this, EDR completed field evaluations and photography of multiple constructed projects (including the BIWF) from a variety of distances in order to verify the model predictions for the FAA L-864, L-810, and the navigation lights. All photographs were observed by two individuals to verify that the exposure captured matched the intensity of light observed in the field. If the photograph did not match, additional images utilizing variable exposures were taken until both parties agreed with the results. These images were used to determine the appropriate intensities for each of the fixtures in the computer model. The lights were placed at the appropriate height and position on each WTG (accounting for curvature of the earth and refraction). The flash rate was set to the appropriate interval for the animated video simulations.

With the exception of the navigation lights, it was assumed that the AOWLs (two nacelle lights and up to three mid-tower lights) would flash in a synchronized manner, as currently set forth by BOEM guidelines and the FAA and advisory circular. Nighttime simulations show all WTGs with their lights on illustrating maximum illumination. However, Section 2.1.1 discusses technology being considered by Atlantic Shores to reduce the overall activation time of the AOWLs. Due to the effects of the curvature of the earth and refraction, USCG navigation lights on the WTGs were only considered in views that had a direct line of sight to the deck at the WTG base, which is approximately where the USCG lights would be located. The complete set of photographic simulations developed for the SLVIA are provided in Attachment E of Appendix II-M1.

## 5.3 Ocean, Seascape, and Landscape Assessment Methodology

For the SLIA, visual impacts associated with the Project are assessed based on how they affect the "sense of place" associated with each Seascape, Landscape, and Ocean character area. Each of the character areas were evaluated based on personal infield experience and through a library of character area photographs that were cataloged during field review. In addition, online mapping was used for immersive 360-degree imagery of some of the character areas to assist in the evaluation.

The SLVIA guidance requires the sensitivity for each ocean, seascape, and landscape character area be evaluated by determining their susceptibility and value. This assessment was completed by making an informed professional judgement regarding the character area's aesthetic, experiential, and perceptual aspects that contribute to its character. Next, magnitude is determined by assessing the size or scale of the change, the geographic extent of the proposed Project, and the duration and reversibility of the change. The size or scale of the change is not referring to the size or scale of the Project, but rather the degree of change that would occur with the Project in place. This is judged to be small, medium, or large under the SLVIA methodology. The overall magnitude of impacts is determined using the matrix in Table 5.3-1.

### Table 5.3-1. Matrix for Determining Magnitude

| Matrix For Determining Magnitude | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size and Scale Rating | Geographic Extent Rating | | | | | | | | |
| | Large | Large | Large | Medium | Medium | Medium | Small | Small | Small |
| Large (5-6) | Magnitude **Large** | Magnitude **Large** | Magnitude **Large** | Magnitude **Large** | Magnitude **Large** | Magnitude **Medium** | Magnitude **Large** | Magnitude **Medium** | Magnitude **Small** |
| Medium (3-4) | Magnitude **Large** | Magnitude **Large** | Magnitude **Medium** | Magnitude **Medium** | Magnitude **Medium** | Magnitude **Small** | Magnitude **Medium** | Magnitude **Small** | Magnitude **Small** |
| Small (1-2) | Magnitude **Large** | Magnitude **Medium** | Magnitude **Small** | Magnitude **Medium** | Magnitude **Small** | Magnitude **Small** | Magnitude **Small** | Magnitude **Small** | Magnitude **Small** |
| Negligible | Magnitude **Negligible** | | | | | | | | |
| Duration/Reversibility Rating | | | | | | | | | |
| | Poor | Fair | Good | Poor | Fair | Good | Poor | Fair | Good |

Duration is considered "long-term" due to the 20- to 30-year expected lifespan of the Project. Additionally, offshore wind projects are a "fully reversible" action, meaning at the end of their useful life, the WTGs and OSSs will be dismantled and removed from the OCS. Therefore, for the purposes of this SLVIA, duration and reversibility combined and result in a "fair" rating on a scale of poor, fair, good.

Once the sensitivity of the VIA receptors, magnitude, duration, reversibility, and VPR were determined, the SLVIA methodology recommends using a matrix to combine sensitivity and magnitude for determining the overall impact. However, sensitivity and magnitude should not be combined unless there is a specific aspect of the value or susceptibility that suggests scenic protection status, setting, or view importance that is clearly stated in the resource's protective legislation. Therefore, the overall impact determination associated with impacts to viewers should not assume sensitivity alone warrants the elevation of impact from the magnitude. Rather, the nature of the factors contributing to sensitivity (value and susceptibility) should be further examined to make a judgment as to whether the magnitude rating (small, medium, or large) should become the overall impact (minor, moderate, or major) or if it should be elevated based on the factors contributing to sensitivity. Therefore, the SLVIA serves as guidance for this judgement-based decision rather than a formulaic determination (personal communication with BOEM in January 2024).

## 5.4 Visual Impact Assessment Methodology

As required by the SLVIA methodology, each selected KOP was assessed to determine the viewer sensitivity, magnitude of impact, visual prominence, duration, and reversibility. With each of these components assessed, the overall impact can be determined. Each evaluation form for the VIA and SLIA was completed by an individual with a professional background and training in landscape architecture, planning, and/or Geographic Information Systems (GIS). Ratings were either completed in the field at the respective KOPs or character areas, or in the office. In every case, the evaluator had previously visited the KOP or character area on multiple occasions. For the evaluation, the photosimulations were viewed on printed color copies in the field, or on a large, definition screen in the office. The evaluator viewed the simulations at the appropriate distance but also zoomed into the digital versions by a factor of up to 150 percent of the original size.

Similar to the SLIA evaluation, the VIA considered viewer sensitivity by making informed judgements regarding the susceptibility and value placed on the location and views from each KOP. These judgements are then combined to determine the overall sensitivity. Next the photosimulations are evaluated to determine the magnitude of impact, which is a combination of the size, scale, and geographic extent of the impact. Then the sensitivity and magnitude of impact are evaluated to determine the overall impact.

## 5.5 Presence of Structures

### 5.5.1 Ocean, Seascape, and Landscape Impact - Offshore

The SLIA evaluation determined that 9 of the 19 SCAs could experience major adverse impacts as a result of the Project. These SCA's include Open Water/Ocean, Offshore SCA, Undeveloped Beach, Undeveloped Bay, Residential Beachfront, Atlantic City, Salt Marsh, Commercial Beachfront, and Recreation. For all SCAs with major impacts the sensitivity was determined to be high as a result of either high value or high susceptibility, or both. For many SCAs, the size and geographic extent was large with the exception of the Atlantic City and Recreation SCA.

The Project is expected to result in moderate adverse impacts in Bayfront Residential and Dredged Lagoon LCAs. This is generally due to the small geographic extent and moderate sensitivity.

The Inland Residential, Town/Village Center, Commercial Strip Development, and Limited Access Highway are anticipated to experience minor impacts due to either small scale of change, geographic extent, or low to moderate sensitivity.

Due to low visibility, small geographic extent, and small scale, the Forest, Agriculture, Inland Open Water, and Industrial LCAs all received negligible impact determinations.

### 5.5.2 Impacts to Viewers (Visual Impact Assessment) - Offshore

The following is a summary of the visual impact assessment from each of the 31 KOPs evaluated in the VIA portion of Appendix II-M. The KOP impact summary can be found in Attachment E of Appendix II-M.

The Project would result in major visual impacts at 16 KOP locations. In all cases, the impacts result from medium to large size and scale contrast and the geographic extent was determined to encompass a moderate to large area. The combination of size, scale, and geographic extent resulted in a large magnitude of impact and major visual impacts. In all cases, the sensitivity of these KOPs was determined to be high as a result of moderate to high susceptibility and value. These views range in distance from 8.5 mi (13.7 km) at SBB01 to 16.2 mi (26.1 km) at AC04. The KOPs are located in the Atlantic City SCA, Residential Beachfront SCA, Dredged Lagoon LCA, Recreation SCA, Salt Marsh LCA, and the Undeveloped Beach SCA. At these KOPs visual prominence ratings range from 4 to 6, suggesting that the WTGs are plainly visible but not dominant, the WTGs strongly attract viewer attention, or the WTGs dominate and occupy the majority of the field of view. These views typically present strong line, form, and color contrast and blade movement and lighting (at night) would attract viewer attention.

The Project would result in moderate overall visual impacts at five KOPs. The Project would have moderate size and scale contrast within a small to medium geographic extent resulting in moderate magnitude of impact. The susceptibility and value ranged from medium to high, resulting in high sensitivity for all five KOPs. These views range in distance from 15.3 mi (24.6 km) at LAT01 to 25.0 mi (40.2 km) at OC05. The KOPs are located in the Commercial Beachfront SCA, Residential Beachfront SCA, Dredged Lagoon LCA, and the Salt Marsh LCA. At these KOPs visual prominence ratings range from 3 to 4, suggesting that the WTGs are visible after a brief glance in the general direction of the Project and unlikely to be missed (VPR 3), or the Project is plainly visible, could not be missed by casual observers, but does not strongly attract visual attention (VPR 4). These views typically present moderate line, form, and color contrast and blade movement and lighting (at night) could attract viewer attention.

The Project would result in minor visual impacts at six KOPs. The Project would result in small to moderate scale contrast within a small geographic extent, resulting in a small magnitude of impact. Each of the KOPs had a sensitivity ranging from low to high. These views range in distance from 14.6 mi (23.5 km) at ST02 to 28 mi (40.1 km) at BYB01. The KOPs are located in the Commercial Beachfront SCA, Residential Beachfront SCA, Atlantic City SCA, and Commercial Strip Development LCA. At these KOPs visual prominence ratings range from 2 to 4, suggesting that the Project would be visible when scanning in the general direction of the Project (VPR 2), visible after a brief glance (VPR 3), or plainly visible, but does not strongly attract viewer attention (VPR 4). These views typically present weak line, form, and color contrast and blade movement and lighting (at night) is unlikely to be visible or to attract viewer attention. For KOPs with a VPR of 3 or 4, the magnitude of impact was reduced due to obstructions that screened the majority of the Project (AC02 and AC06).

The Project would result in negligible or no magnitude effects during clear viewing conditions resulting in negligible visual impacts at four KOPs. These views range in distance from 24.9 mi (40.1 km) at HT01 to 41.8 mi (67.36 km) at SHB02. The KOPs are located in the Industrial LCA and Residential Beachfront SCA. At these KOPs visual prominence ratings range from 0 to 1, suggesting that the WTGs are difficult to see and only visible with extended, or they are not visible to the unaided eye. These views typically present no line, form, or color contrast and blade movement and lighting (at night) is unlikely to be visible or to attract viewer attention. Ocean, Seascape, and Landscape Impact – Onshore

Depending on which site is ultimately selected for the substation and/or converter station, the impact to landscape character areas will range from minor to major. Sites that have a distinct industrial character and with impacts largely contained within Industrial landscape character areas will typically result in minor to moderate impacts. Examples include the Randolph Road and Brooks Road sites in New Jersey and the Sunset Industrial Park Site in New York.

However, if significant visibility is expected to occur in inland, low density residential character areas, the impacts are expected to be Major. An example of this occurs at the Larrabee Lanes Pond Site in New Jersey.

### 5.5.3 Visual Impact Assessment – Onshore

Eight KOPs were selected to illustrate each of the eight locations considered for the eight Substation/Converter Station sites currently under consideration. Generally, the selected KOPs represent the most open unobstructed public views of the proposed facility. The Brook Road and Randolph Road site both have low sensitivity and the Substation/Converter Station design fits with many of the existing buildings and infrastructure that already exist in the area. As such the Substation/Converter Station would result in minor impacts to these viewers. The Lane Pond Substation/Converter Station, however, would result in major impacts due to the proximity of sensitive viewers and the scale of the change. The River Road, Route 66, and Asbury Avenue Substation/Converter Station Sites, if selected would result in minor impacts due to the small geographic extent and low to moderate viewer sensitivity, despite low to medium magnitude impacts. The Arthur Kill Substation/Converter Station would result in moderate visual impacts due to the moderate sensitivity and medium magnitude resulting from the proposed Substation/Converter Station. Similarly, the Sunset Industrial Park Substation/Converter Station would result in moderate impacts due to medium magnitude impacts and high sensitivity. Given the degree of waterfront development, the sensitivity does not warrant elevating the visual impacts to major at the Sunset Industrial Park Substation/Converter Station.

## 5.6 Traffic

### 5.6.1 Offshore

Marine traffic associated with construction of the Project is not anticipated to have significant visual impacts. During the construction phase, the increased presence of ships on the horizon could result in temporary visual impacts, drawing attention to the vessels and associated construction equipment as they install the WTGs and OSSs, and as they move to and from the Lease Area. This would have the secondary effect of drawing attention toward the WTGs as they are being erected. However, views of distant boats on the horizon are not uncommon within the zone of visual influence, and these visual impacts would be temporary in nature, only lasting for the duration of the construction period.

### 5.6.2 Onshore Facilities

During construction and decommissioning of the onshore facilities (e.g., onshore substations and/or converter stations and buried duct banks) vehicular traffic will increase and construction equipment will be present at the landfall site, along the buried interconnection cable route, at the proposed onshore substations and/or converter stations, and at the POIs. While this activity would result in short term visual effects, it would be largely confined to roads and previously disturbed/developed sites, and therefore would not be out of place within the onshore zone of visual influence.

# 5.7 Light

## 5.7.1 Offshore

The WTGs and OSSs and their associated foundations will be equipped with marine navigation lighting and marking in accordance with USCG and BOEM guidance. To aid mariners navigating within and near the Lease Area, each WTG position will be maintained as a Private Aid to Navigation and will include yellow flashing lights on each foundation which will be visible in all directions. In accordance with USCG regulations, it is anticipated that the marine navigation lights on structures along the perimeter of the Lease Area development will be visible at a range of 3 or 5 nautical miles (nm) (depending on the structure's location), whereas lights on interior structures will be visible at a range of 2 nm during 90% of the conditions that occur throughout a typical year. As such, it is anticipated that when these features are not screened by curvature of earth, they could be visible to onshore viewers during clear conditions.

All of the WTGs will also be equipped with aviation obstruction warning lights in accordance with FAA and/or BOEM guidance to aid aircraft operating in the airspace of the Lease Area. Based on current guidance in FAA Advisory Circular (AC) 70/7460-1M, the aviation obstruction warning lighting system on the proposed WTGs will include two medium intensity red flashing lights on the nacelle and an additional level of low intensity flashing red lights on the midsection of the WTG tower. The lights will be arranged so that they are visible by a pilot approaching from any direction. If the height of the OSSs exceeds 200 ft (61 meters [m]) above MSL or any obstruction standard contained in 14 CFR Part 77, the OSSs will include an aviation obstruction warning lighting system in compliance with FAA and/or BOEM requirements. Section 5.2.6 discusses how the proposed ADLS will effectively eliminate the nighttime visual impacts associated with the aviation obstruction warning lighting system.

Separate viewshed analyses and photosimulations were completed to determine the potential geographic extent of nighttime visibility from seascapes and landscapes within the zone of theoretical visibility and the anticipated degree of potential visual impacts resulting from the aviation obstruction warning and marine navigation lights. The photosimulations are included in Appendix II-M1.

Assuming the aviation and marine navigation lights are active, the nighttime lighting on the Offshore Facilities could result in Major impacts to viewers as well as the ocean, seascape, and landscape. However, if ADLS is implemented, these impacts would be negligible to minor, depending on the viewer proximity to the Project and availability of views of the navigation lights.

## 5.7.2 Onshore

General lighting will be manually engaged on an as-needed basis at the substations and/or converter stations if maintenance or repairs are required at night. The expected use of lighting will be daily during construction, start-up, and commissioning, and approximately three times a year for repairs or detailed inspections during normal operations. Light fixtures will be LED floodlights mounted on dedicated poles or lightning masts (likely 40 to 50 ft [12 to 15 m] high) to illuminate the general substation area. Illumination levels are expected to be no more than 22 lux (2-foot candles [fc]).

In addition to general lighting at the substations and/or converter stations, one photocell-controlled pole-mounted LED streetlight-style fixture will be placed at the entrance gate. The fixture will be hooded to minimize glare and off-site light trespass. Light fixtures will also be placed at entrance doors to the control structure and other buildings. These fixtures will be wall-mounted and equipped with hoods to direct and limit the illumination. Atlantic Shores will coordinate with local officials to ensure the lighting scheme complies with any applicable municipal requirements.

## 5.8 Summary of Potential Effects and Proposed Environmental Protection Measures

Atlantic Shores understands the importance of scenic ocean views to local residents, tourists, and visitors to New Jersey's shore communities and is committed to minimizing adverse visual impacts to the maximum extent practicable. To that end, Atlantic Shores has developed the following proposed environmental protection measures to effectively reduce the potential visual impacts, as practicable given the nature of the technology and the location of the Project:

**Offshore**

- The Project will be located in a designated offshore wind development area that has been identified by BOEM as suitable for the proposed type of development.
- The larger of the OSSs under consideration for the Projects are proposed to be placed further offshore in order to reduce their potential visibility.
- The WTGs will be painted no lighter than Pure White (RAL 9010) and no darker than Light Grey (RAL 7035) to eliminate the need for daytime warning lights or red paint marking of the blade tips.
- WTGs and OSSs will be marked and lit in accordance with the minimum FAA, BOEM and USCG requirements necessary to maintain navigation and aviation safety.
- ADLS will be used, if practicable and permitted, to reduce the time the aviation obstruction lighting on WTGs is illuminated. The ADLS Efficacy Analysis (Appendix II- M-2) suggests that ADLS would reduce the activation time of the aviation obstruction warning lights (on the WTG nacelle and mid-tower) by 99.6 percent. According to past aviation traffic patterns, the lights would only be active during approximately 20 hours and 25 minutes per year. The activation times range from 3 hours and 2 minutes during the month of September to just 14 minutes in May. Considering this mitigation alternative, it is unlikely that the aviation obstruction warning lights would result in nighttime visual impacts to onshore resources due to the minimal and intermittent degree of activation.

**Onshore**

- Onshore interconnection cables will be installed underground rather than on aboveground structures.

- Onshore substations/converter stations will be sited adjacent to existing utility infrastructure, and if possible, on parcels zoned for commercial or industrial use.
- Vegetative screening will be evaluated as a means of reducing or minimizing the moderate potential visual impacts associated with the proposed substation and/or converter station.
- All infrastructure will be decommissioned at the end of the Projects' operational life cycle.

# 6.0 Cultural Resources

This section describes the aboveground historic properties, terrestrial archaeological resources, and marine archaeological resources within the Onshore and Offshore Project Areas, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning. The Onshore Project Area includes proposed landfall sites, onshore interconnection cable route options, potential substation and/or converter station sites, and temporary construction staging areas. Existing facilities will be used for O&M[41] and potential substation and/or converter station sites will be evaluated in a future COP Supplement.[42] The Offshore Project Area includes the Lease Area, Export Cable Corridors (ECCs), and trenchless interconnection cable routes.

Aboveground historic properties are herein defined as districts, buildings, structures, objects, or sites that are listed in, or determined eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior, or which have been designated as National Historic Landmarks (NHL) by the Secretary of the Interior (54 USC § 300308). Aboveground historic properties can include residential, commercial, and industrial sites, natural landscapes, and Traditional Cultural Properties (TCPs), and other property types.

Terrestrial archaeological resources are defined herein as any prehistoric or historic sites, objects, buildings, structures, or districts that are listed in or eligible for listing in the NRHP or have been designated as NHLs. Archaeological sites are valuable cultural resources that contain a wealth of tangible information about the past. Identifying, understanding, and to the extent appropriate, preserving terrestrial archaeological resources increases our opportunities for cultural enrichment, education, and knowledge of the past.

Marine archaeological resources are defined herein as any submerged historic properties including archaeological sites, objects, districts, or structures (including shipwrecks) that are listed in or eligible for listing in the NRHP have been designated as NHLs. These may also include Ancient Submerged Landforms (ASLFs), which represent coastal habitats that may have been available to people living in the region before marine transgression.

All cultural resources have been and will continue to be evaluated under the BOEM *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (hereafter, BOEM's *Guidelines*; BOEM, 2020), Section 106 and Section 110 of the National Historic Preservation

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[41] This Project will rely on existing O&M facilities, which are not anticipated to result in adverse effects on aboveground historic properties or terrestrial archaeological resources. No further surveys or evaluations are recommended in association with the existing O&M facilities.

[42] Atlantic Shores is actively assessing suitable locations for onshore substations and/or converter stations and temporary construction staging areas. As Project design progresses, potential onshore substation and/or converter station sites and temporary construction staging areas will be selected. Information regarding the potential visibility of the onshore substation and/or converter station sites and temporary construction staging areas will be evaluated at that time.

Act, and the National Environmental Policy Act Special Requirements for Protecting National Historic Landmarks (36 CFR Part 800.10),

To facilitate BOEM's Section 106 review, Atlantic Shores has defined a Preliminary Area of Potential Effects (PAPE)[43] for the project, based on the PDE as described in Volume I of the COP, which includes all areas currently under consideration as options for Project components and activities. According to BOEM, "a PDE approach is a permitting approach that allows a project proponent the option to submit a reasonable range of design parameters within its permit application, allows a permitting agency to then analyze the maximum impacts that could occur from the range of design parameters, and may result in the approval of a project that is constructed within that range" (BOEM, 2018). The PDE approach allows Atlantic Shores design flexibility and an ability to respond to advancements in industry technologies and techniques.

Based on review of BOEM's *Guidelines* (BOEM, 2020), Atlantic Shores has proposed that the overall PAPE for the project include the following geographic areas within distinct sub-PAPEs:

- the viewshed from which renewable energy structures would be visible, whether located offshore (Offshore Facilities visual effects PAPE, see Section 6.1.1.1) or onshore (Onshore Facilities visual effects PAPE, see Section 6.1.1.2), constituting the Project's overall PAPE for visual effects

- the depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities in the Onshore Project Area, within New Jersey (NJ physical effects PAPE, see Section 6.2.1.1), and New York (NY physical effects PAPE, see Section 6.2.1.2, constituting the Project's overall PAPE for physical effects to terrestrial archaeological resources

- the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities in the Offshore Project Area (Marine PAPE, see Section 6.3.1), constituting the marine archaeological resources portion of the PAPE

- any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the PAPE.

The Area of Potential Effect (APE) for a project is determined by the responsible federal agency in consultation with relevant SHPOs. BOEM will determine the APE based on consultation with the relevant SHPOs once BOEM has formally initiated NHPA Section 106 consultation[44]. The process for identifying and evaluating effects on historic properties resulting from the construction and operation of the Project will involve consultation with BOEM, the New Jersey Historic Preservation Office (NJHPO), the New York State Historic Preservation Office (NYSHPO), federally recognized Tribal Nations, Tribal

[43] Because the Area of Potential Effects (APE) is typically developed in consultation with the involved state historic preservation offices (SHPOs) as part of the Section 106 review process, and because formal consultation with the New Jersey Historic Preservation Office (NJHPO) and the New York State Historic Preservation Office (NYSHPO) has not yet been initiated, the APEs in this document are referred to as the preliminary APEs (PAPEs).

[44] Per 36 CFR § 800.3(c), federal agencies must consult with THPOs when determining the APE if historic properties within tribal lands (reservation or federal trust properties) may be affected by an undertaking.

Historic Preservation Officers (THPOs), and other consulting parties with a demonstrated interest in the historic properties (e.g., historic preservation organizations).

## 6.1 Aboveground Historic Properties

This section describes aboveground historic properties within the Project's overall PAPE for visual effects, the affected environment and associated IPFs, and environmental protection measures to avoid, minimize, or mitigate potential adverse effects to these resources.

Aboveground historic properties that may be affected by the Project were evaluated in accordance with:

- BOEM's *Guidelines for Providing Archaeological and Historic Property Information* pursuant to 30 CFR Part 585 (BOEM, 2020a);
- Section 106 and Section 110 of the National Historic Preservation Act (NHPA);
- National Environmental Policy Act (NEPA);
- Special Requirements for Protecting National Historic Landmarks (36 CFR Part 800.10);
- Section 7:4 of the New Jersey Administrative Code, the State of New Jersey Executive Order #215 (NJHPO 2008); and
- Section 14.09 of the New York State Parks, Recreation, and Historic Preservation Law, as applicable.

The evaluation of the Project's potential effect on aboveground historic properties is described in the Onshore Interconnection Facilities Historic Resources Effects Assessment (HREA) report, which is included as Appendix II-N1, and Offshore Historic Resources Visual Effects Assessment (HRVEA) report, which is included as Appendix II-O. The purpose of the HREA and HRVEA reports is to evaluate the Project's potential effects on the qualities that make aboveground historic properties eligible for listing in the NRHP. The results of the HREA and HRVEAs for the Offshore and Onshore Facilities are summarized in the following subsections.

### 6.1.1 Affected Environment

A standard visual study area for offshore wind farms has not been expressly defined in regulatory guidance documents. However, *Guidelines for Providing Archaeological and Historical Property Information Pursuant to 30 CFR Part 585* (BOEM, 2023) indicates that visual effects should be evaluated using photo simulations from locations within "the onshore viewshed from which renewable energy structures, whether located offshore or onshore, would be visible." As such, the affected environment will consist of the Project's overall PAPE for visual effects, which incorporates all areas from which both the offshore and onshore Project components and/or facilities could be seen, as determined by a viewshed analysis prepared as part of the *Seascape, Landscape, and Visual Impact Assessment* (Appendix II-M3 of the COP).

The viewshed analysis was based upon a highly detailed digital surface model (DSM) of the area within 46 miles (74 km) of the WTA generated from lidar data,[45] which includes the elevations of land features, buildings, trees, and other objects large enough to be resolved by lidar technology. A bare-earth DEM, representing topography only, was also created in order to make corrections to the DSM and to the initial viewshed result. The DSM and DEM were both created with a horizontal resolution of 3 meters (m) to allow direct comparison of ground elevation with the elevation of surface features (such as buildings and vegetation). Within the Project's overall PAPE for visual effects, the affected environment for aboveground historic properties consists of two distinct sub-PAPEs, the Offshore Facilities visual effects PAPE (see Figure 3.1.1 and Section 6.1.1.1) and the Onshore Facilities Visual Effects PAPE (see Section 6.1.1.2).

Project components and facilities that could have a visual effect on aboveground historic properties, as well as preliminary estimates of the maximum dimensions associated with each component, are included in Table 6-1.1. Potentially visible offshore components are anticipated to include up to 157 WTGs and 8 small, 4 medium, or 2 large OSS within the Lease Area, and up to one permanent met tower. The onshore components consist of the onshore substation and/or converter station sites and temporary construction staging areas. The proposed offshore cable system will be located beneath the seafloor, and the proposed onshore interconnection cables will be located underground, therefore the Project's overall PAPE for visual effects is not affected by those buried cables. As Project design progresses, potential onshore substation and/or converter station sites and temporary construction staging areas will be selected.[46] Information regarding the potential visibility of the onshore substation and/or converter station sites and temporary construction staging areas will be evaluated at that time (see Section 5.1.2).

### Table 6.1-1. Summary of PAPE for Visual Effects

| Project Component | Max Height (MSL) | Visual Study Area | Notes |
|---|---|---|---|
| **Offshore Facilities Visual Effects PAPE** | | | |
| **Wind Turbines (WTG)** | | | |
| Max Number: 157 | 1,048.8ft (319.7 m) | 40 nm (74 km) radius | Aircraft Detection Lighting System (ADLS) under consideration, pending FAA and BOEM approval |
| **Offshore Substations (OSS)** | | | |
| Max Number: 8<br>(8 small, 4 medium, and/or 2 large) | Small: 98 ft (30 m)<br>Medium: 115 ft (35 m)<br>Large: 131 ft (40 m) | Less than 40 nm (74 km) radius | Closest distance from coast<br>Small: 12 mi (19 km)<br>Med. and Large: 13.5 mi (22 km) |
| **Meteorological Tower** | | | |

[45] Lidar data availability varies throughout the 46-mile (74 km) viewshed radius, requiring the use of more than one data source. The following four lidar datasets were incorporated into the DSM: NOAA 2014, USGS 2015, Cumberland County 2008, and American Recovery and Reinvestment Act (ARRA) 2010.

[46] Atlantic Shores is actively assessing suitable locations for onshore substations and/or converter stations and temporary construction staging areas. The PAPE summary tables in the following subsections list these locations as to be determined (TBD). Details will be provided once preliminary designs are confirmed.

| Project Component | Max Height (MSL) | Visual Study Area | Notes |
|---|---|---|---|
| Max Number: 1 | 590.6 ft (180 m) | Less than 40 nm (74 km) radius | Maximum height of the met tower will not exceed 16.5 ft (5 m) above the hub height of the largest WTG installed |
| **Onshore Facilities Visual Effects PAPE** | | | |
| **Onshore Substation and/or Converter Station Site/s** | | | |
| TBD[4] | 100 ft (30.5 m) | 1 mi (1.6 km) radius | 100 ft height represents lightning masts only |
| **Temporary Construction Staging Areas** | | | |
| TBD | TBD | TBD | Potential visibility will be temporary |

Based on an estimated WTG maximum height of 1,048.8 ft (319.7 m) and an anticipated onshore substation and/or converter station maximum height of 60 ft (18.3 m), the maximum radius of theoretical visibility of offshore Project components is 40 nautical miles (nm) (74 km) while the maximum radius of theoretical visibility of onshore Project components is 1 mi (1.6 km), based on guidance from BOEM and NYSHPO. The Project's Visual Study Area was defined as the 40 nm (74 km) and 1 mi (1.6 km) radii, representing the maximum limit of theoretical visibility for each respective Project component considering the size of the proposed facilities, earth curvature, atmospheric clarity, and human visual acuity (see Section 5.0).

As mentioned above, the final APE will be formally determined by BOEM in consultation with the NJHPO and NYSHPO as part of the Section 106 consultation process. The process for identifying and evaluating potential effects on aboveground historic properties resulting from the construction and operation of the Project will involve consultation with BOEM, the NJHPO, the NYSHPO, participating Tribal Nations, and other interested consulting parties. To identify aboveground historic properties that could be affected by the Project, Atlantic Shores first conducted a desktop review of the records of state and federal agencies, GIS databases, previous cultural resources surveys, local inventories, and historical collections to develop an inventory of previously identified aboveground historic properties within the PAPEs for the Project.

Resources reviewed as part of this process included:

- The NYSHPO's Cultural Resources Information System (CRIS) website (NYSHPO 2023).
- The New Jersey Department of Environmental Protection (NJDEP) Look Up Cultural Resources Yourself (LUCY) website (NJDEP 2021)
- The Atlantic County Division of Parks and Recreation Historical Sites webpage (Atlantic County 2021)
- The Monmouth County Parks System (MCPS) Monmouth County Historic Sites Inventory (MCHSI) website (MCPS 2021)
- Multiple Property Documentation Forms for relevant aboveground historic properties located within the PAPEs

- Aboveground historic properties identified as part of studies conducted by BOEM in 2012 in order to prepare a GIS database of known aboveground cultural resources/historic properties that could be affected by the introduction of offshore energy facilities along the east coast of the United States[47]
- Municipal-level (i.e., county, town, city, or village) historian's offices and associated online databases
- Privately run local and regional historical societies.

In addition, Atlantic Shores identified any potentially previously unreported aboveground historic properties (i.e., properties that appear to be at least 40 years of age or more that have not been previously documented or included in existing historic databases) located within the PAPEs. This process included the following:

- Identification of all structures within the PAPEs using the Microsoft United States Building Footprint database
- Obtaining open parcel data and assessors' information to determine the age of the structures (if available) in order to identify all structures within the PAPEs that are 40 years of age or greater
- Completion of a desktop analysis, including a review of recent aerial photographs, street views, and pictometry images (where available) to determine whether each structure is extant, or no longer meets NRHP eligibility criteria (i.e., has lost integrity or is clearly not historically significant)
- Delineation of potential historic districts for neighborhoods or clusters of properties consisting of similar style and construction dates, or otherwise linked by historic significance
- Field review to identify additional potential aboveground historic properties and to verify the integrity of the previously identified aboveground historic properties

Per 36 CFR Part 61, Secretary of the Interior qualified architectural historians initiated a desktop and field review to identify the aboveground historic properties within the PAPEs. A summary of research information specific to the offshore and onshore visual effects PAPEs is included in Sections 6.1.1.1 and 6.1.1.2, respectively.

[47] Klein, J.I., M.D. Harris, W.M. Tankersley, R. Meyer, G.C. Smith, and W.J. Chadwick. 2012. Evaluation of visual impact on cultural resources/historic properties: North Atlantic, Mid-Atlantic, South Atlantic, and Florida Straits. Volume I: Technical report of findings. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2012-006. 24 pp., and Klein, J.I., M.D. Harris, W.M. Tankersley, R. Meyer, G.C. Smith, and W.J. Chadwick. 2012. Evaluation of visual impact on cultural resources/historic properties: North Atlantic, Mid-Atlantic, South Atlantic, and Florida Straits. Volume II: Appendices. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2012-007. 10 appendices.

The HREVEA and HREA did not include analysis of previously identified archaeological sites located within the PAPEs. Analyses of the Project's potential to affect archaeological resources are described in the Marine Archaeological Resources Assessment (MARA; Appendix II-Q to the COP) and Terrestrial Archaeological Resources Assessment (TARA; Appendix II-P1 to the COP) reports.

#### 6.1.1.1 Offshore Visual Effects PAPE

The offshore visual effects PAPE includes all areas from which WTGs and OSSs within the Lease Area could be theoretically visible and includes areas within Cape May, Atlantic, Burlington, Ocean, and Monmouth County, New Jersey. Following a review of the desktop and field survey results, a total of 113 aboveground historic properties were identified within the offshore visual effects PAPE, including:

### Table 6.1-2. Aboveground Historic Properties within the PAPE

| Property Designation | Occurrences of Aboveground Historic Properties Within The PAPE |
|---|---|
| NHL properties | 2 |
| Aboveground Historic Properties and Historic Districts Listed in the NRHP | 26 |
| Aboveground Historic Properties and Historic Districts Determined Eligible for Listing in the NRHP* | 57 |
| Aboveground Historic Properties and Historic Districts Recommended Eligible for Listing in the NRHP** | 28 |
| **Total** | **113** |

* This includes properties formally determined NRHP-eligible by NJHPO or BOEM whose NRHP eligibility was confirmed as part of the field surveys.

** This includes properties previously inventoried without a formal determination of NRHP eligibility that have been recommended by EDR to meet NRHP eligibility, including properties contributing to NRHP-eligible historic districts.

Atlantic Shores recognizes that TCPs associated with Native American communities may be present within the Offshore Facilities visual effects PAPE, and such properties would potentially be sensitive to visual impacts from Project construction and installation, O&M activities, or decommissioning. Atlantic Shores recognizes that government-to-government consultations between BOEM and the Tribal Nations under Section 106 of the NHPA may be necessary to identify such properties and to inform BOEM's consideration of potential visual effects to any extant TCPs.

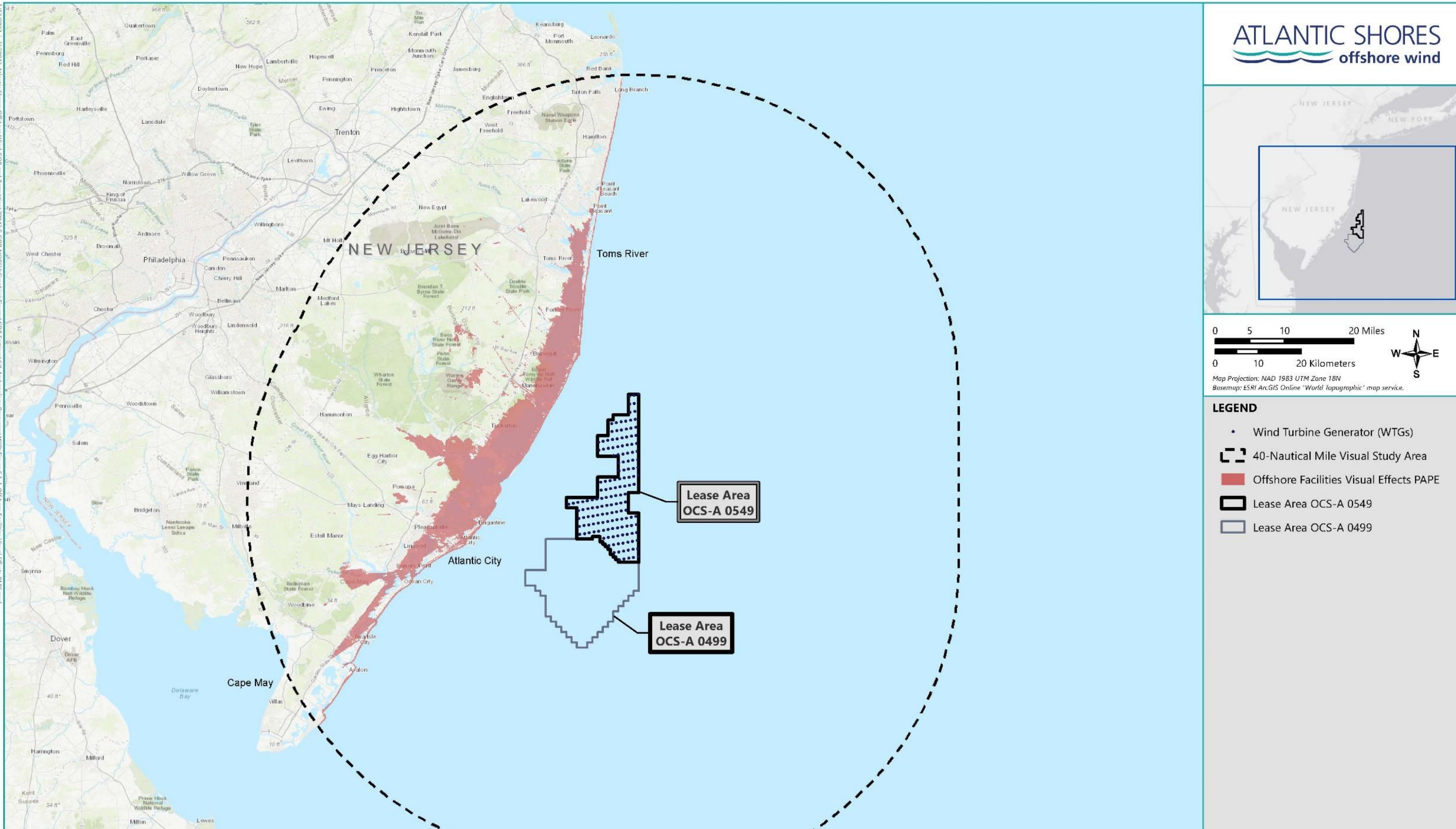



**Figure 6.1-1**

*Offshore Facilities Visual Effects PAPE*

#### 6.1.1.2 Onshore Visual Effects PAPEs

The onshore visual effects PAPEs includes all areas from which the onshore substation and/or converter station sites and temporary construction staging areas within the Onshore Project Area could theoretically be visible within New Jersey and New York. The HREA includes a lidar generated onshore visual effects PAPE within a 1-mi (1.6 km) radius Visual Study Area surrounding each of the proposed onshore substation and/or converter station sites and temporary construction staging areas. Aboveground historic properties were identified within the onshore visual effects PAPE per the methods described above in Section 6.1.1. Following the desktop and field review, a total of 21 aboveground historic properties were identified within the onshore visual effects PAPEs.

**Table 6.1-3. Occurrences of Aboveground Historic Properties Within the PAPEs**

| | NHL properties | Aboveground Historic Properties and Historic Districts Listed in the NRHP | Aboveground Historic Properties and Historic Districts Determined Eligible for Listing in the NRHP* |
|---|---|---|---|
| **Lanes Ponds Road Site** | 0 | 0 | 1* |
| **Randolph Road Site** | 0 | 0 | 1* |
| **Brook Road Site** | 0 | 0 | 1* |
| **Route 66 Site** | 0 | 0 | 1* |
| **Asbury Avenue Site** | 0 | 0 | 1* |
| **Arthur Kill Road Site** | 0 | 0 | 4* |
| **River Road Site** | 0 | 0 | 4* |
| **Sunset Industrial Park Site** | 1 | 1 | 10 |
| **TOTALS** | **1** | **1** | **19** |

*Occurrence of aboveground historic property is in multiple PAPEs.

### 6.1.2 Potential Impacts and Proposed Environmental Protection Measures

Construction and installation of the Project is not anticipated to require the demolition or physical alteration of any aboveground historic properties. The Project's potential effect on a given aboveground historic property could be a temporary or long-term change in the aboveground historic property’s visual setting. The potential IPFs that may affect aboveground historic properties during the Projects’ lifecycles are presented in Table 6.1-4 and summarized in the following subsections.

**Table 6.1-4. Impact Producing Factors for Aboveground Historic Properties**

| Impact Producing Factor (IPF) | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Presence of structures and cables | | ● | |
| Lighting | ● | ● | ● |
| Noise | ● | ● | ● |

| Impact Producing Factor (IPF) | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Traffic | ● | ● | ● |

In addition to these IPFs, construction and installation of the Project may result in temporary intrusions (such as traffic, noise, and lights) to the visual setting of aboveground historic properties within the visual effects PAPEs. However, these activities are temporary and are not anticipated to effect or diminish the characteristics for which potential aboveground historic properties within the visual effects PAPEs may be listed in, determined eligible for listing in, or may be eligible for listing in the NRHP. Temporary intrusions during construction and installation activities are not anticipated to result in significant effects on aboveground historic properties; therefore, are not discussed further.

### 6.1.2.1 Presence of Structures and Cables

In accordance with 36 CFR Part 800, the presence of large numbers of modern structures (such as WTGs, OSSs, O&M facilities, or onshore substations and/or converter stations) may result in a change to the historic setting of aboveground historic properties by introducing new vertical elements on the ocean horizon in historic maritime settings and contexts or in onshore historic settings and contexts. This IPF section focuses on the potential effects posed by the presence of structures introduced by the Project's offshore and onshore facilities. Installation of buried cables will have no visual effect on aboveground historic properties as they will be buried underground and within the seabed; therefore, they are not discussed further.

#### 6.1.2.1.1 Offshore Facilities

The primary potential adverse effect on aboveground historic properties resulting from the Project would be consistent with 36 CFR § 800.5(a)(2)(v), "Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features." The potential effect resulting from the introduction of the offshore components into the visual setting for any historic or architecturally significant property is dependent on several factors, including distance, visual dominance, orientation of views, viewer context and activity, and the types and density of modern features in the existing view (such as buildings/residences, overhead electrical transmission lines, cellular communications towers, billboards, highways, and silos). As it pertains to aboveground historic properties, *setting* is defined as "the physical environment of a historic property" and is one of seven aspects of a property's *integrity*, which refers to the "ability of a property to convey its significance" (NPS, 1990). The other aspects of integrity include location, design, materials, workmanship, feeling, and association (NPS, 1990).

The potential effect resulting from the introduction of the offshore facilities into the visual setting for an aboveground historic property is dependent on several factors, including:

- those characteristics of a historic property that qualify it for listing in the NRHP (i.e., the rationale for the property's historical significance),

- whether or not a historic property has a maritime setting and the integrity of that setting, including the presence of existing modern features or other visual elements that post-date a property's period of significance,
- the degree to which a property's maritime setting contributes to the historical significance of the property,
- the distance separating the aboveground historic property from the Project components (i.e., wind turbines and OSS) which determines the scale of the turbines relative to a viewer's location, and
- the magnitude and nature of visual changes to existing views introduced by the proposed facilities, in terms of visual dominance, orientation of potential views, and density of new visual elements.

The first three of these factors are related to the nature of each historic property and the relationship between each aboveground historic property and the surrounding physical environment. Of particular interest in the assessments for offshore wind facilities are the characteristics of maritime settings associated with some aboveground historic properties and how those settings could be affected by the construction and operation of multiple, large wind turbines on the OCS. The latter two factors summarized above relate to the physical parameters of the proposed facilities and their spatial relationships to aboveground historic properties with potential views of the facilities.

Criteria for determining a significant maritime setting are defined in the *Evaluation of Visual Impact on Cultural Resources/Historic Properties: North Atlantic, Mid-Atlantic, South Atlantic, and Florida Straits* (BOEM 2012) which states:

> *"Resources within this category derived their importance, in whole or in part, from their proximity to the sea. They included TCPs, coastal fortifications, parks and seashores, residential estates, lighthouses, life-saving stations, breakwaters, marinas, fishing and resort communities, and shore lodgings of all kinds, including hotels, motels, inns, seasonal cottages, and permanent residences"* (BOEM 2012).

The quantitative factors used to assess potential visual effects will include measures of distance, viewshed analyses based on specific height measurements on the WTGs, and measurements of areas of potential visibility. The viewshed analyses will indicate the portion of WTGs visible above mean sea level. These quantitative measures will include the following:

- distance from the nearest visible WTG
- blade tip elevation visibility
- WTG aviation light elevation visibility
- mid-tower aviation light elevation visibility
- U.S. Coast Guard (USCG) light elevation visibility

- total acreage of each aboveground historic property
- total acreage of visibility within each aboveground historic property
- the portion of the aboveground historic property (% of acreage) from which the Project would be potentially visible.

The majority of aboveground historic properties that fall within the Project's viewshed will have somewhat obstructed views of the Project due to screening provided by intervening topography, vegetation, and/or buildings and structures. The proposed WTGs are located between 8.46 miles (13.61 km) to 45.98 miles (73.99 km) away from the aboveground historic properties located within the PAPE. Visual simulations prepared for the Project show that in some cases views of the ocean will be disrupted by the size and scale of the WTGs. Distance may be a mitigating factor in some cases. However, under clear conditions even at distances of 20 miles (32.2 km) away, WTGs spread across the horizon will likely become focal points of viewers from the shore. The Project will result in the greatest potential effects on the visual setting of aboveground historic properties located along the shoreline. While all the aboveground historic properties within the PAPE have potential views of the WTGs, because of distance as well as the Earth's curvature, not all of the aboveground historic properties would have views of full WTGs (i.e., in which the entire above-surface WTG structure was visible) and not all aboveground historic properties will be adversely affected by the Project.

Applying the Criteria of Adverse Effect per NHPA Section 106, 36 CFR § 800.5, of the 113 aboveground historic properties located within the PAPE assessed for potential visual effects, the Project will have a potential adverse effect on a total of 26 aboveground historic properties. The result of the analysis is detailed in the Offshore HRVEA (see Appendix II-N2).

Atlantic Shores' assessment of potential adverse visual effects to aboveground historic properties is intentionally conservative and intended to identify possible adverse effects that may warrant further consideration through future consultation with agencies and other stakeholders during the Section 106 consultation process.

#### 6.1.2.1.2 Onshore Facilities

The purpose of the HREA is to identify and document aboveground historic properties within the onshore visual effects PAPEs and to evaluate the potential visual effects on the qualities that make aboveground historic properties eligible for listing in the NRHP. The onshore substation and/or converter station sites and temporary construction staging areas will be the only visible components of the Project during operation that have the potential to affect the visual setting of aboveground historic properties.

No aboveground historic properties will be physically affected by the construction of the substations/converter stations. The potential effect resulting from the introduction of the substations/converter stations into the visual setting for an aboveground historic property is dependent on several factors, including:

- those characteristics of an aboveground historic property that qualify it for listing in the NRHP (i.e., the rationale for the property's historical significance)
- whether or not setting contributes to the historical significance of the property
- the distance separating the aboveground historic property from the substations/converter stations
- the magnitude and nature of visual changes to existing views introduced by the proposed facilities, in terms of visual dominance, orientation of potential views, and density of new visual elements.

The first three of these factors are related to the nature of each aboveground historic property and the relationship between each aboveground historic property and the surrounding physical environment. The last relates to the physical parameters of the proposed facilities and their spatial relationships to historic properties with potential views of the Facilities. The potential effect of the onshore components on a given aboveground historic property would be a change in the property's visual setting resulting from the introduction of new structures/buildings.

As stated above, construction and operation of the onshore facilities will not require the demolition or physical alteration of any aboveground historic properties. The potential effect on a given aboveground historic property would be a change (resulting from the introduction of new structures) in the property's visual setting. The onshore facilities would introduce new structures into the landscape; however, at a maximum height of 100 feet (lighting masts only), the proposed facilities will not be out of scale or character with the existing types of development currently present in the vicinity. As such, it is anticipated that the facilities will not result in adverse effects to aboveground historic properties. In addition, to minimize potential impacts, the onshore substation and/or converter station sites will be sited near existing substations, or on parcels zoned for commercial and industrial/utility use to the maximum extent practicable.

### 6.1.2.2 Light

Per 36 CFR Part 800, lighting produced by the Project could result in a change to the integrity of the historic setting of aboveground historic properties by introducing new sources of light into historic contexts, both onshore and offshore. Depending on the existing conditions in which an aboveground historic property is located, the introduction of an additional light source may be disruptive, or not noticeable at all. This IPF section describes the potential impacts to aboveground historic properties caused by light sources related to the Project.

#### 6.1.2.2.1 Offshore Facilities

All of the WTGs will be equipped with aviation obstruction warning lights in accordance with the FAA, and/or BOEM guidance to aid aircraft operating in the airspace of the Project. To evaluate the potential effects associated with lighting produced by the offshore facilities, an ADLS Efficacy Analysis was completed to determine the likely activation time of the FAA light if ADLS is implemented (see Appendix II-M2). The analysis indicates that under typical conditions, the ADLS would be activated for a total of approximately 20 hours and 25 minutes over a 1-year period.

Considering the low frequency of light activation on similar offshore wind projects, the potential visual effects associated with the aviation obstruction lights will likely be intermittent and minor.

Nighttime construction activities are likely to be visible from onshore vantage points and will result in the presence of direct light sources and skyglow in a previously dark seascape. However, the visibility will be temporary in nature and at times will be obscured from view due to atmospheric conditions or curvature of the Earth. In addition, other temporary lighting (e.g., helicopter hoist status lights) may be utilized on the WTGs for safety purposes, when necessary. Similarly, some outdoor OSS lighting (in addition to any required aviation or marine navigation lighting) will be necessary for maintenance that may occur at night. Atlantic Shores anticipates using controls to ensure that outdoor OSS lighting will be illuminated only when the OSS is manned. When unmanned, general outdoor lighting will be off.

The Project will mitigate to the maximum extent practicable potential impacts from lighting from offshore facilities during O&M by ensuring that the offshore facilities will be lit and marked in accordance with FAA, BOEM and USCG requirements for aviation and navigation obstruction lighting, respectively, and by using ADLS or related means (e.g., dimming, shielding) to limit visual effects, pursuant to approval by the FAA and BOEM, commercial and technical feasibility at the time of Facility Design Report/Fabrication and Installation Report approval, and dialogue with stakeholders.

#### 6.1.2.2.2 Onshore Facilities

Operational lighting will be required for the safe and secure operation of onshore substations and/or converter stations. Due to the developed nature of most of the Onshore Project Area, the lights are not expected to contribute significantly to the sky glow resulting from existing light sources present in each of the respective areas. Therefore, it is not anticipated that the lighting from the onshore facilities would have an effect on aboveground historic properties.

Plantings to create screening will be installed at the onshore substation and/or converter station sites to the maximum extent practicable to reduce potential visibility and thereby avoid impacts from lighting from onshore facilities during O&M.

### 6.1.2.3 Noise

Airborne noise produced by the Project could result in a change to the integrity of the historic setting of aboveground historic properties by introducing modern sounds into historic contexts both on and offshore. Aboveground historic properties set in urban contexts may not be affected by an increase in airborne noise, while in other contexts it may lead to the disruption of the historic setting by which an aboveground historic property derives its significance. This IPF section focuses on the potential impacts of noise created by the Project on aboveground historic properties.

#### 6.1.2.3.1 Offshore Facilities

An assessment of operational noise is pending final facility siting and preliminary engineering design. Based on assessments of operational noise conducted for similar offshore wind projects, the noise generated by the WTGs is not expected to be audible at the nearest shorelines. Therefore, operational noise associated with the Project is not anticipated to have an impact to the aboveground historic properties.

##### 6.1.2.3.2 Onshore Facilities

The design of onshore facilities will depend on whether HVAC, HVDC, or a combination of both HVAC and HVDC onshore interconnection cables are constructed. It is anticipated that the HVDC design would have generally lesser sound impacts on the surrounding community than HVAC technology. Therefore, only the HVAC onshore substation design will be evaluated to provide the most conservative assessment of potential noise impacts. The onshore interconnection cables will not generate noise during operations since the cable will be buried beneath existing roads or within other public and utility right-of-ways (ROWs). The onshore substations and/or converter stations will be designed to comply with the NJDEP and NYDPS sound level limits. Screening will be implemented at the onshore substation and/or converter station sites to the maximum extent practicable, to reduce potential noise impacts from onshore facilities during O&M.

#### 6.1.2.4 Traffic

An increase in traffic associated with the Project could result in a change to the integrity of the historic setting of aboveground historic properties by creating an increase in the flow of aircraft, vessels, or land-based vehicles that could disrupt onshore or offshore historic contexts. This IPF section focuses on the potential impacts of increased traffic created by the Project on aboveground historic properties.

##### 6.1.2.4.1 Offshore Facilities

Given the relative frequency of seagoing vessels on the horizon within the offshore visual effects PAPE, it is not likely that traffic related to the Project will be a noticeable change. Traffic during construction and installation, as well as O&M of the Project is not anticipated to affect the integrity of the historic setting of aboveground historic properties for the duration of the Project's activity.

##### 6.1.2.4.2 Onshore Facilities

O&M of the onshore substations and/or converter stations will be unmanned during routine operations and will be inspected regularly based on manufacturer-recommended schedules. Personnel will be on site as necessary for any maintenance or repairs. It is likely that no noticeable increase over existing traffic patterns will occur. The onshore interconnection cables will have no regular maintenance unless there is a failure or malfunction requiring exposure and repair of the cable. If any unforeseen maintenance is required, impacts to traffic from potential traffic detours might occur. Traffic during the operation of the Project is not anticipated to affect the integrity of the historic setting of aboveground historic properties for the duration of the Project's activity.

#### 6.1.2.5 Summary of Proposed Environmental Protection Measures

Atlantic Shores has taken proactive steps to avoid, minimize, and mitigate to the maximum extent practicable the potential effects to aboveground historic properties. Atlantic Shores will implement the following environmental protection measures to reduce potential impacts on aboveground historic properties. These measures are based on protocols and procedures successfully implemented for similar offshore wind projects and involve the mitigation of visual effects, in most cases:

- Atlantic Shores will engage with relevant stakeholders to determine additional avoidance, minimization, or mitigation measures regarding potential effects on aboveground historic properties as required by 30 CFR Part 585.626(b)(15)
- The OSSs will be set back sufficient to minimize their visibility from the shore
- The WTGs will be painted no lighter than Pure White (RAL 9010) and no darker than Light Grey (RAL 7035) as recommended by BOEM and the FAA. Turbines of this color eliminate the need for daytime warning lights or red paint marking of the blade tips
- ADLS or related means (e.g., dimming or shielding) will be used to limit visual impact, pursuant to approval by the FAA and BOEM, commercial and technical feasibility at the time of FDR/FIR approval, and dialogue with stakeholders
- The onshore interconnection cables will be installed underground, thus avoiding potential effects on the visual setting of historic properties
- The onshore substation and/or converter station sites will be sited near existing substations, or on parcels zoned for commercial and industrial/utility use to the maximum extent practicable
- Screening will be implemented at the onshore substation and/or converter stations sites to the to allow the facility to blend into the surrounding urban environment to the extent practicable as well as to reduce potential visibility and noise
- If necessary, Historic Properties Treatment Plans (HPTPs) will be drafted for aboveground properties determined by BOEM to be adversely affected by the Project, in order to describe the scope and implementation of mitigation to resolve adverse effects to historic properties.

Options to avoid identified adverse effects on aboveground historic properties are limited, given the nature of the Project (i.e., very tall, vertical structures) and its siting criteria (i.e., the open ocean). Therefore, for most wind energy projects, mitigation of impacts to historic properties typically consists of supporting initiatives that benefit historic sites or buildings and/or the public's appreciation of historic resources to offset potential impacts to historic properties resulting from the introduction of WTGs into their visual setting. The specifics of these initiatives are typically identified in consultation with appropriate stakeholders subsequent to determination of whether a given historic property would be adversely affected by a project. Prior to that determination of adverse effects, it is not possible to definitively identify adversely affected properties and therefore, the appropriate stakeholders to initiate these consultations.

Atlantic Shores will initiate outreach with appropriate regional stakeholders who may participate in consultations to discuss any potential adverse effects to historic properties, as well as identify appropriate mitigation projects. Atlantic Shores anticipates engaging in consultation with BOEM, the

NJDEP, the NJHPO, and the NYSOPRHP in its capacity as the NYSHPO, participating Native American Tribes, as well as regional and local historical societies, municipal historians, and owners/operators of historic properties to explore and discuss appropriate potential mitigation opportunities.

This section describes the aboveground historic properties, terrestrial archaeological resources, and marine archaeological resources within the Onshore and Offshore Project Areas, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning. The Onshore Project Area includes proposed landfall sites, onshore interconnection cable route options, potential substation and/or converter station sites, and temporary construction staging areas. Existing facilities will be used for O&M[48] and potential substation and/or converter station sites will be evaluated in a future Construction and Operations Plan (COP) Supplement.[49] The Offshore Project Area includes the Lease Area, Export Cable Corridors (ECCs), and trenchless interconnection cable routes.

Aboveground historic properties are herein defined as districts, buildings, structures, objects, or sites that are listed in, or determined eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior, or which have been designated as National Historic Landmarks (NHL) by the Secretary of the Interior (54 USC § 300308). Aboveground historic properties can include residential, commercial, and industrial sites, natural landscapes, and Traditional Cultural Properties (TCPs).

Terrestrial archaeological resources are defined herein as any prehistoric or historic sites, objects, buildings, structures, or districts that are listed in or eligible for listing in the NRHP or have been designated as NHLs. Archaeological sites are valuable cultural resources that contain a wealth of tangible information about the past. Identifying, understanding, and to the extent appropriate, preserving terrestrial archaeological resources increases our opportunities for cultural enrichment, education, and knowledge of the past.

Marine archaeological resources are defined herein as any submerged historic properties including archaeological sites, objects, districts, or structures (including shipwrecks) that are listed in or eligible for listing in the NRHP have been designated as NHLs. These may also include Ancient Submerged Landforms (ASLFs), which represent coastal habitats that may have been available to people living in the region before marine transgression.

All cultural resources have been and will continue to be evaluated under the Bureau of Ocean Energy Management's (BOEM) *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (hereafter, BOEM's *Guidelines*; BOEM 2020), Section 106 and Section 110

[48] This Project will rely on existing O&M facilities, which are not anticipated to result in adverse effects on aboveground historic properties or terrestrial archaeological resources. No further surveys or evaluations are recommended in association with the existing O&M facilities.

[49] Atlantic Shores is actively assessing suitable locations for onshore substations and/or converter stations and temporary construction staging areas. As Project design progresses, potential onshore substation and/or converter station sites and temporary construction staging areas will be selected. Information regarding the potential visibility of the onshore substation and/or converter station sites and temporary construction staging areas will be evaluated at that time.

of the National Historic Preservation Act (NHPA), and the National Environmental Policy Act Special Requirements for Protecting National Historic Landmarks (36 CFR Part 800.10),

To facilitate BOEM's Section 106 review, Atlantic Shores has defined a Preliminary Area of Potential Effects (PAPE)[50] for the project, based on a Project Design Envelope (PDE; described in Volume I of the COP), which includes all areas currently under consideration as options for Project components and activities. According to BOEM, "A PDE approach is a permitting approach that allows a project proponent the option to submit a reasonable range of design parameters within its permit application, allows a permitting agency to then analyze the maximum impacts that could occur from the range of design parameters, and may result in the approval of a project that is constructed within that range" (BOEM 2018). The PDE approach allows Atlantic Shores design flexibility and an ability to respond to advancements in industry technologies and techniques.

Based on review of BOEM's *Guidelines* (BOEM 2020), Atlantic Shores has proposed that the overall PAPE for the project include the following geographic areas within distinct sub-PAPEs:

- the viewshed from which renewable energy structures would be visible, whether located offshore (Offshore Facilities Visual Effects PAPE, see Section 6.1.1.1) or onshore (Onshore Facilities Visual Effects PAPE, see Section 6.1.1.2), constituting the Project's overall PAPE for Visual Effects

- the depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities in the Onshore Project Area, within New Jersey (NJ Physical Effects PAPE, see Section 6.2.1.1), and New York (NY Physical Effects PAPE, see Section 6.2.1.2, constituting the Project's overall PAPE for Physical Effects to terrestrial archaeological resources

- the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities in the Offshore Project Area (Marine Physical Effects PAPE, see Section 6.3.1), constituting the marine archaeological resources portion of the PAPE

- any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the PAPE.

The final Area of Potential Effects (APE) will be formally determined by BOEM as part of the Section 106 consultation process. The process for identifying and evaluating effects on historic properties resulting from the construction and operation of the Project will involve consultation with BOEM, the New Jersey Historic Preservation Office (NJHPO), the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP) in its capacity as the New York State Historic Preservation Office (NYSHPO), federally recognized tribes, Tribal Historic Preservation Officers (THPOs), and other

[50] Because the Area of Potential Effects (APE) is typically developed in consultation with the involved state historic preservation offices (SHPOs) as part of the Section 106 review process, and because formal consultation with the New Jersey Historic Preservation Office (NJHPO) and the New York State Historic Preservation Office (NYSHPO) has not yet been initiated, the APEs in this document are referred to as the preliminary APEs (PAPEs).

consulting parties with a demonstrated interest in the historic properties (e.g., historic preservation organizations).

## 6.2 Terrestrial Archaeological Resources

This section describes terrestrial archaeological resources in the Atlantic Shores Onshore Project Area, associated impact producing factors (IPF), and environmental protection measures to avoid, minimize, or mitigate potential impacts to these resources.

Terrestrial archaeological resources are defined as any prehistoric or historic sites, objects, buildings, structures, or districts that are listed in or eligible for listing in the National Register of Historic Places (NRHP), maintained by the Secretary of the Interior, or have been designated as National Historic Landmarks (NHL) by the Secretary of the Interior (54 USC § 300308). Archaeological sites are valuable cultural resources that contain a wealth of tangible information about the past. Identifying, understanding, and to the extent appropriate, preserving terrestrial archaeological resources increases our opportunities for cultural enrichment, education, and knowledge of the past.

Specific requirements for submittal of an analysis of potential impacts to terrestrial archaeological resources within this COP are provided in *Guidelines for Providing Archaeological and Historic Property Information* pursuant to 30 CFR Part 585, Section 106 and Section 110 of the National Historic Preservation Act (NHPA), and the National Environmental Policy Act (NEPA) (BOEM, 2020). In addition, the onshore substations are subject to review under Section 7:4 of the New Jersey Administrative Code, the State of New Jersey Executive Order #215 (NJHPO, 2008), Article VII of the New York State Public Service Law, Section 14.09 of the New York State Parks, Recreation and Historic Preservation Law, and the New York State Environmental Quality Review Act (SEQRA) and its implementing regulations (6 NYCRR Part 617).

All archaeological work within the state of New Jersey was conducted under the guidance of the NJHPO *Guidelines for Phase I Archaeological Investigations: Identification of Archaeological Resources* (2000) and *Guidelines for Preparing Cultural Resources Management Archaeological Reports Submitted to the Historic Preservation Office* (2008). In New York, terrestrial archaeological resources have been and will continue to be evaluated in accordance with the New York Archaeological Council (NYAC) *Standards for Cultural Resources Investigations and the Curation of Archaeological Collections in New York State* (the *NYAC Standards*; NYAC, 1994) and the New York State Historic Preservation Office (NYSHPO) *Phase I Archaeological Report Format Requirements* (NYSHPO, 2005).

To support the assessment of terrestrial archaeological resources within the Onshore Project Area, in accordance with the above regulations and guidance, Atlantic Shores conducted both desktop research and pedestrian reconnaissance surveys in the form of terrestrial archaeological resources assessments (TARAs) of the Larrabee and Atlantic onshore interconnection facilities in New Jersey and the Fresh Kills/Goethals and Gowanus onshore interconnection facilities in New York. No assessments were conducted on operations and maintenance facilities (O&M facilities) in this COP because the Project will be relying on preexisting facilities.

The facilities associated with the Larrabee and Atlantic onshore interconnection facilities in New Jersey and the Fresh Kills/Goethals and Gowanus onshore interconnection facilities in New York are depicted on Figures 4.8-1, 4.8-1a-b and 4.8-2, 4.8-2a-b of Volume I. The findings from background research, archaeological reconnaissance, and desktop assessment related to the onshore interconnection facilities are presented in the *Terrestrial Archaeological Resources Assessment – Atlantic Shores North Offshore Wind Project - Onshore Interconnection Facilities* reports (EDR, 2022; Appendix II-P1; EDR, 2023; Appendix II-P2).

### 6.2.1 Affected Environment

The affected environment for terrestrial archaeological resources will consist of the Project's preliminary area of potential effects (PAPE) for physical effects, which incorporates the maximum breadth and depth of all areas of onshore ground disturbing activity, or other construction activities that could result in demolition or alteration of existing historical sites, buildings, or other built features. This encompasses all locations currently under consideration by Atlantic Shores for landfall sites, onshore interconnection cable route options, onshore substation and/or converter station sites, and temporary construction staging areas. The Project has identified multiple landfall sites and onshore interconnection cable route options and variations that are currently being refined and evaluated.

Within the Project's overall PAPE for physical effects, the affected environment for terrestrial archeological resources consists of two distinct sub-PAPEs, which are associated with the Project's proposed onshore interconnection cable route options (the NJ Physical Effects PAPE and NY Physical Effects PAPE). The NJ Physical Effects PAPE includes the Larrabee and Atlantic Onshore Interconnection Cable Routes, the Kingsley, Ashbury, and Monmouth Landfall Sites, and the proposed onshore substation and/or converter station locations. The NY Physical Effects PAPE includes the Fresh Kills/Goethals and Gowanus Onshore Interconnection Cable Routes, the Wolfe's Pond, Lemon Creek, and Fort Hamilton Landfall sites, and the proposed onshore substation and/or converter station locations. The Project will rely on existing O&M facilities which are not included in the overall PAPE for physical effects. As Project design progresses temporary construction staging areas are expected to be chosen.

Project components that comprise the PAPE for Physical Effects, as well as preliminary estimates of the maximum horizontal and vertical limits of ground disturbance associated with each component, are tabulated in Table 6.2-1 and Table 6.2-2 and summarized as follows:

- The NJ Physical Effects PAPE includes: the Larrabee Physical Effects PAPE and the Atlantic Physical Effect PAPE (Figure 6.2-1).
    - The Larrabee Physical Effects PAPE (Larrabee PAPE) includes the Monmouth Landfall Site, the Larrabee Onshore Interconnection Cable Route, and two potential options for the Proposed Larrabee Onshore Substation and/or Converter Station (Lanes Pond Road Site and/or Randolph Road Site[51])

[51] Note that the Brook Road Site is now proposed to be developed separately under the New Jersey Board of Public Utilities (NJBPU) State Agreement Approach (SAA). Although no specific actions or effects are proposed by Atlantic Shores at this location, research and analysis of the Brook Road Site has been retained in the TARA, as the project may utilize future facilities at the site.

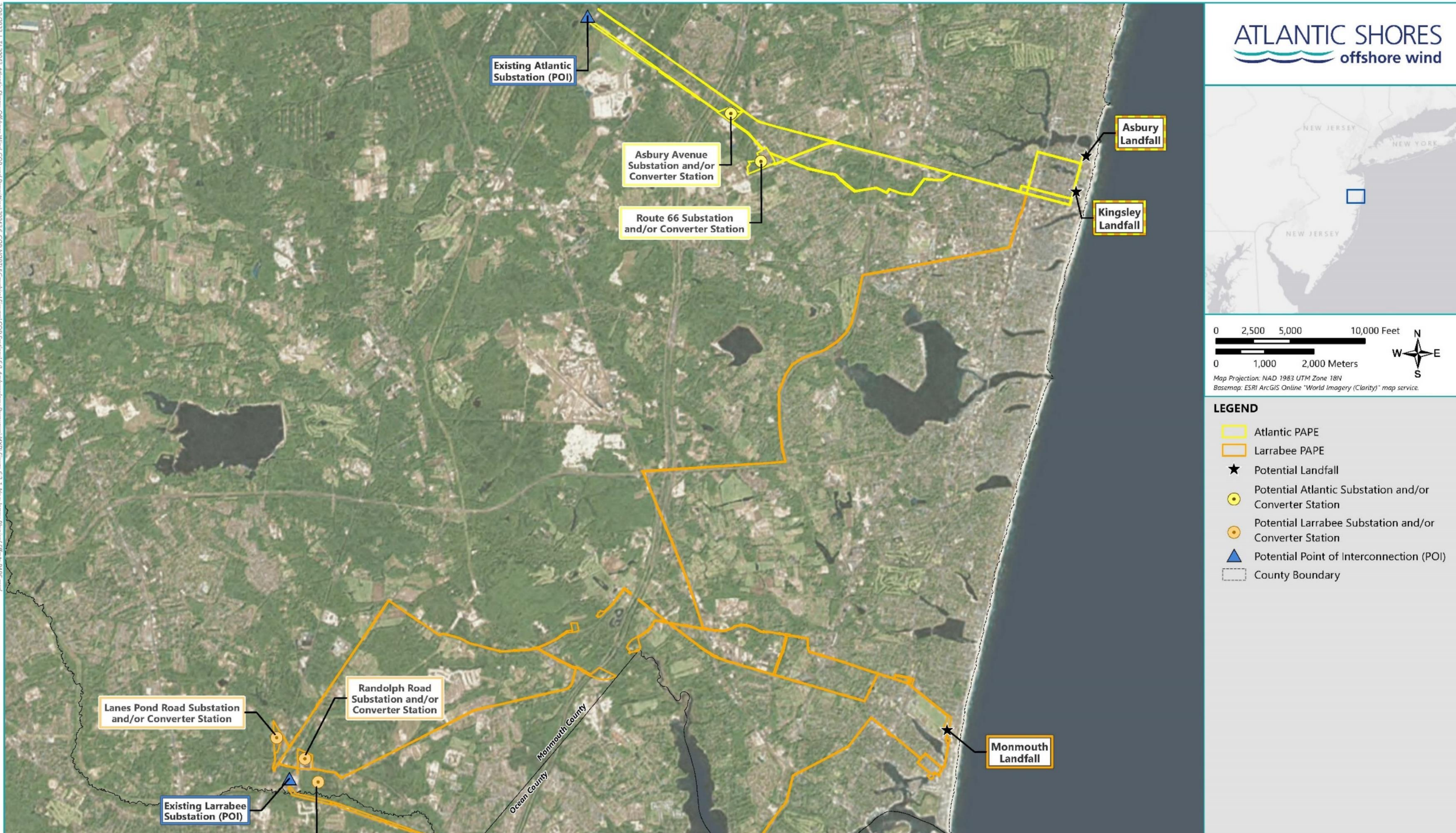



**Figure 6.2-1**

*New Jersey Physical Effects PAPE*

- The Monmouth Landfall Site is made up of two landfall options (collectively 8.60 acres [3.48 ha]) on the grounds of the New Jersey Army National Guard Training Center, immediately west of the Atlantic Ocean shoreline. Collectively, both landfall options are hereafter included when referencing the proposed Monmouth Landfall Site.
  - The first landfall option is a previously disturbed area in the southeast corner of the National Guard Training Center.
  - The second landfall option is a partially disturbed area on the eastern side of the National Guard Training Center, north of the first landfall option.

  Maximum vertical depth of disturbance is anticipated to be 16.8 ft. (5.12 m) at the landfall location from the installation of onshore transition vaults, within which the offshore export cable will be split into onshore cables.

- The Larrabee Onshore Interconnection Cable Route is an approximately 12-mi. (19.5-km) underground transmission route that largely uses existing linear corridors to connect the Monmouth Landfall Site to the existing Larrabee Substation POI. Its three routes are the Larrabee North Option, the Larrabee South Option, and the Larrabee to Ashbury Connector. The Larrabee Onshore Interconnection Cable Route consists of an approximately 20-ft. wide (6-m) corridor within which the underground, onshore cables will be installed within concrete duct banks. Installation of the onshore interconnection cable routes will typically be accomplished via open trenching to a depth of up to 11.5 ft. (3.5 m), which is the maximum vertical effect along most of the onshore interconnection cable route. Some specialty trenchless techniques (i.e., HDD, pipe jacking, and/or jack-and-bore) that avoid surface disturbance will be used to avoid impacts to busy roadways, wetlands, waterbodies, or existing developments or features and could result in disturbance up to 30 ft. (9 m) below ground surface.
- The Onshore Substations and/or Converter Stations are facilities where transmission voltage will be stepped up/stepped down or converted in preparation for interconnection to the electrical grid at either of the existing POIs. Atlantic Shores has identified three potential locations for the proposed Larrabee Onshore Substation and/or Converter Station in the vicinity of the Larrabee Onshore Route.
  - The Lanes Pond Road option is an approximately 16.3-acre (6.6-ha) parcel consisting of agricultural fields and wooded areas south of the intersection of Miller Road and Lanes Pond Road in Howell Township.
  - The Brook Road option is an approximately 99.4-acre (40.2-ha) combination of two parcels consisting primarily of forested uplands and some wetlands between Randolph Road and the Metedeconk River in Howell Township.

- The Randolph Road option is an approximately 24.6-acre (9.97-ha) combination of three parcels consisting of a steel fabrication facility with associated laydown yard, offices, and parking, as well as forested wetlands surrounding Dicks Brook. The location is north of Randolph Road to the northeast of the existing Larrabee POI in Howell Township.

Construction activities resulting in ground disturbance at the onshore substation and/or converter station locations may include land and tree clearing, grading, fencing, trenching and excavation, landscaping/planting, and installation of equipment foundations. The maximum vertical effect of these activities is anticipated to be approximately 60 ft. (18.3 m) in depth.

- The Atlantic Physical Effects PAPE (Atlantic PAPE) includes the Asbury and Kingsley Landfall Sites, the Atlantic Onshore Interconnection Cable Route, and two Onshore Substation and/or Converter Station (Route 66 and Asbury Avenue)
    - The Asbury Landfall Site is located on a an approximately 2.08-acre (0.84 ha) paved public parking lot and grass lawn northwest of the intersection of Kingsley Street and 7th Avenue in Asbury Park. Approximately 0.47 mi. (0.76 km) to the south, the Kingsley Landfall Site is located on an approximately 1.75-acre (0.71 ha) paved public parking lot bounded by Kingsley Street, and Ocean, 2nd, and 3rd Avenues. Maximum vertical depth of disturbance for both Landfall Sites is anticipated to be 16.8 ft. (5.12 m) at the landfall location from the installation of onshore transition vaults, within which the offshore export cable will be split into onshore cables.
    - The Atlantic Onshore Interconnection Cable Route (Atlantic Onshore Route) is an approximately 7-mi. (12 km) underground transmission route that largely uses existing linear infrastructure corridors to connect the Asbury and/or Kingsley Landfall Sites to the proposed onshore substation and/or converter station at the Route 66 and/or Asbury Avenue Site and the existing Atlantic Substation POI. The Atlantic Onshore Interconnection Cable Route consists of an approximately 20-ft. wide (6.0-m) corridor within which the underground, onshore cables will be installed within concrete duct banks. Installation of the onshore interconnection cable routes will typically be accomplished via open trenching to a depth of up to 11.5 ft. (3.5 m), which is the maximum vertical effect along most of the onshore interconnection cable route. Some specialty trenchless techniques (i.e., HDD, pipe jacking, and/or jack-and-bore) that avoid surface disturbance will be used to avoid impacts to busy roadways, wetlands, waterbodies, or existing developments or features and could result in disturbance up to 30 ft. (9 m) below ground surface.
    - Atlantic Shores has identified two potential locations for the proposed Atlantic Onshore Substation and/or Converter Station in the vicinity of the Atlantic Onshore Route:

        - The Route 66 Site at 3501 Route 66, is situated on approximately 35.47 acres (14.36 ha) of woodland, abandoned commercial buildings, and paved parking lots in Neptune, New Jersey
        - The Asbury Avenue Site at 4090 Asbury Avenue is situated on approximately 15.66 acres (6.34 ha) of undeveloped wooded lots in Tinton Falls, New Jersey

    Construction activities resulting in ground disturbance at the onshore substation and/or converter station locations may include land and tree clearing, grading, fencing, trenching and excavation, landscaping/planting, and installation of equipment foundations. The maximum vertical effect of these activities is anticipated to be approximately 60 ft. (18.3 m) in depth.

- The NY Physical Effects PAPE includes: the Fresh Kills/Goethals Physical Effects PAPE and the Gowanus Physical Effects PAPE (Figure 6.2-2).
    - The Fresh Kills/Goethals Physical Effects PAPE (Fresh Kills/Goethals PAPE) includes the Lemon Creek and Wolfe's Pond Landfall Sites, the Fresh Kills/Goethals Onshore Interconnection Cable Route, and two potential options for the Proposed Larrabee Onshore Substation and/or Converter Station (Arthur Kill Road and River Road).
        - Atlantic Shores has identified two potential Landfall Sites that may be utilized along the Fresh Kills/Goethals Onshore Route:
            - The Lemon Creek Landfall Site is located on an approximately 0.95-acre (0.39-ha) paved public parking lot on the grounds of Lemon Creek Park. Recent aerial photography depicts the southernmost portion of the landfall site as partially wooded. The site is bounded to the north and east by paved roadways (Sequine Avenue and Johnston Terrace).
            - The Wolfe's Pond Landfall Site is located on an approximately 3.40-acre (1.38-ha) paved parking lot on the grounds of Wolfe's Pond Park. Recent aerial photography depicts the southern and southwestern portion of the landfall site as partially vegetated with grass and pine trees. The site is bounded to the northeast by a paved roadway (Chester Avenue).

        Maximum vertical depth of disturbance for all Landfall Sites is anticipated to be 16.8 ft. (5.12 m) at the landfall location from the installation of onshore transition vaults, within which the offshore export cable will be split into onshore cables.

## Table 6.2-1. Summary of NJ Physical Effects PAPE

| Project Component | Maximum Horizontal Effect | Maximum Vertical Effect |
|---|---|---|
| **Larrabee Physical Effects PAPE** | **409.57 ac. (165.74 ha)** | |
| **Landfall Sites** | | |
| Monmouth Landfall Site | 8.60 ac. (3.48 ha) | 16.8 ft. (5.12m) |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Lanes Pond Road Option | 16.27 ac. (6.84 ha) | 60 ft. (18.3 m) |
| Randolph Road Option | 16.3 ac. (6.6 ha) | 60 ft. (18.3 m) |
| Brook Road Option[a] | 99.4 ac. (40.2 ha) | 60 ft. (18.3 m) |
| **Larrabee Onshore Interconnection Cable Route Options[b]** | | |
| Larrabee North Option<br>Larrabee South Option<br>Larrabee to Asbury Connector | 187.94 ac. (76.0 ha)<br>105.89 ac. (42.73 ha)<br>66.54 ac. (59.17 ha)<br>20 ft. (6 m) width of Open Trenching | Open Trenching 11.5 ft. (3.5 m)<br>Specialty Installation 30 ft. (9 m) |
| **Atlantic Physical Effects PAPE** | **180.41 ac. (73.01 ha)** | |
| **Landfall Sites** | | |
| Asbury Landfall Site | 2.08 ac. (0.84 ha) | 16.8 ft. (5.12m) |
| Kingsley Landfall Site | 1.75 ac. (0.71 ha) | 16.8 ft. (5.12m) |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Route 66 Site | 35.47 ac. (14.36 ha) | 60 ft. (18.3 m) |
| Asbury Avenue Site | 15.66 ac. (6.34 ha) | 60 ft. (18.3 m) |
| **Atlantic Onshore Interconnection Cable Route Options[b]** | | |
| Atlantic Onshore Route | 124.5 ac. (50.38 ha)<br>20 ft. (6 m) width of Open Trenching | Open Trenching 11.5 ft. (3.5 m)<br>Specialty Installation 30 ft. (9 m) |

a. Note that since the Brook Road Site is proposed to be developed separately under the NJBPU SAA, it has been removed from the Larrabee Physical Effects PAPE and its listed acreage is not included in the maximum horizontal effects total. Although no specific actions or effects are proposed by Atlantic Shores at this location, discussion of the Brook Road Site has been retained as part of the study area in the TARA since the project may utilize future facilities on the site.

b. Trenchless portions of the PAPE, including planned HDD and/or jack and bore locations, are included as part of the Onshore Routes. The maximum vertical effect of these installations is described as "Specialty Installation" in this table.

.


**Figure 6.2-2**

*New York Physical Effects PAPE*

    - The Fresh Kills/Goethals Onshore Interconnection Cable Route is an approximately 36.40-mi. (58.58-km) collection of underground transmission route options that largely uses existing linear corridors to connect one or more landfall sites to planned onshore substation and/or converter stations and the existing Fresh Kills Substation POI. The Fresh Kills/Goethals Onshore Interconnection Cable Route consists of an approximately 20-ft. (6.0-m) wide corridor within which the underground, onshore cables will be installed within concrete duct banks. Installation of the onshore interconnection cable routes will typically be accomplished via open trenching to a depth of up to 11.5 ft. (3.5 m), which is the maximum vertical effect along most of the onshore interconnection cable route. Some specialty trenchless techniques (i.e., HDD, pipe jacking, and/or jack-and-bore) that avoid surface disturbance will be used to avoid impacts to busy roadways, wetlands, waterbodies, or existing developments or features and could result in disturbance up to 30 ft. (9 m) below ground surface.

    - Atlantic Shores has identified two potential locations for proposed substations and/or converter stations in the vicinity of the Fresh Kills/Goethals Onshore Route:
        - The Arthur Kill Road Substation and/or Converter Station Site is an approximately 208-acre (84-ha) parcel consisting of scrub brush, mixed woodlands, and the Kinder Morgan Terminal comprised of solar panels in the south and a pipeline terminal in the north and west. The eastern and southwestern portions of the site consist of mixed woodlands and secondary growth. The site is bounded to the south by paved roadways (Ellis Road and Arthur Kill Road), to the north and west by Arthur Kill, and to the east by deciduous woodlands.
        - The River Road Substation and/or Converter Station Site is an approximately 150-acre (60.8-ha) parcel consisting of scrub brush, wetlands, and mixed woodland. A roadway, Water Street, intersects through the Site and connects it to the existing Goethals Substation POI.

      Construction activities resulting in ground disturbance at the onshore substation and/or converter station locations may include land and tree clearing, grading, fencing, trenching and excavation, landscaping/planting, and installation of equipment foundations. The maximum vertical effect of these activities is anticipated to be approximately 60 ft. (18.3 m) in depth.

- The Gowanus Physical Effects PAPE (Gowanus PAPE) includes the Fort Hamilton Landfall Site, the Gowanus Onshore Interconnection Cable Route, and the Sunset Industrial Park Substation and/or Converter Station Site.
    - Atlantic Shores has identified one potential Landfall Site that may be utilized along the Fresh Kills/Goethals Onshore Route:

- The Fort Hamilton Landfall Site is located in Brooklyn on approximately 12.2 acres (4.92 ha). The site is located on baseball fields associated with Ben Vitale Ballfields. Recent aerial photography depicts the western and northeastern portion of the landfall site as paved parking lots associated with the baseball fields. The site is bounded to the south by the Belt Parkway, to the west by roadways (John Wayne Avenue and Sterling Dr) and a hospital parking lot, and to the north and east by baseball fields. Modern structures associated with the baseball fields are in the northern and western portions of the landfall site.

Maximum vertical depth of disturbance for all Landfall Site is anticipated to be 16.8 ft. (5.12 m) at the landfall location from the installation of onshore transition vaults, within which the offshore export cable will be split into onshore cables.

- The Gowanus Onshore Interconnection Cable Route (Gowanus Onshore Route) is an approximately 14.76-mi. (23.75-km) collection of underground transmission route options that largely uses existing linear infrastructure corridors to connect the Fort Hamilton Landfall Site to a proposed onshore substation and/or converter station and the existing Gowanus Substation POI (Figure 1-7). The Gowanus Onshore Interconnection Cable Route consists of an approximately 20-ft. (6-meter) wide corridor within which the underground, onshore cables will be installed within concrete duct banks. Installation of the onshore interconnection cable routes will typically be accomplished via open trenching to a depth of up to 11.5 ft. (3.5 m), which is the maximum vertical effect along most of the onshore interconnection cable route. Some specialty trenchless techniques (i.e., HDD, pipe jacking, and/or jack-and-bore) that avoid surface disturbance will be used to avoid impacts to busy roadways, wetlands, waterbodies, or existing developments or features and could result in disturbance up to 30 ft. (9 m) below ground surface.
- The Sunset Industrial Park Substation and/or Converter Station Site is an approximately 15.25-acre (6.17-ha) parcel currently occupied by paved lots and multiple businesses. The site is bounded to the west and south by the Gowanus Canal/ New York Bay, to the north by 19th Street, and to the east by 3rd Avenue. Preliminary design anticipates using only the south-central portion of the site (approximately 6.50 acres [2.63 ha]). Construction activities resulting in ground disturbance at the onshore substation and/or converter station locations may include land and tree clearing, grading, fencing, trenching and excavation, landscaping/planting, and installation of equipment foundations. The maximum vertical effect of these activities is anticipated to be approximately 60 ft. (18.3 m) in depth.

## Table 6.2-2. Summary of NY Physical Effects PAPE

| Project Component | Maximum Horizontal Effect | Maximum Vertical Effect |
|---|---|---|
| **Fresh Kills/Goethals Physical Effects PAPE** | **606.33 ac. (245.37 ha)** | |
| **Landfall Sites** | | |
| Lemon Creek Landfall Site | 0.76 ac. (0.31 ha) | 16.8 ft. (5.12 m) |
| Wolfe's Pond Landfall Site | 2.74 ac. (1.11 ha) | 16.8 ft. (5.12 m) |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Arthur Kill Road Substation and/or Converter Station Site | 174.29 ac. (70.53 ha) | 60 ft. (18.3 m) |
| River Road Substation and/or Converter Station Site | 150.16 ac. (60.77 ha) | 60 ft. (18.3 m) |
| **Fresh Kills/Goethals Onshore Interconnection Cable Route Options[a]** | | |
| Fresh Kills/ Goethals Onshore Route | 276.6 ac. (112.0 ha)<br>20 ft. (6 m) width of Open Trenching | Open Trenching 11.5 ft. (3.5 m)<br>Specialty Installation 30 ft. (9 m) |
| **Gowanus Physical Effects PAPE** | **144.93 ac. (59.65 ha)** | |
| **Landfall Sites** | | |
| Fort Hamilton Landfall Site | 10.89 ac. (4.41 ha) | 16.8 ft. (5.12 m) |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Sunset Industrial Park Substation and/or Converter Station Site | 6.50 ac. (2.63 ha) | 60 ft. (18.3 m) |
| **Gowanus Onshore Interconnection Cable Route Options[a]** | | |
| Gowanus Onshore Route | 126.28 ac. (51.10 ha)<br>20 ft. (6 m) width of Open Trenching | Open Trenching 11.5 ft. (3.5 m)<br>Specialty Installation 30 ft. (9 m) |

c. Trenchless portions of the PAPE, including planned HDD and/or jack and bore locations, are included as part of the Onshore Routes. The maximum vertical effect of these installations is described as "Specialty Installation" in this table.

As mentioned a, the final Area of Potential Effects (APE) will be formally determined by BOEM in consultation with the NJHPO and the NYSHPO as part of the Section 106 consultation process. The process for identifying and evaluating effects on terrestrial archaeological resources resulting from the construction and operation of the Project will involve consultation with BOEM, the NJHPO, the NYSHPO, participating Native American Tribes, and other consulting parties with a demonstrated interest in the historic properties (e.g., historic preservation organizations).

Pedestrian reconnaissance survey to document and photograph existing conditions within and adjacent to the Project's PAPE were conducted during field visits between September 2020 and August 2022.

To inventory and characterize previously identified archaeological resources and evaluate the potential for unidentified terrestrial archaeological resources to be present within the PAPEs, the following research was conducted:

- Archaeological reconnaissance of Facility Sites to assess and document existing conditions
- Local and regional histories review
- A review of the NJHPO's Look Up Cultural Resources Yourself (LUCY) website, the NYSHPO's Cultural Resource Information System (CRIS) website, and the New York City Landmarks Preservation Commission (NYCLPC) on-line GIS mapping service, as applicable
- Review of archaeological site forms within a 0.5-mi. (0.8-km) buffer of the PAPE
- Review of previous cultural resources surveys encompassing or intersecting portions of the PAPE
- Historical map review
- Topographic survey
- Lidar and hillshade analysis
- Mapping of buried utilities
- Review of as-built road drawings
- Present and past aerial photography review
- Soils assessment, including soil boring data.

The following primary and secondary sources were reviewed to assess the potential for previously unidentified cultural resources within the PAPEs. Additional information regarding these sources is provided in Appendices II-P1 and II-P2:

- NJHPO online cultural resources database (LUCY)
- NYSHPO online cultural resources database (CRIS)
- New Jersey State Museum archaeological site files
- Library of Congress digital collections
- New York Public Library digital collections
- Historic American Building Survey / Historic American Engineering Record digital collections
- Howell Heritage and Historical Society (2020)
- New Jersey Historical Society digital collections

- Monmouth County Historical Association online resources
- Staten Island Historical Society digital collections
- David Rumsey Map Collection database
- NRHP nominations as provided by the NPS
- New Jersey State Library Genealogy and Local History collection
- New Jersey State Archives online catalog
- JSTOR online journal database.

In addition, local and regional histories, historical mapping, community management documents, and archaeological resources were consulted, including the following:

- *Geography and History of New Jersey* by Meredith and Hood (1921)
- *History of Monmouth County, New Jersey* by Ellis (1885)
- *History of Monmouth and Ocean Counties* by Salter (1890)
- *Outline history of New Jersey* by Morrison (1950)
- Monmouth County Master Plan (2016)
- Borough of Sea Girt Master Plan Reexamination Report (2018)
- Wall Township Master Plan (1999)
- Howell Township Master Plan (1994)
- *Gazetteer of the State of New York: Embracing A Comprehensive View of the Geography, Geology, and General History of the State, and A Complete History and Description of Every County, City, Town, Village, and Locality* by French (1860)
- *Civil, Political, Professional and Ecclesiastical History, and Commercial and Industrial Record of the County of Kings and the City of Brooklyn, N.Y.* by Stiles (1884)
- *History of Richmond County (Staten Island), New York from its discovery to the Present Time* by Bayles (1887)
- *A Synoptical History of the Towns of Kings County from 1525 to Modern Times* by Custer (1911)
- *Handbook of North American Indians*, Vol. 15: Northeast (Trigger, 1978)
- *The Encyclopedia of New York State* by Eisenstadt (2005)

- Multiple sources of historic cartography and aerial imagery (Beers, 1873, 1874; Bien, 1891; Burr, 1829; Butler, 1853; Gordon, 1828; Historic Aerials, 2022; Hopkins, 1860; Howell, 1878; Lott, 1804; Sanborn Fire Insurance Maps, 1886–1943, USGS, 1890-1967; Wolverton, 1889)
- Multiple archaeological publications related to central New Jersey and New York (Braun, 1974; Chesler, 1982, 1984; Chesler and Richardson, 1980; Engelhart et. al., 2011; Funk, 1976; NPS, 2018; Pagoulatos, 2003, 2004; Rieth and Hart, 2011; Scheldenrein, 1995; Schrabisch, 1915, 1917; Smith, 1950; Trigger, 1978; Tuck, 1978).

Both TARAs were prepared by and/or under the supervision of archaeologists with professional qualifications that meet the Secretary of Interior's Guidelines for Professional Qualifications in Archaeology (36 CFR Part 61). The following subsections summarize the findings from the background research, archaeological reconnaissance, and desktop assessment for the NJ and NY Physical Effects PAPEs. The detailed results are presented in Appendices II-P1 and II-P2.

### 6.2.1.1 New Jersey Physical Effects PAPE

To inventory and characterize previously identified terrestrial archaeological resources and evaluate the potential for unidentified terrestrial archaeological resources to be present within the NJ Physical Effects PAPE, Atlantic Shores conducted field reconnaissance and background research, the results of which are presented in Appendix II-P1. Note that the Monmouth Landfall Site and some of the Larrabee onshore interconnection cable route options were previously investigated in the *Phase IA Terrestrial Archaeological Resources Assessment, Atlantic Shores Offshore Wind Project – Onshore Facilities* (EDR 2021a) report prepared in support of two other offshore wind projects being developed by Atlantic Shores within BOEM Lease Area OCS-A 0499.

Relative to the potential for intact terrestrial archaeological resources to be present within the NJ Physical Effects PAPE, an assessment of both PAPEs is summarized in the following subsections:

#### 6.2.1.1.1 Larrabee PAPE Assessment Results

With respect to the archaeological potential of the Larrabee Physical Effects PAPE, the results of the assessment in Appendix II-P1 can be summarized as follows:

- Larrabee North Option
    - Prior ground disturbance was identified within the proposed Monmouth Landfall Site and Larrabee North Option. Depth to subsoil is approximately 1.0 to 2.0 ft. (0.3 to 0.6 m) for most of the Larrabee North Option. As noted previously, Atlantic Shores has elected to site the buried onshore cables within existing, previously disturbed road, bike path, and railroad ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout most of the Larrabee North Option.

- One previously recorded archaeological resource (28-Mo-283) is purportedly mapped within the Monmouth Landfall Site PAPE, although NJSM mapping has shown to be inconsistent since other forms have depicted the location of the site to be located 0.2 mi. west of the PAPE. Phase IB archaeological survey was conducted across the National Guard Training Center in 2004 and 2005 in an attempt to reconfirm the boundaries of 28-Mo-283. The site was not relocated in this survey and most of the terrain on which the Monmouth Landfall Site PAPE is sited was determined by the surveying archaeologists to be previously disturbed. Mapping from this cultural resource survey illustrates that 95 STPs were excavated within the Monmouth Landfall Site PAPE on a terrain that was determined to be almost completely disturbed. 14 STPs excavated in the PAPE only uncovered cultural material dating to the twentieth century. Archaeologists recommended no additional survey on the portion of the National Guard Training Center containing the Monmouth Landfall Site PAPE, a sentiment that was concurred by NJHPO. As such, no additional archaeological investigation is anticipated to be necessary for the Monmouth Landfall Site within the Larrabee Physical Effects PAPE.
- There are ten previously identified archaeological sites within 0.5 mi. (0.8 km) of the Larrabee Onshore Route. These sites consist of six Native American sites, three historic-period sites, and one multicomponent site. The Native American sites are generally clustered along tributaries to the Manasquan River north of the Larrabee Onshore Route near the intersection of the Felix Memorial Bikeway and Hospital Road. One historic-period site is an outbuilding associated with a now demolished structure within a golf course. The second historic period site (28-Mo-407) is located 0.2 mi. south of the Onshore Route PAPE and is comprised of eighteenth and nineteenth century artifact concentrations and features associated with the Thomas Shearman family, Joseph Mount, and/or Commodore Robert Stockton.
- Historical map and photography review demonstrates that MDS are mapped in the immediate vicinity of the proposed Larrabee North Option, with most MDS mapped along existing roadways and at intersections that were largely established by the mid-nineteenth century. MDS are concentrated in the eastern portion of the Larrabee North Option along Sea Girt Avenue.
- A portion of the proposed Larrabee North Option is collocated with the Edgar Felix Memorial Bikeway, within the former railroad corridor of the Farmingdale and Squan Railroad. A previous intensive-level architectural survey identified a segment of the Edgar Felix Memorial Bikeway as part of the former Farmingdale and Squan Railroad (RBA, 2012). The research and fieldwork for that survey concluded that the Farmingdale and Squan Railroad was ineligible for listing on the NRHP. A NJHPO opinion letter dated August 16, 2021, concurred with the results of the survey, stating "No Historic Properties Affected" within the APE for the bridge replacement (NJHPO, 2012).

- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, "Potentially Undisturbed" areas adjacent to paved roadways (within which the onshore cables are sited) where depth to culturally sterile subsoil is less than approximately 2.0 ft. (0.6 m) as well as in any wetlands or areas of steep slope.
- Targeted archaeological shovel testing is recommended within those portions of the Monmouth Landfall Site, Larrabee North Option, and potential Larrabee Onshore Substation and/or Converter Station options indicated as Medium and Medium-High sensitivity "Potential Phase IB Survey Areas" in Appendix II-P1: Figure 2-15 .
- Phase IB STP survey has been completed for several areas along the proposed Larrabee North Option (Appendix II-P1, Figure 2-16). A total of 206 STPs were excavated across 16 designated survey areas along the Larrabee North Option. No archaeological sites were identified, and no archaeological artifacts were encountered during the Phase IB survey. As such, no mitigation or avoidance measures are proposed, and no further archaeological work is recommended for the areas that were surveyed. The areas that have not yet been surveyed include: the Lanes Pond Road Site, the Randolph Road Site, and approximately 21.58 acres of the Larrabee North Option. The Phase IB survey results for these remaining areas will be presented in future a revision to the TARA (Appendix II-P1).In addition, the Project's Monitoring Plan and Post Review Discoveries Plan (MPRDP)will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering unanticipated cultural material and/or cultural features s during work in the Larrabee North Option.

- Larrabee South Option
    - Prior ground disturbance was identified within the proposed Larrabee North Option. Depth to culturally sterile subsoil is approximately 1.0 to 2.0 ft. (0.3 to 0.6 m) for most of the Larrabee South Option. As noted previously, Atlantic Shores has elected to site the buried onshore cables within existing, previously disturbed road, bike path, and railroad ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout most of the Larrabee South Option.
    - Two previously recorded archaeological resources are located within the PAPE for the Larrabee South Option. Site 28-Mo-019 is mapped as encompassing the portion of the PAPE along Main Street in Manasquan, and site 28-Mo-086 is mapped within one of the Larrabee South Option's planned HDD areas on the east bank of the Manasquan River. The current state of both sites is unknown. Although site 28-Mo-086 was determined as eligible for the NRHP, the site was reported to be in imminent danger of destruction at the time of recording in 1975-1976. Additionally, site 28-

Mo-019 is an early recorded site that lacks spatial specificity since it was not formally delineated. As such, EDR considers site 28-Mo-019 as an area of elevated sensitivity rather than a discrete site area to be avoided. The areas of the PAPE on which these sites are located are considered to have Medium-High sensitivity for the presence of Native American archaeological resources and are recommended for targeted Phase IB archaeological shovel testing.

- The five Native American sites, one historic period site, and four sites of unknown cultural affiliation previously identified in the vicinity of the Larrabee South Option are generally clustered into two areas, on coastal landforms near the Monmouth Landfall Site and on the north side of the Manasquan River near NJ Route 70. The presence of these sites indicates increased sensitivity for archaeological sites, and specifically those of Native American affiliation, to be located in the vicinity of those areas.
- Historical map review demonstrates that MDS are mapped in the vicinity of the proposed Larrabee South Option, with most mapped along existing roadways and at intersections that were largely established by the mid-nineteenth century. Of note, historical maps illustrated the existence of a bridge and other structures in the vicinity of the present-day NJ Route 70 crossing of the Manasquan River, indicating the well-established presence of this crossing.
- It is not anticipated that there is any potential for burials associated with the Greenwood Cemetery to be located beneath the paved surface of Old Bridge Road, and no remote sensing survey is recommended. Though no additional Phase IB survey is recommended, archaeological monitoring during installation of the onshore cables may be appropriate in this area. In addition, the Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering potential grave shafts or burials
- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, "Potentially Undisturbed" areas adjacent to paved roadways (within which the onshore cables are actually sited) where depth to culturally sterile subsoil is less than approximately 2.0 ft. as well as in any wetlands or areas of steep slope.
- Targeted archaeological shovel testing is recommended within those portions of the Larrabee South Option indicated as Medium and Medium-High sensitivity "Potential Phase IB Survey Areas" in Appendix II-P1: Figure 2-17.
- In addition, the Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering unanticipated cultural material and/or cultural features during work in the Larrabee South Option.

- Larrabee to Asbury Connector

- Depth to culturally sterile subsoil is approximately 1.0 to 2.0 ft. (0.3 to 0.6 m) for most of the Larrabee to Asbury Connector. As noted previously, Atlantic Shores has elected to site the buried onshore cables within existing, previously disturbed road, bike path, and railroad ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout most of the Larrabee to Asbury Connector.
- No previously recorded archaeological resources are located within the Larrabee to Asbury Connector.
- There are eight previously identified archaeological sites within 0.5 mi. (0.8 km) of the PAPE for the Larrabee to Asbury Connector. Five of the previously identified archaeological sites are located in the vicinity of the Shark River. The presence of these sites indicates increased sensitivity for Native American archaeological sites in that area, as well as in proximity to other perennial fresh water sources.
- The historical map and photography review demonstrates rapid urbanization of the area surrounding the Larrabee to Asbury Connector beginning in the mid-twentieth century.
- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, “Potentially Undisturbed” areas adjacent to paved roadways (within which the onshore cables are actually sited) where depth to culturally sterile subsoil is less than approximately 2.0 ft. as well as in any wetlands or areas of steep slope.
- Targeted archaeological shovel testing is recommended within those portions of the Larrabee to Asbury Connector indicated as Medium and Medium-High sensitivity “Potential Phase IB Survey Areas” in Appendix II-P1: Figure 2-18.
- Due to the presence of previously identified archaeological sites in the vicinity the Shark River, archaeological monitoring of the construction and installation of the onshore cables in this area is recommended. It is anticipated that the exact locations and scope of this monitoring will be determined in consultation with BOEM, NJHPO, and consulting Native American Tribes during Section 106 consultation regarding the Project.
- In addition, the Project’s MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering unanticipated cultural material and/or cultural features during work in the Larrabee to Asbury Connector.

###### 6.2.1.1.2 Atlantic PAPE Assessment Results

With respect to the archaeological potential of the Atlantic Physical Effects PAPE, the results of the assessment in Appendix II-P1 can be summarized as follows:

- Prior ground disturbance was identified within the proposed Asbury and Kingsley Landfall Sites, Atlantic Onshore Route, and portions of the Route 66 Site. Outside of historic fill, urban land, and udorthents, depth to culturally sterile subsoil is approximately 1.0 to 2.0 ft. (0.3 to 0.6 m) for most of the Atlantic Onshore Route, although some areas may contain intact eolian deposits with an increased depth to culturally sterile subsoil.

- As noted previously, Atlantic Shores has elected to site portions of the Atlantic Onshore Route within existing, previously disturbed road ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout potions of the Atlantic Onshore Interconnection Cable Route on Asbury Avenue and NJ Route 66.

- The portions of the Atlantic Onshore Route options sited within the existing utility corridor that parallels Asbury Avenue to the south contains multiple areas of limited to no discernable soil disturbance (other than tree clearing) with increased potential for encountering potentially undisturbed archaeological deposits.

- No previously recorded archaeological sites are located within the Atlantic PAPE.

- There is one previously identified archaeological site within 0.5 mi. (0.8 km) of the Atlantic PAPE. The Lippincott Hill Site (28-At-203) is a Native American site northwest of the existing Atlantic Substation POI within Naval Weapons Station Earle. This site was located within mapped Evesboro series sands on an elevated landform. This indicates a higher likelihood for Native American sites to be encountered in similar settings.

- Two archaeological surveys of the Atlantic Onshore Route within the existing high voltage utility corridor between the existing Oceanview and Atlantic Substations were conducted by the Louis Berger Group in 2014 and 2015. EDR incorporated the results of this previous subsurface testing into its desktop assessment and archaeological sensitivity analysis, classifying the shovel tested areas as "Previously Surveyed" and "Excluded from field survey consideration."

- Historical map review demonstrates that MDS are mapped in the vicinity of the proposed Atlantic Onshore Route along Asbury Avenue, from Ocean Grove to Asbury Park, and at intersections that were established by the mid-twentieth century. The Asbury Park Landfall sites and Asbury Avenue portions of the Atlantic Onshore Route are sited on routes that were established in the late-nineteenth century.

- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, "Potentially Undisturbed" areas adjacent to paved roadways (within which the onshore cables are sited) where depth to culturally sterile subsoil is less than approximately 2.0 feet as well as in any wetlands or areas of steep slope.

- The Atlantic Onshore Route runs adjacent to the Mount Calvary Cemetery south of Asbury Avenue/ NJ Route 66 and east of NJ Route 18. The proposed Asbury Onshore Route will not impact the Mount Calvary Cemetery, as it is located outside of the PAPE, In addition, it is not anticipated that there is any potential for burials associated with the Mount Calvary Cemetery to be located within the PAPE because the earliest aerial photography of the cemetery depicts the closest burial markers approximately 300 ft. (91.44 m) south of Asbury Avenue, with burials encroaching closer to the road only in the mid to late 1900s after Asbury Avenue was already established. As such, no remote sensing survey is recommended.

- No additional archaeological investigation is recommended for the proposed Asbury and Kingsley Landfall Sites. Additional archaeological testing is recommended within portions of the Atlantic Onshore Route, Route 66 Site, and Asbury Avenue Site, indicated as Medium and Medium-High sensitivity "Potential Phase IB Survey Areas" in Appendix II-P1: Figures 3-6 and 3-13.

#### 6.2.1.2 New York Physical Effects PAPE

To inventory and characterize previously identified terrestrial archaeological resources and evaluate the potential for unidentified terrestrial archaeological resources to be present within the NY Physical Effects PAPE, Atlantic Shores conducted field reconnaissance and background research, the results of which are presented in Appendix II-P2.

Relative to the potential for intact terrestrial archaeological resources to be present within the NY Physical Effects PAPE, a preliminary assessment is summarized in the following subsections:

##### 6.2.1.2.1 Fresh Kills/Goethals Assessment Results

With respect to the archaeological potential of the Fresh Kills/Goethals Physical Effects PAPE in Staten Island West, the results of the assessment in Appendix II-P2 can be summarized as follows:

- Prior ground disturbance was identified within all proposed or potential components of the Fresh Kill/Goethals Physical Effects PAPE, which includes the proposed Lemon Creek, and Wolfe's Island Landfall Sites, Fresh Kills/Goethals Onshore Route, and the Arthur Kill Road and River Road Substation and/or Converter Station Sites. In addition to mapped soil units characterized as "Urban Land," other anthropogenic soil units such as Verrazano, Marinepark, and Greenbelt soils are prevalent throughout the PAPE. Outside of the areas of mapped historic fill, urban land, and other anthropogenic soils, depth to culturally sterile subsoil throughout the Fresh Kills/Goethals PAPE is highly variable. Areas of Hasbrouck and Haledon soils have a depth to subsoil of approximately 0.5 to 1.0 ft. (0.15 to 0.30 m), while areas of Boonton soils have a depth to subsoil of approximately 2.0 ft. (0.6 m) and Windsor soils may contain intact eolian deposits with an increased depth to culturally sterile subsoil.

- As noted previously, Atlantic Shores has elected to site the buried onshore cables within existing, previously disturbed road ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout most of the Fresh Kills/Goethals PAPE.

- Two previously recorded archaeological sites (USN 08501.002615 and NYSM site 743) and 24 NYS Museum areas are mapped within or intersecting with the Fresh Kill/Goethals PAPE. USN 08501.002615 (V-57 Centerboard Schooner Site) and NYSM 743 are located within the PAPE for the Arthur Kill Road Substation and/or Converter Station. Information about these sites and areas is scarce. Although USN 08501.002615 was categorized as eligible for the S/NRHP, the site form was missing from the CRIS database. It is assumed by the name that the site is a potential historic shipwreck that was inaccurately mapped on land). NYSM site 743 and the 24 NYSM areas are Native American sites described variously as camps, traces of occupation, village, and middens. One NYSM Area (4600) is reported to contain burials. Note that NYS Museum Areas typically indicate areas of elevated archaeological sensitivity since the sites lack spatial specificity and were never formally delineated. As such, EDR considered all NYSM Areas as locations of elevated sensitivity rather than discrete sites to be avoided. In addition, the majority of the PAPE is within an NYSHPO determined Archaeological Sensitive Area. Due to the level of urban development in the Fresh Kills/Goethals PAPE and the lack of information on these previously recorded archaeological sites, targeted Phase IB archaeological shovel testing is only recommended for "Potentially Undisturbed" portions of the PAPE that overlap these NYSM areas, where depth to culturally sterile subsoil is greater than approximately 2.0 ft. (0.6 m).

- One archaeological district (Sandy Ground Historic Archaeological District) is immediately adjacent to the PAPE, and an additional 147 previously recorded archaeological sites, 20 NYS Museum Sites, and 47 NYS Museum areas are within 0.5 mi. (0.8 km) of the Fresh Kills/Goethals PAPE. Of the sites with USN identifiers, there are 106 historic-period sites, six multicomponent sites, 35 Native American sites, and one site with no information. The historic-period sites include historic mansions and houses, historic settlements, and vessel sites along the shoreline. The Native American sites are primarily lithic scatters and shell middens, with one site (USN 08501.003358) reported to have pottery and hearth features. Of the NYSM sites and areas, one site (NYSM 747 – Sandy Ground) dates to the historic period as one of the oldest free black communities in New York. Eight NYSM sites/areas have no information available. The remaining NYSM sites and areas are Native American sites described variously as camps, hamlets, villages, workshops, middens, and traces of occupation. Five Native American sites are reported to have burials. In total, 47 of these sites are listed in the State/National Register of Historic Places (S/NRHP), 16 are eligible for listing in the S/NRHP, 46are not eligible, and the remaining 107 are undetermined. The number of archaeological resources within the vicinity indicates generally elevated archaeological sensitivity of the area (and coastal Staten Island in general). Due to the level of urban development in the Fresh Kills/Goethals PAPE, targeted Phase IB archaeological shovel testing is recommended in "Potentially Undisturbed" portions of the PAPE located within 1,000 ft. of previously recorded archeological resources, where depth to culturally sterile subsoil is greater than approximately 2.0 ft. (0.6 m).

- Historical map review demonstrates that much of the Fresh Kills/Goethals PAPE remained relatively undeveloped until the late nineteenth and early twentieth century, when various areas of the PAPE were developed for roads, railroads, and various structures that resulted in multiple periods of extensive earthmoving and grading throughout the PAPE. MDS are mapped around the Lemon Creek Landfall Site and much of the Fresh Kills/Goethals onshore route, concentrated in the southern and western portions of the route along Arthur Kill Road, Hyland Boulevard, Huguenot Avenue, and Richmond Avenue.

- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, "Potentially Undisturbed" areas adjacent to paved roadways (within which the onshore cables are sited) where depth to culturally sterile subsoil is less than approximately 2.0 feet as well as in any wetlands or areas of steep slope.

- One reported former cemetery is located near the Wolfe's Pond Landfall Site, five cemeteries are located adjacent to the Fresh Kills/Goethals Onshore Route, and one cemetery is located near the Arthur Kill Road Substation and/or Converter Station Site. These cemeteries are all located outside of the PAPE and no ground disturbance will occur within the cemeteries during construction associated with the proposed project components. The Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering potential grave shafts or burials

- Additional archaeological testing and/or archaeological monitoring is recommended within portions of all proposed or potential components of the Fresh Kill/Goethals Physical Effects PAPE, indicated as Medium and Medium-High sensitivity "Potential Phase IB Survey Areas" in Appendix II-P2: Attachment C. The Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering unanticipated cultural material and/or cultural features during work in the Fresh Kills/Goethals PAPE.

##### 6.2.1.2.2 Gowanus Assessment Results

With respect to the archaeological potential of the Gowanus Physical Effects PAPE in Staten Island East and Brooklyn, the results of the assessment in Appendix II-P2 can be summarized as follows:

- Prior ground disturbance was identified within the proposed Gowanus Onshore Route, Sunset Industrial Park Substation and/or Converter Station Site, and Fort Hamilton Landfall Site. The majority of the PAPE consists of mapped soil units characterized as "Urban Land" and other anthropogenic soil units such as Verrazano, Marinepark, Greenbelt, Laguardia, Fortress Sand, and Flatbush soils. Outside of the areas of mapped historic fill, urban land, and other anthropogenic soils, depth to culturally sterile subsoil throughout the Fresh Kills/Goethals PAPE is highly variable, ranging from approximately 0.5 to 2.0 feet (0.15 to 0.60 meters).

- As noted previously, Atlantic Shores has elected to site the buried onshore cables within existing, previously disturbed road, bike path, and railroad ROWs, where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits throughout most of the Gowanus PAPE.

- Two previously recorded NYSM Areas intersect with the Gowanus PAPE. Information about these areas is scarce but both are Native American sites described variously as camps, middens, and a cache. In addition, portions of the Gowanus Onshore Route are located within a NYSHPO Archaeological Sensitive Area. Note that NYSM Areas typically indicate areas of elevated archaeological sensitivity since the sites lack spatial specificity and were never formally delineated. As such, EDR considered all NYSM Areas as locations of elevated sensitivity rather than discrete sites to be avoided. Due to the level of urban development in the Gowanus PAPE, targeted Phase IB archaeological shovel testing is only recommended for "Potentially Undisturbed" portions of the PAPE that overlap these NYSM areas, where depth to culturally sterile subsoil is greater than approximately 2.0 ft. (0.6 m).

- An additional four previously recorded archaeological sites are within 0.5 mi. (0.8 km) of the Gowanus PAPE. All four sites are Euro-American in cultural affiliation, with dates ranging from the early eighteenth century to the early twentieth century. One site (Barkeloo Family Cemetery site; USN 04701.018702) wwas determined eligible for listing on the NRHP while the remaining three sites are undetermined. No ground disturbance from construction associated with the Gowanus Onshore Route will occur within the Barkeloo Family Cemetery Site. Areas of the Gowanus PAPE located within 1,000 ft. of the remaining three sites are considered to have Medium-High sensitivity for the presence of archaeological resources and are recommended for targeted Phase IB archaeological shovel testing (Attachment D, Sheets 1-3).

- Historical map review demonstrates that areas of the Gowanus PAPE, specifically along the Onshore Route and Sunset Industrial Park Substation and/or Converter Station Site, were among some of the first areas in Brooklyn to be settled by the mid-nineteenth century. These areas continued to be heavily developed for the next 100 years. MDS along the Onshore Route are largely concentrated along coastal regions and roads. The Fort Hamilton Landfall Site remained undeveloped until the early to mid-twentieth century, when it was developed for. Road and structure construction throughout the PAPE resulted in multiple periods of extensive earthmoving and grading.

- Pedestrian survey (with the possibility of judgmental shovel testing) is recommended in any Low sensitivity, "Potentially Undisturbed" areas adjacent to paved roadways (within which the onshore cables are sited) where depth to culturally sterile subsoil is less than approximately 2.0 feet as well as in any wetlands or areas of steep slope.

- Two reported cemeteries are located near the Gowanus Onshore Route. These cemeteries are all located outside of the PAPE and no ground disturbance will occur within the cemeteries during construction associated with the proposed project components. The Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering potential grave shafts or burials.

- Additional archaeological testing and/or archaeological monitoring is recommended within portions of the proposed, Fort Hamilton Landfall Site, Site, Sunset Industrial Park Substation and/or Converter Station Site, and Gowanus Onshore Route indicated as Medium and Medium-High sensitivity "Potential Phase IB Survey Areas" in Appendix II-P2: Attachment D. The Project's MPRDP will be in effect for all construction and installation activities, providing guidance and instructions to all contractors on how to proceed in the event (however unlikely) of encountering unanticipated cultural material and/or cultural features during work in the Gowanus PAPE.

### 6.2.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPF which may affect terrestrial archaeological resources during the construction/installation or decommissioning of the onshore interconnection facilities are presented in Table 6.2-3.

**Table 6.2-3. Impact Producing Factors for Terrestrial Archaeological Resources**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Land Disturbance | • | | |

The PAPE for Physical Effects to terrestrial archaeological resources includes all potential onshore facilities within the Onshore Project Area and is the depth and breadth of terrestrial areas that may be potentially impacted by any ground-disturbing activities. The only significant IPF on terrestrial archaeological resources from construction and installation of the proposed onshore facilities is land disturbance associated with site clearing, grading, excavation, and filling during the construction and installation phase of the proposed landfall sites, onshore interconnection cable route options, potential substation and/or converter station sites, and temporary construction staging areas (TBD). Routine O&M and/or decommissioning activities for the proposed onshore facilities are not expected to result in additional land disturbances or other IPFs to terrestrial archaeological resources, as they are anticipated to occur within the same areas as construction and installation activities.

#### 6.2.2.1 Land Disturbance

Ground disturbing activities associated with construction activities (e.g., site clearing, grading, excavation, and filling) have the potential to affect archeological resources. However, as detailed in Section 6.2.1, Atlantic Shores has proposed Onshore Facilities be primarily located within previously disturbed lots, paved roadways, railroads ROWs, and bike paths where disturbance during construction and installation of the existing infrastructure likely exceeded the depth of potential archaeological deposits. This siting strategy avoids or significantly reduces potential impacts to adjacent undisturbed soils and avoids or minimizes the risk of potentially encountering undisturbed archaeological deposits. Therefore, there is very little likelihood for intact or potentially significant archaeological resources to be located within those portions of the PAPE categorized as "Disturbed" in the *Archaeological Reconnaissance and Desktop Assessment Results* (Figures 2-8, 2-15 ,2-17, 2-18, 3-6, and 3-13 Appendix

II-P1 and Attachments C and D of Appendix II-P2), and no further investigation is anticipated to be necessary in those areas.

Although every effort has been made to site Project facilities in areas that have been previously disturbed and away from known archaeological resources, unanticipated discoveries during construction could occur. Atlantic Shores has prepared a MPRDP in accordance with State and Federal laws for agency review and approval prior to construction. The plan provides specific contacts and a reporting protocol in the unlikely event that archaeological materials or human remains are discovered during construction.

#### 6.2.2.2 Summary of Proposed Environmental Protection Measures

As detailed in Appendices II-P1 and II-P2, the results of the TARAs did not identify any known terrestrial archaeological resources within the PAPE for Physical Effects. The Project is not anticipated to result in any impacts to terrestrial archaeological resources, outside of possible impacts to the relevant NRHP eligible Historic Districts.

Additional archaeological testing may be appropriate within “Potential Phase IB Survey Areas” where the proposed Onshore Facilities are sited within those portions of the PAPE categorized as “Potentially Undisturbed” (Appendix II-P1: Figures 2-8, 2-15, 2-17, 2-18, 3-6 and 3-13; Appendix II-P2: Attachments C and D). A summary of the identified “Potential Phase IB Survey Areas” for each proposed Onshore Facility Site is included in Table 6.2-4 and Table 6.2-5.

**Table 6.2-4. Summary of Identified “Potential Phase IB Survey Areas” within the NJ Physical Effects PAPE for Proposed Onshore Facility Sites**

| Onshore Facility Site | Recommended Additional Measures to Identify Archaeological Resources | Appendix II-P1 Figure Mapping |
|---|---|---|
| **Larrabee Physical Effects PAPE 409.57 ac.** | **Combined Phase IB STP Survey 74.46 ac. (18.18%)** | **Figures 2-15 2-17, and 2-18** |
| **Landfall Site/s** | | |
| Monmouth Landfall Site 8.32 ac. | No further investigation | N/A |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Lanes Pond Road Site 16.27 ac. | Targeted Phase IB STP Survey 10.87 ac. (66.81%) | Sheet: 43 |
| Randolph Road Site 24.64 ac. | Targeted Phase IB STP Survey 10.66 ac. (43.2%) | Sheet: 44 |
| **Larrabee Onshore Interconnection Cable Route Options** | | |
| Larrabee North Option 187.94 ac. | Targeted Phase IB STP Survey 26.35 ac. (14.1%) | Figure 2-15, Sheets: 1, 4 ,5-12, 15-19, 22, 25-32, 36-38, 40-44 |

| Onshore Facility Site | Recommended Additional Measures to Identify Archaeological Resources | Appendix II-P1 Figure Mapping |
|---|---|---|
| Larrabee South Option<br>105.9 ac. | Targeted Phase IB STP Survey<br>25.53 ac. (24.1%) | Figure 2-17, Sheets: 4, 7-9, 11, 13-25 |
| Larrabee to Asbury Connector<br>66.5 ac. | Targeted Phase IB STP Survey<br>1.05 ac. (1.53%) | Figure 2-18, Sheets: 6-7, 9-10, 14, 20 |
| **Atlantic Physical Effects PAPE<br>180.41 ac** | **Combined Phase IB STP Survey<br>47.23 ac (26.18%)** | **Figure 3-13** |
| **Landfall Site/s** | | |
| Asbury Landfall Site<br>2.09 ac. | No further investigation | N/A |
| Kingsley Landfall Site<br>1.75 ac. | No further investigation | N/A |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Route 66 Site<br>35.12 ac. | Partial Phase IB STP Survey<br>10.65 ac. (30.32%) | Sheet: 18 |
| Asbury Avenue Site<br>15.67 ac. | Partial Phase IB STP Survey<br>8.77 ac. (55.97%) | Sheet: 20 |
| **AtlanticOnshore Interconnection Cable Route Options** | | |
| Atlantic Onshore Route<br>124.96 ac. | Targeted Phase IB STP Survey<br>27.81 ac. (22.26 %) | Sheets: 5-25, 27-28 |

## Table 6.2-5. Summary of Identified "Potential Phase IB Survey Areas" within the NY Physical Effects PAPE for Proposed Onshore Facility Sites

| Onshore Facility Site | Recommended Additional Measures to Identify Archaeological Resources | Appendix II-P2 Attachment Mapping |
|---|---|---|
| **Fresh Kills/Goethals Physical Effects PAPE<br>606.33 ac.** | **Combined Phase IB STP Survey<br>108.03 ac. (17.82%)** | **Attachment C** |
| **Landfall Sites** | | |
| Lemon Creek Landfall Site<br>0.76 ac. | Targeted Phase IB STP Survey<br>0.09-ac. (11.84%)<br>Archaeological Monitoring | Sheet: 8 |
| Wolfe's Pond Landfall Site<br>2.74 ac. | Targeted Phase IB STP Survey<br>0.49 ac. (17.88%)<br>Archaeological Monitoring | Sheet: 6 |
| **Onshore Substation and/or Converter Station Site/s** | | |

| Onshore Facility Site | Recommended Additional Measures to Identify Archaeological Resources | Appendix II-P2 Attachment Mapping |
|---|---|---|
| Arthur Kill Road Substation and/or Converter Station Site<br>174.29 ac. | Targeted Phase IB STP Survey<br>39.03 ac. (22.40%)<br>Archaeological Monitoring | Sheets: 35-36 |
| River Road Substation and/or Converter Station Site<br>150.16 ac. | Targeted Phase IB STP Survey<br>64.18 ac. (42.74%)<br>Archaeological Monitoring | Sheets: 75-76 |
| **Fresh Kills/Goethals Onshore Interconnection Cable Route Options** | | |
| Fresh Kills/Goethals Onshore Route<br>196.80 ac. | Targeted Phase IB STP Survey<br>16.80 ac. (6.07%)<br>Archaeological Monitoring | Sheets: 1-74 |
| **Gowanus Physical Effects PAPE**<br>**144.93 ac.** | **Combined Phase IB STP Survey**<br>**96.00 ac. (4.14%)[1]** | **Attachment D** |
| **Landfall Sites** | | |
| Fort Hamilton Landfall Site<br>10.89 ac. | Targeted Phase IB STP Survey<br>3.45 ac. (31.68 %)<br>Archaeological Monitoring | Sheet: 1 |
| **Onshore Substation and/or Converter Station Site/s** | | |
| Sunset Industrial Park Substation and/or Converter Station Site<br>6.50 ac. | Archaeological Monitoring | Sheet: 27 |
| **Gowanus Onshore Interconnection Cable Route Options** | | |
| Gowanus Onshore Route<br>126.28 ac. | Targeted Phase IB STP Survey<br>2.54 ac. (2.01%)<br>Archaeological Monitoring | Sheets: 1-27 |

If additional archaeological testing of the PAPE is deemed appropriate by BOEM, Atlantic Shores anticipates that the Phase IB survey results pertaining to identification of historic properties within the NJ and NY Physical Effects PAPEs will not be available until after the Draft Environmental Impact Statement (DEIS). Atlantic Shores will update Appendices II-P1 and II-P2 following completion of any required Phase IB archaeological field investigations (begun Summer 2013 and continuing through 2024). Atlantic Shores anticipates BOEM will establish commitments for reviewing the sufficiency of these report updates as phased identification and evaluation of historic properties (either through stipulations within a Memorandum of Agreement or through conditions on the Record of Decision). This approach would be in accordance with BOEM's existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585*, and ensure potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction (BOEM, 2020).

Any route options or substation and/or converter locations removed from Project consideration prior to conducting any potential Phase IB archaeological field survey for the Project will result in the omission of any corresponding Potential Phase IB Survey Areas from the field effort. Additional Potential Phase IB Survey Areas may be added within portions of the PAPE categorized as "Potentially Undisturbed" if Project updates or alterations call for the use of roadside ROW or additional areas outside of the current siting.

Atlantic Shores has committed to the following environmental protection measures to reduce the risk of potential impacts on terrestrial archaeological resources. These measures are based on protocols and procedures successfully implemented for similar offshore wind projects and their respective onshore facilities:

- Onshore Facilities have been primarily sited within previously disturbed and developed areas (e.g., roadways, ROWs, previously developed industrial/commercial areas) to the maximum extent practicable, to avoid or minimize impacts to previously unrecorded archaeological resources.

- Additional archaeological testing may be appropriate where the proposed Onshore Facilities are sited within those portions of the PAPE categorized as "Potentially Undisturbed." Potential Phase IB techniques and methodologies are outlined in Appendices II-P1 and II-P2, and any Phase IB workplans will be developed in consultation with the NJHPO and the NYSHPO. The results of any Phase IB investigations will inform decisions regarding any necessary avoidance or mitigation in those areas.

- Onshore Facilities have been sited in areas where there are no previously identified archaeological resources, thereby avoiding and minimizing impacts to known terrestrial archeological resources.

- Continued consultation with the NJHPO, the NYSHPO, and participating Native American Tribes will be conducted to determine if additional (i.e., Phase IB) archaeological investigations will be required for any areas within the PAPE for Physical Effects to terrestrial archaeological resources which may be identified as previously undisturbed in the results of the TARAs; and

- A Monitoring Plan and Post Review Discoveries Plan will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during construction.

If after adoption of these measures BOEM determines an adverse effect/s on any terrestrial archaeological resources, Atlantic Shores anticipates continuing consultation with BOEM, the NJDEP, the NJHPO, the NYSHPO, and participating Native American Tribes, as well as regional and local historical societies, municipal historians, and private landowners of terrestrial archaeological resources, to explore and discuss additional appropriate potential avoidance, minimization, or mitigation measures.

## 6.3 Marine Archaeological Resources

This section describes marine archaeological resources in the Offshore Project Area, the affected environment and associated impact producing factors (IPF), a description of the potential offshore facilities, and environmental protection measures to avoid, minimize, or mitigate potential effects to these resources.

Marine archaeological resources are defined as any submerged historic properties including archaeological sites, objects, districts, or structures (including shipwrecks) that are listed in or eligible for listing in the NRHP have been designated as NHLs. These may also include Ancient Submerged Landforms (ASLFs), which represent coastal habitats that may have been available to people living in the region before marine transgression.

In addition to the federal regulations outlined in Section 6.0, the evaluation of IPFs for submerged historic properties described in this section will support BOEM review of the Project as required by Section 7:4 of the New Jersey Administrative Code, and the State of New Jersey Executive Order #215 and the NJHPO's *Guidelines* (NJHPO 2008). In New York State waters, marine archaeological resources will be evaluated according to the NYAC *Standards* (NYAC 1994).

The evaluation of the Project's potential effects on marine archaeological resources is described in the Marine Archaeological Resources Assessment (MARA), which is included as Appendix II-Q of the Project's COP. The purpose of the MARA is to identify potential submerged cultural resources, which could represent historic properties, within the Lease Area and associated ECCs. The following subsections include a description of the affected environment (Section 6.3.1) as well as a summary of the MARA results.

### 6.3.1 Affected Environment

The affected environment will consist of the Project's Marine Physical Effects PAPE, which includes the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities in the Offshore Project Area. The Marine Physical Effects PAPE encompasses the 81,200 acres (328.6 $km^2$) Lease Area, the 25,600 acres (103.6 $km^2$) Monmouth ECC, the 36,480 acres (147.6 $km^2$) Northern ECC (which includes the Asbury ECC and branches to New York landfall sites), and trenchless interconnection cable routes (Figure 6.3-1).

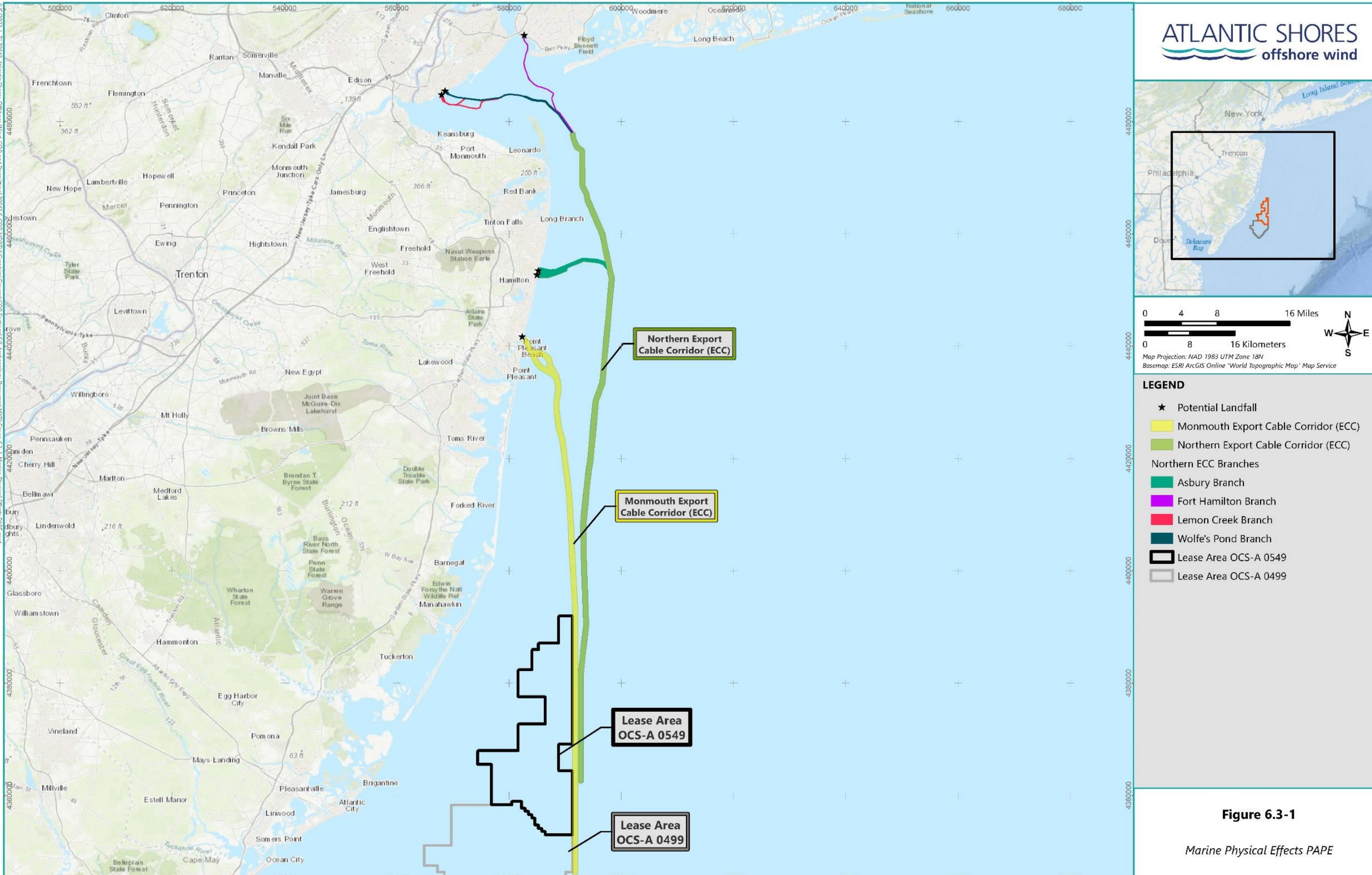



**Figure 6.3-1**

*Marine Physical Effects PAPE*

Construction activities are expected to affect a small percentage of the seabed encompassed by the Marine Physical Effects PAPE, which represents the maximum disturbance associated with the Project Design Envelope (PDE) for the following specific components and installation activities:

- WTG foundations: The PDE for WTG foundations includes piled, suction bucket, and gravity foundations, as described in Section 4.2 of COP Volume I.
- OSS foundations: The PDE for OSS foundations includes piled, suction bucket, and gravity foundations, as described in Section 4.4 of COP Volume I.
- Offshore cable system: The PDE includes inter array cables, inter-link cables, export cables, and in-water interconnection cables, as described in Section 4.5 of COP Volume I.
- Meteorological (met) towers and buoys: The PDE includes piled, suction bucket, and gravity foundations for the met tower and a steel chain weight anchor for the Met buoys, as described in Section 4.6 of COP Volume I.
- Vessel anchoring and jack-up vessels: As described in Section 4.10 of COP Volume I, vessel anchoring and jack-up vessels are minimally intrusive to the seabed and the depth of disturbance for these activities range from 3.3 to 16.4 ft (1 to 5 m). These activities are anticipated to occur within the rows and corridors defined for installation of the WTGs and offshore cables, as described in Sections 4.2 and 4.5 of COP Volume I, respectively.

The Marine Physical Effects PAPE includes all areas where these activities could occur. The components of the Project that have the potential to cause permanent or temporary disturbance to the seabed are described and tabulated in Section 4.0 of Volume I of the COP and summarized in Table 6.3-1.

### Table 6.3-1. Summary Seabed Disturbance within the Marine Physical Effects PAPE

| Installation Activity by Component | Max Area of Seafloor Disturbance | | | Maximum Depth of Potential Seafloor Disturbance |
|---|---|---|---|---|
| | Permanent Disturbance | Additional Temporary Disturbance | Total[a] | |
| **Lease Area OCS-A 0549** | | | | |
| **Wind Turbines (WTG)** | | | | |
| WTG Foundation Installation (Including Scour Protection) | 0.63 $mi^2$ (1.63 $km^2$) | 0.43 $mi^2$ (1.11 $km^2$) | 1.06 $mi^2$ (2.75 $km^2$) | 262.5 ft (80.0 m) for monopile foundations without scour protection (see Table 4.2-1 in COP Volume 1). |
| WTG Installation and Commissioning | N/A (Included in WTG foundation footprint) | 0.09 $mi^2$ (0.23 $km^2$) | 0.09 $mi^2$ (0.23 $km^2$) | Depth of disturbance for jack up vessels and anchoring range from 3.3 to 16.4 ft (1 to 5 m). |
| **Offshore Substation (OSS)** | | | | |

| Installation Activity by Component | Max Area of Seafloor Disturbance | | | Maximum Depth of Potential Seafloor Disturbance |
|---|---|---|---|---|
| | Permanent Disturbance | Additional Temporary Disturbance | Total[a] | |
| OSS Foundation Installation (Including Scour Protection) | 0.03 $mi^2$ (0.08 $km^2$) | 0.04 $mi^2$ (0.10 $km^2$) | 0.06 $mi^2$ (0.16 $km^2$) | 262.5 ft (80.0 m) for monopile foundations without scour protection (see Table 4.2-2 in COP Volume 1). |
| **Inter-Array Cable Corridors (IACCs)** | | | | |
| Inter-Array Cable Installation (Including Cable Protection) | 0.41 $mi^2$ (1.06 $km^2$) | 2.49 $mi^2$ (6.45 $km^2$) | 2.90 $mi^2$ (7.51 $km^2$) | Cable installation is anticipated to require a trench with a maximum depth of approximately 9.8 ft (3.0 m) and a maximum width of up to approximately 3.3 ft (1 m). |
| **Inter-link cable** | | | | |
| Inter-Link Cable Installation (Including Cable Protection) | 0.06 $mi^2$ (0.16 $km^2$) | 0.48 $mi^2$ (1.09 $km^2$) | 0.48 mi2 (1.09 km2) | Cable installation is anticipated to require a trench with a maximum depth of approximately 9.8 ft (3.0 m) and a maximum width of up to approximately 3.3 ft (1 m). |
| **Met Tower** | | | | |
| Met Tower Installation (Including Scour Protection) | N/A | N/A | N/A | There is sufficient conservatism in the total estimates of permanent and temporary seafloor disturbance from WTG foundation installation to account for the impacts from the met tower's installation. |
| **Metocean Buoys** | | | | |
| Metocean Buoy Installation | N/A | 0.01 $mi^2$ (0.03 $km^2$) | 0.01 $mi^2$ (0.03 $km^2$) | Maximum depth of disturbance is anticipated to be 3.3 ft (1.0 m). |
| **Maximum Total Seabed Disturbance in Lease Area** | 1.13 $mi^2$ (2.92 $km^2$) | 3.54 $mi^2$ (9.17 $km^2$) | 4.60 $mi^2$ (11.91 $km^2$) | The depth of seabed disturbance for project components is variable but the maximum depths of anticipated disturbance for components is summarized in this table. |
| **Export Cable Corridor (ECC)** | | | | |
| **Monmouth ECC** | | | | |

| Installation Activity by Component | Max Area of Seafloor Disturbance | | | Maximum Depth of Potential Seafloor Disturbance |
|---|---|---|---|---|
| | Permanent Disturbance | Additional Temporary Disturbance | Total[a] | |
| Export Cable Installation (Monmouth Landfall to OSS) | 0.30 $mi^2$ (0.73 $km^2$) | 1.98 $mi^2$ (5.13 $km^2$) | 2.28 $mi^2$ (5.90 $km^2$) | Cable installation is anticipated to require a trench with a maximum depth of approximately 9.8 ft (3.0 m) and a maximum width of up to approximately 3.3 ft (1 m). |
| **Northern ECC (including Asbury ECC and branches to New York landfall Sites)** | | | | |
| Export Cable Installation (New York Landfall to OSS) | 0.34 $mi^2$ (0.86 $km^2$) | 2.70 $mi^2$ (7.01 $km^2$) | 3.04 $mi^2$ (7.87 $km^2$) | Cable installation is anticipated to require a trench with a maximum depth of approximately 9.8 ft (3.0 m) and a maximum width of up to approximately 3.3 ft (1 m). |
| **Maximum Total Seabed Disturbance in ECCs** | 0.64 $mi^2$ (1.59 $km^2$) | 4.68 $mi^2$ (12.14 $km^2$) | 5.32 $mi^2$ (13.77 $km^2$) | The depth of seabed disturbance for project components is variable but the maximum depths of anticipated disturbance for components is summarized in this table. |
| **Gowanus Interconnection** | | | | |
| **Hudson Bay Narrows Crossing** | | | | |
| Trenchless Interconnection Cable Routes | TBD | TBD | TBD | TBD |

[a]/For WTG, OSS, and met tower foundations, the foundation type with the maximum footprint is not the same as the type with the maximum area of additional seabed disturbance. Thus, the sum of the maximum area of permanent disturbance and additional temporary disturbance does not equal the total seabed disturbance.

As mentioned previously, the final APE will be formally determined by BOEM in consultation with the NJHPO and NYSHPO as part of the Section 106 consultation process. The process for identifying and evaluating effects on marine archaeological resources resulting from the construction and operation of the Project will involve consultation with BOEM, the NJHPO, the NYSOPRHP in its capacity as the NYSHPO, participating Native American Tribes, and other consulting parties with a demonstrated interest in the historic properties (e.g., historic preservation organizations).

Detailed studies to identify marine archaeological resources that are listed in, eligible for listing in, or potentially eligible for listing in the State or National Register of Historic Places (S/NRHP) have been completed, the results of which are provided in the MARA (Appendix II-Q). The QMA conducted a review of multiple HRG datasets collected over multiple survey campaigns that took place in 2019–2022.

To inventory and characterize previously identified and evaluate the potential for unidentified marine archaeological resources to be present within the Marine Physical Effects PAPE, Atlantic Shore conducted the following research activities:

- Marine High-Resolution Geophysical (HRG) surveys
- Geotechnical investigations (vibracore and borehole core sampling)
- A review of BOEM's *Inventory and Analysis of Archaeological Site Occurrence on the Atlantic Outer Continental Shelf* (TRC 2012)
- BOEM's Archaeological Resource Information Database (BOEM, 2019)
- Global GIS Data Services, LLC, Global Maritime Wrecks Database (GMWD)
- National Oceanic and Atmospheric Administration (NOAA) Wrecks and Obstructions Database including the Automated Wreck and Obstruction Information System (AWOIS; NOAA 2020)
- NOAA Electronic Navigation Charts Database (ENC)
- New Jersey Maritime Museum Shipwreck Database (NJMM).

The research and analysis presented in the MARA was prepared by and/or under the supervision of Qualified Marine Archaeologists (QMAs) and in accordance with BOEM's *Guidelines* (BOEM 2020). A summary of research information specific to the Marine Physical Effects PAPE is included in Sections 6.3.1.1 through 6.3.1.3. A summary of the results and interpretation of the HRG survey data and geotechnical investigations is provided in Section 6.3.1.4.

#### 6.3.1.1 Geology of the Continental Shelf and Sea Levels Through Time

The modern New Jersey Outer Continental Shelf (OCS) is situated between the Hudson canyon to the north and Delaware Shelf Valley to the south and measures approximately 75 to 93 mi (120 to 150 km) wide with an area of roughly 9,652.5 $mi^2$ (25,000 $km^2$) (Carey et al. 2005). The northeast continental shelf generally breaks into a steep downward slope toward the Atlantic abyssal plain at depths ranging from 328 to 426 ft (100 to 130 m). However, the eastern extents of the shelf are extended by the Hudson Apron, an additional 10 to 12 mi (15 to 20 km). The shelf is considered a mature, passive continental platform with low subsidence and sediment influx rates (Nordfjord et al. 2006). The shelf is associated with a storm-dominated, mixed energy shoreline, with a tidal range of 3 to 6 ft (1 to 2 m) and mean wave height of roughly 3 ft (1 m) (Carey et al. 2005).

Fluctuating sea levels exerted a strong influence over sedimentation and topography on the OCS. The NJ OCS experienced three high sea-level stands (highstands) during the Late Pleistocene to Early Holocene timespan; each highstand is associated with sediment deposition within the PAPE. Highstands occurred during marine isotope stage (MIS) 5e (124,000–119,000 years ago), MIS 3 (55,000-35,000 years ago) and MIS 1 (18,000-present) (Wright et al. 2009). The MIS 5e highstand was approximately 6 m (20 ft) above modern sea levels (Lambeck et al. 2002, Waelbroeck et al. 2002).

Deposition during interglacial cycles occurred in two phases. As sea level rose and transgressed across the NJ OCS, sediments were deposited along the mouths of rivers as deltas and submerged (subaqueous) fans and within the incised channels. Once the encroaching sea rose over portions of the shelf, marine sediments were deposited across broad swaths of the ancient landscape. A summary of sea level change since the last glacial maximum (LGM) is presented in Table 6.3-2.

### Table 6.3-2. Sea-level Depths and Approximate Shoreline Locations after the Last Glacial Maximum

| Age cal BP | Depth Relative to Modern Sea Level | Distance to Modern Shoreline |
|---|---|---|
| 3,000 | -9.8 ft (3 m) | .5 mi (.81 km) |
| 6,000 | -23 ft (7 m) | 1.95 mi (3 km) |
| 8,000 | -59 ft (18 m) | 6.7 mi (10.9 km) |
| 11,500 | -190 ft (58 m) | 60 mi (97 km) |
| 13,000 | -213 ft (65 m) | 65 mi (105 km) |
| 15,000 | -311 ft (95 m) | 80 mi (129 km) |
| 21,000 | -426 ft (130 m) | 84 mi (137 km) |

Alternating with the highstands were periods of declining sea level associated with glaciations in the northern hemisphere. Lowered sea levels are generally correlated with periods of erosion and fluvial incision of the exposed OCS landscapes. Incised river channels associated with the LGM (i.e., 29,000 to 22,000 years ago) follow similar courses to channels created during earlier glacial cycles. Once portions of the ancient shelf were exposed by the receding seas, vegetation adapted to the evolving climate was established and portions of the subaerial landscape stabilized.

The MARA presents the interpretation of geotechnical data to describe the sequence of marine sediments within the Lease Area and the potential for submerged pre-contact archaeological resources to be present within the PAPE. The primary sediment horizons as informed by Accelerator Mass Spectrometer (AMS) dating of samples from geotechnical cores collected within the PAPE are tabulated in Table 6.3-3 and summarized as follows:

- Holocene Deposits - The Holocene marine sediments (U0) are the most recently deposited sequence within the Lease area and cable corridors. It ranges in thickness from less than 1 m (3 ft) to less than 7 m (23 ft). The sediments are characterized by high-energy deposits of sands with marine bivalves, including older shell redeposited from further offshore. These sediments consist of new fluvial and deltaic deposits reworked and mixed with older offshore deposits.

  There is a low probability for precontact archaeological material in primary context because these marine sediments were deposited after marine transgression. However, a moderate probability is present for post-contact maritime artifacts and precontact archaeological material in secondary context based on the local archaeological record. This probability increases where U0 is present in near-shore contexts.

- Transgressive Channel Group Deposits - The transgressive channel group deposits (TCG) include substantial paleo-channel sequences across the Lease Area and ECCs. These channels generally extend from the northwest to southeast across the Lease Area. The channel deposits contain evidence for multiple cycles of channeling and infill events as anastomosing channels. The deposit ranges in thickness from less than 1.0 m (3 ft) to 11 m (36 ft). During the LGM, the channels incised across the subaerially exposed shelf into the older sediments.

  Among the subsurface sedimentary units observed, the TCG channel unit has the highest likelihood of containing precontact archaeological material in primary context, especially on preserved channel-margin deposits that may represent floodplains, back bays, or other protective environments. Precontact archaeological materials may also be present in secondary context, having been redeposited by fluvial activity or high-energy shoreline erosion during sea-level rise. No post-contact archaeological materials are expected to be present in this unit due to its antiquity.

- Late Pleistocene Deposits – The Late Pleistocene deposits have been subdivided into three units that represent at least three different episodes of sea-level fluctuations (U1, U2, and U3).

  - U1 - Sedimentary deposition from about 39,000 to 28,000 cal BP. Exhibits high lateral and vertical variability across the Lease Area. Environments include deltas, peritidal flats, lagoons, and barrier-island complexes. No precontact archaeological materials are expected to be present within U1 due to its presumed age, though the U1 horizon is the primary unit which the TCG channels have down cut. As such, it is likely that human populations living adjacent to the fluvial systems represented by the TCG channels lived on subaerially exposed U1 surfaces during the late Pleistocene. There is potential for precontact archaeological materials to be present on preserved U1 surfaces. Eroded U1 surfaces are unlikely to contain such materials, and if present, they are most likely in secondary context.

  - U2 – Sedimentary deposition from about 52,000 to 42,000 cal BP. The unit ranges in thickness from less than 1.0 m (3 ft) to approximately 18.5 m (61.0 ft). Most of the sediment within U2 includes both sand and clay interbedded within sandy layers. No precontact archaeological materials are expected to be present within U2 due to its presumed age.

  - U3 - Sedimentary deposition older than about 52,000 cal BP, based on radiocarbon (C14) dates from recent geotechnical samples and regional stratigraphic correlation. The unit ranges in thickness from less than 1.0 m (3.0 ft) to approximately 10.5 m (34.5 ft) in the northern and southern portions of the Lease Area. No precontact archaeological materials are expected to be present within U3 due to its presumed age.

### Table 6.3-3. Regional Stratigraphic Ages and Interpreted Horizons within the PAPE

| Period | Epoch (with *approximate age) | Unit/Key Bounding Horizons |
|---|---|---|
| Quaternary | Holocene (9,000 [east]/7,400 [west] cal BP to Present) | U0 |

| Period | Epoch (with *approximate age) | Unit/Key Bounding Horizons |
|---|---|---|
| | | Horizon 000 (Base of U0) |
| | Early Holocene (~12,000–7,400 cal BP) to Upper Late Pleistocene (~28,000–12,000 cal BP) | TCG (Transgressive Channel Group)<br><br>Erosional unconformity at base of TCG |
| | Late Pleistocene (39,000–28,000 cal BP) | U1<br>Horizons H005, H010, and H017<br><br>Base of U1 is defined by H020 |
| | Late Pleistocene (52,000–42,000 cal BP) | U2<br>Horizons H030, H050, H070<br><br>Base of U2 is defined by H080 |
| | Late Pleistocene (129,000–52,000 cal BP) | U3<br>Base of U3 is defined by H100 |
| Tertiary | Coastal Plains Deposits (Pre-Quaternary age–Miocene to Pliocene) | CP |

*Approximate ages inferred from recent C14 dating of geotechnical samples within the Lease Area and correlation to regional stratigraphic studies.

#### 6.3.1.2 Potential for Pre-contact Settlement in the Project Area

There are no confirmed submerged pre-contact archaeology sites in the immediate vicinity of the Atlantic Shores Lease Area; however, the theorized migration of Native Americans suggests the potential for undiscovered sites to exist. Several collections of pre-contact artifacts derived from submerged contexts have been identified along New Jersey’s Atlantic coast. These collections clearly demonstrate the ancient indigenous use of the now-submerged lands. Based on palaeoecological reconstructions of past environments on the OCS and adjacent portions of the mainland, the PAPE would have supported a diverse range of economically and culturally important plant and animal species comparable to those utilized by ancient indigenous peoples in inland and shoreline settings. Both global and regional settlement patterns for the periods of subaerial exposure of the PAPE suggest ancient occupations and other uses of the OCS off the coast of New Jersey would have clustered along the margins of waterways, marshes, and estuaries where a broad and reliable range of food resources were available. Elevated locations providing expansive views of the surrounding landscape were also likely used to monitor the movement of people and game and potentially for ceremony. Potential bedrock or secondary sources of stone for the manufacture of tools is also likely to have influenced ancient indigenous land-use patterns.

Based on geophysical and geotechnical data and recent analyses conducted along the Mid-Atlantic sections of the OCS, the MARA includes sea level reconstructions and an assessment of potential exposed lands on the OCS. These potential exposed lands, referred to as Ancient Submerged Landforms (ASLFs), represent coastal habitats that may have been available to people living in the region before marine transgression. In addition, Atlantic Shores will engage the appropriate Native American Tribes to aid in the identification of potential ASLFs within the PAPE.

In addition to the assessment of potential ASLFs, identifying potential archaeological sites dating from the Pre-contact Period within the PAPE will require the identification of preserved landforms from the periods when humans may have occupied the landscape. The potential for pre-contact archaeological sites to have been preserved in the PAPE relies on specific conditions during geomorphological evolution on the continental shelf. The effect of erosion and other forms of sediment transport on the landscape following occupation largely determines whether associated archaeological sites may be preserved. If any areas are identified where intact ancient soils (paleosols) are present in the underlying Upper Late Pleistocene to Early Holocene deposits, associated archaeological materials that could be present are more likely to occur in-situ.

In addition, the MARA includes a historic context for the pre-contact period of New Jersey, New York, and the OCS (Appendix II-Q: Section 2.3) as well as the chronology of archaeological periods identified in the sediment analyses (see Section 6.3, above).

#### 6.3.1.3 Probability for Historic Maritime Cultural Resources in the Project Area

The MARA includes a detailed historic context summarizing the historical development of maritime trade and associated infrastructure in the region (Appendix II-Q: Section 2.4). The MARA includes a discussion of historic maritime cultural trends, including significant ports, vessel types, and causes for marine losses, which provide detail regarding the types of historic-period marine archaeological resources that could be present within the Offshore Project Area. Given the intensity and longevity of maritime activity in this region, navigation charts are expected to show numerous vessel wrecks, obstructions, and other navigational hazards within the Offshore Project Area, especially in the Northern ECC in the Hudson Bay.

The historic context informed the assessment of the range of potential historic period submerged historic properties that could be located within the PAPE and how specific shipwrecks related to documented patterns in local history.

In order to determine whether previously reported historic shipwrecks are located within or near the PAPE, the QMA completed an intensive review of several databases, including the following:

- BOEM’s Archaeological Resource Information Database
- Global GIS Data Services, LLC, Global Maritime Wrecks Database (GMWD)
- National Oceanic and Atmospheric Administration (NOAA) Wrecks and Obstructions Database including the Automated Wreck and Obstruction Information System (AWOIS)
- NOAA Electronic Navigation Charts Database (ENC)
- NYSHPO’s CRIS website

- New Jersey Maritime Museum Shipwreck Database (NJMM).

In addition, offshore waters located in proximity to life-saving stations and lighthouses, typically have a higher likelihood of hazardous nearshore areas and therefore shipwrecks, as do nearshore environments due to the dynamic conditions. Additional shipwrecks are likely to exist on the seabed than have been accounted for in historic and contemporary literature (Pearson et al. 2003). The potential for submerged cultural resources should be considered moderate to high within the ECCs where shallower waters led to more hazardous conditions. However, the dynamic ocean conditions decrease the potential for preservation of shipwrecks.

#### 6.3.1.4 MARA Assessment Results

Multiple geotechnical campaigns (vibracore and borehole core sampling) resulted in the assessment of 36 vibracore locations within the Lease Area, Monmouth ECC, New Jersey Landfall Corridor, Northern ECC, and New York Landfall Corridors (Appendix II-Q: Section 3.3.7). Out of those 36 vibracores, 48 C14 samples and sic species identification samples were collected. All species identification samples were collected from the top U0 horizon and included gastropods and mollusks (Appendix II-Q: Section 4.5.1). Descriptions of each of the 36 vibracore locations, including depth, sediment type, interpreted depositional environment, C14 derived age, and sub-bottom profiles are included in the MARA (Appendix II-Q: Section 4.5.2).

The QMA conducted a review of multiple HRG datasets collected over multiple survey campaigns that took place in 2019–2022. The surveys were non-intrusive, and no potential submerged cultural resources were impacted during data collection. HRG data were processed, and the knowledge gained from the post-contact and pre-contact research was applied when interpreting the survey results. Tables of findings and illustrations depicting survey results, including navigation maps, bathymetry maps, magnetic anomaly statistics, magnetic contour maps, side-scan sonar mosaics, acoustic contact statistics, acoustic contact imagery, sub-bottom acoustic reflectors, and archaeological resource charts, are presented in the MARA (Appendix II-Q: Appendix D).

As a result of the analysis of the HRG data, a total of 40 potential submerged historic resources were identified within the PAPE (Appendix II-Q: Table 5.1-1). Thirteen of these targets are located within Lease Area OCS-A0549, nine targets are located within the Monmouth ECC, ten targets are located within the Northern ECC, and eight targets are within the New York Landfall approaches. Potential submerged cultural resources were cross referenced with the data obtained from shipwreck databases and secondary sources to identify the possible source of each potential resource (name of shipwreck). The remainder of the documented magnetic anomalies and acoustic contacts within the PAPE likely relate to modern debris. Three shipwrecks were identified outside of the PAPE but within the Lease Area (Appendix II-Q: Table 5.1-3). The QMA recommended avoidance of the 40 potential submerged historic resources by a minimum distance of 50 m (164 ft) from the extent of the outer edge of the magnetic anomalies or acoustic contacts used to identify each target.

Additionally, 133 ASLFs were identified within the PAPE (Appendix II-Q: Table 5.1-2). Twenty-eight targets are located within the Lease Area, 16 targets are located within the Monmouth ECC, 56 targets are located within the Northern ECC, 28 targets are located within the New York Landfall approaches, and five targets are located within the New Jersey Landfall approach. The QMA recommended mitigation or avoidance when feasible for all identified ASLFs.

## 6.3.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect marine archaeological resources during construction and installation, O&M, or decommissioning of the Project are presented in Table 6.3-4.

**Table 6.3-4. Impact Producing Factors for Marine Archaeological Resources**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Anchoring and jack-up vessels | • | • | • |
| Installation and maintenance of new structures and cables | • | • | • |

In addition to the IPFs described in Table 6.3-4, marine archaeological resources may also be affected by discharges from vessels and accidental releases (although these are considered unlikely occurrences). The introduction of oil and other chemicals can, among other impacts, hasten the degradation of organic materials lying on, or just below, the seabed. These potential impacts are considered to have a low likelihood of occurrence and are discussed in Section 9.2 Non-Routine and Low-Probability Events.

The Project's Marine Physical Effects PAPE includes the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities in the Offshore Project Area. The collected and analyzed HRG and geotechnical survey is being used to guide and refine the siting, design, and engineering of offshore project components, including WTG and OSS foundations and offshore cables (export, inter-array, inter-link cables, and trenchless interconnection cable routes). The identification of potential submerged cultural resources, and ASLFS will inform the strategies and measures adopted to appropriately avoid and/or mitigate potential effects to significant cultural resources identified in the Offshore Project Area. The QMA recommended avoidance strategies relative to IPFs for marine archaeological resources are described in this section.

### 6.3.2.1 Anchoring and Jack-Up Vessels

Vessel anchoring and use of jack-up vessels have the potential to disturb sediments on the ocean floor and therefore could affect marine archaeological resources (if present). Jack-up vessels have legs that lower into the seabed and brace the vessel as it elevates above sea level, where it can safely perform operations in a stable, elevated position. Temporary anchoring and use of jack-up vessels within the Offshore Project Area will occur during construction and decommissioning and to a lesser extent during O&M with variations in duration and extent according to the specific work activity. The area of seabed disturbance for anchors and jack-up vessels are described in Table 4.2-1 in Volume I. Vessel anchoring and jack-up vessels are minimally intrusive to the seabed and the depth of disturbance for these activities range from 3.3 to 16.4 ft (1 to 5 m).

All vessel anchoring and jacking associated with Project activities will occur within areas that have been covered by the marine archaeological surveys. Based on these assessments the QMA has identified 40 historic period marine archaeological resources within the Marine Physical Effects PAPE, including shipwrecks or potential shipwrecks. The QMA recommended avoidance of the 40 potential submerged historic resources by a minimum distance of 50 m (164 ft) from the extent of the outer edge of the magnetic anomalies or acoustic contacts used to identify each target.

In addition to the historic period resources, the QMA identified 133 ASLFs that could retain evidence of Native American occupations of the Marine Physical Effects PAPE prior to marine transgression. The QMA recommended impact avoidance or minimization measures for all identified ASLFs. Atlantic Shores and the QMA will work proactively with BOEM and the SHPO to devise and implement appropriate avoidance, minimization, and/or mitigation measures within the mapped limits of the ASLFs.

#### 6.3.2.2 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new structures and cables will disturb sediments on the ocean floor and therefore could affect archaeological resources (if present). Seafloor-disturbing activities during construction of the WTG and OSS foundations include seabed preparation for certain foundation types, foundation placement, and scour protection installation. Seafloor-disturbing activities during installation of the offshore cables include pre-installation activities (sand wave clearing, boulder relocation, and a pre-lay grapnel run), offshore cable installation, cable protection where needed, and excavation at horizontal directional drilling (HDD) pits. The sediment disturbance associated with these activities is described in Section 4.0 of Volume I.

All WTG foundations, OSS foundations, ECCs, and trenchless interconnection cable routes are included within areas covered by the marine archaeological surveys. As noted in Section 6.3.1.4, Atlantic Shores will apply the QMA-recommended 50 m (164 ft) avoidance buffer from the extent of the outer edge of the magnetic anomalies or acoustic contacts used to identify each potential historic period marine archaeological resource during installation and maintenance activities. Atlantic Shores and the QMA will also work proactively with BOEM and the SHPO to devise and implement appropriate avoidance, minimization, and/or mitigation measures during installation and maintenance activities when working within mapped limits of the ASLFs and their associated QMA-recommended avoidance areas.

#### 6.3.2.3 Summary of Proposed Environmental Protection Measures

Atlantic Shores has conducted a thorough documentation and inventory of marine archaeological resources so that submerged historic properties located within the Marine Physical Effects PAPE can be avoided or mitigated. Atlantic Shores has conducted a marine archaeological survey of the Marine Physical Effects PAPE under the direction of a QMA in accordance with BOEM guidelines. Based on the results of the MARA investigations, Atlantic Shores is exploring micrositing and other measures to avoid or minimize impacts to submerged historic properties, as appropriate. The marine survey coverage and the associated MARA provide a sound basis for micro-siting and other protective measures to avoid and/or minimize affects to the identified marine archaeological resources. Using the HRG and geotechnical that has been collected, avoidance, minimization, and mitigation strategies to protect marine cultural resources consist of the following measures:

- Identification of historic-period marine archaeological resources and ASLFs that are the most likely locations for pre-contact landforms that could retain preservation potential of archaeological sites. Engage with participating Native American Tribes to help in the identification and assessment of potential ASLFs, and to inform and aid in the develop of avoidance, minimization, and mitigation strategies (if applicable);

- Establish the QMA resource specific avoidance buffers measuring a minimum of 164 ft [50 m] from the extent of the outer edge of the magnetic anomalies or acoustic contacts used to identify each identified historic period marine archaeological resource or potential marine archaeological resource to minimize the risk of disturbance during construction.

- Consideration of all survey data, including potential marine archaeological resource locations and characteristics, to guide the siting, design, and engineering of offshore Project components, including WTG and OSS foundations and offshore cables (export, inter-array, and inter-link cables) and planning for associated temporary construction activities (vessel jacking and anchoring).

- Develop and implement one or more Monitoring Plan and Post Review Discoveries Plans (MPRDP) for offshore construction activities (Appendix II-Q: Appendix J).

- If warranted Atlantic Shores will conduct supplemental surveys or other investigations to support National Register eligibility determinations and/or to mitigate unavoidable adverse effects to submerged historic properties (if applicable).

Atlantic Shores will continue to proactively consult with BOEM, SHPO(s), participating Native American Tribes, and other relevant parties to pursue feasible means of avoiding, minimizing, and/or mitigating potential effects to all submerged historic properties. Avoidance of impacts to all identified ASLFs may not be feasible based on current information and planning efforts. If no prudent and feasible means of avoiding one or more ASLFs are available, Atlantic Shores anticipates that the mitigation process for submerged landscapes will proceed in a phased manner with the following procedural and consultation steps:

- All geologic landforms identified within the PAPE have been mapped to encompass the maximum extent of potential impacts from proposed construction operations.

- Efforts are being made to develop the mitigation, avoidance, and treatment plan while also evaluating the preservation potential and probability modeling for these landscapes to be considered for archaeological criteria in informing these plans.

- In consideration of any comments provided by consulting parties during the BOEM-led Section 106 consultations, data collected and a phased mitigation framework developed by Atlantic Shores will be presented to stakeholders/consulting parties for review and comment.
- In consultation with stakeholders/consulting parties, BOEM, and subject matter experts, Atlantic Shores will develop a treatment plan based on the mitigation framework to address potential submerged historic properties that would be impacted by construction activities.
- Atlantic Shores would be responsible for implementing all mitigation measures documented in the treatment plan.

# 7.0 Socioeconomic Resources

This section provides a detailed description of the socioeconomics within the Atlantic Shores Project Region (Project Region) including demographics, employment, environmental justice, recreation/tourism, land use/coastal infrastructure, navigation/vessel traffic, aviation, and onshore transportation and traffic.

## 7.1 Demographics, Employment, and Economics

This section describes demographics, employment, and economics within the Project Region. It also presents associated impact-producing factors (IPFs) and measures to avoid, minimize, or mitigate potential effects on these socioeconomic resources during construction, operations and maintenance (O&M), and decommissioning of the Project.

To assess demographics, employment, and economics, the Project Region was analyzed at the county geographic level to identify the communities and resources that could be affected by the construction, operation, and decommissioning of the Project. The region is well prepared for coastal and maritime construction projects with plentiful port infrastructure and a robust and available workforce that will be drawn upon to fill the employment needs of the Project. It is not anticipated that new housing or transportation infrastructure will be required to construct and operate the Project. Offshore construction-related activities will occur in the export cable corridors (ECC) and the Lease Area. Onshore project components include potential landfall sites, interconnection cable route options, and Points of Interconnection (POI). Ports will serve as mustering points for labor and staging areas for project components during the construction and O&M phases. See Table 4.10-2 of Volume I for a full list of ports that may be used during construction. Ports evaluated in this section may be used during construction activities associated with the Project and match the ports listed in Table 4.10-2 of Volume I. These facilities occur in New Jersey, New York, Virginia, and Texas along the Atlantic Coast and the Gulf of Mexico. Once operational, the Project will be supported by existing O&M facilities. Finally, the analysis in this section also includes counties within the zone of visual influence, as determined by a digital surface model viewshed analysis of the offshore facilities within the Lease Area. For more information on visual resource considerations, see Section 5.0.

### 7.1.1 Affected Environment

The affected environment, or Project Region, consists of the communities in Atlantic, Burlington, Camden, Cape May, Gloucester, Monmouth, Ocean, and Salem counties in New Jersey, Albany, King and Richmond counties in New York, Portsmouth County in Virginia, and San Patricio County in Texas. Construction, O&M, and decommissioning activities will take place based on the location of the proposed Project infrastructure and the availability of associated support facilities (e.g., ports, staging areas, etc.). These Project infrastructure and support facility locations occur in Gloucester, Monmouth, Ocean, and Salem counties in New Jersey; Albany, Kings, and Richmond counties in New York; Portsmouth County in Virginia; and San Patricio County in Texas. Counties within the zone of visual influence (i.e., digital surface model viewshed) of the Lease Area are also included in this analysis, including Atlantic, Burlington, Camden, Cape May, Monmouth, and Ocean counties in New Jersey. This assessment is based on available U.S. Census Bureau data, including population, employment, economic conditions, and housing.

#### 7.1.1.1 Population

Population characteristics and trends for each county within the socioeconomic Project Region, summarized in Table 7.1-1, help to illustrate the substantial size of the workforce available to support the construction and operation of the Project and provide a basis for evaluating potential changes related to the Project. Of the seven counties, Richmond County, New York, has the largest and most dense population. Salem County, New Jersey is the least populated, but San Patricio County in Texas is the least dense of the counties. Albany and Richmond counties in New York and Portsmouth County (City), Virginia have higher population densities than the states they are in.

Most counties within the Project Region experienced population growth between 2000 and 2021. Gloucester County experienced the largest growth (18.1%). Salem County, New Jersey, has the highest median age (42.5 years), while Portsmouth County (city), Virginia, has the lowest median age (35.5 years).

**Table 7.1-1. Population Trends**

| | Land (sq. mi.) | 2000 Pop. | 2010 Pop. | 2021 Pop. | 2021 Density (Persons/ sq. mi.) | Pop. Change 2000-2021 | 2021 Median Age (Years) |
|---|---|---|---|---|---|---|---|
| State of New Jersey | 7,354 | 8,414,350 | 8,721,577 | 9,234,024 | 1255.6 | 9.7% | 40.0 |
| Atlantic County | 555 | 252,552 | 273,162 | 273,865 | 493.5 | 8.4% | 42.0 |
| Burlington County | 820 | 423,394 | 447,861 | 464,269 | 566.2 | 9.7% | 41.8 |
| Camden County | 227 | 508,932 | 513,574 | 523,771 | 2307.4 | 2.9% | 38.6 |
| Cape May County | 620 | 102,326 | 97,684 | 95,661 | 154.3 | -6.5% | 51.6 |
| Gloucester County | 332 | 254,673 | 285,223 | 300,821 | 906.1 | 18.1% | 40.6 |
| Monmouth County | 469 | 615,301 | 628,112 | 645,354 | 1376.0 | 4.9% | 43.7 |
| Ocean County | 629 | 510,916 | 569,274 | 648,998 | 1031.8 | 27.0% | 41.5 |

| | Land (sq. mi.) | 2000 Pop. | 2010 Pop. | 2021 Pop. | 2021 Density (Persons/ sq. mi.) | Pop. Change 2000-2021 | 2021 Median Age (Years) |
|---|---|---|---|---|---|---|---|
| Salem County | 331 | 64,285 | 65,982 | 64,752 | 195.6 | 0.7% | 42.5 |
| State of New York | 47,123 | 18,976,457 | 19,229,752 | 20,114,745 | 426.9 | 6.0% | 39.2 |
| Albany County | 522 | 294,565 | 304,032 | 314,679 | 602.8 | 6.8% | 38.0 |
| Kings County | 71 | 2,465,326 | 2,466,782 | 2,641,052 | 37197.9 | 7.1% | 36.3 |
| Richmond County | 57 | 443,728 | 463,450 | 493,194 | 8652.5 | 11.1% | 40.4 |
| State of Virginia | 39,482 | 7,078,515 | 8,001,024 | 8,582,479 | 217.4 | 21.2% | 38.5 |
| Portsmouth County (City) | 33 | 100,565 | 95,535 | 97,454 | 2953.2 | -3.1% | 35.5 |
| State of Texas | 261,267 | 20,851,820 | 25,145,561 | 28,862,581 | 110.5 | 38.4% | 35 |
| San Patricio County | 693 | 67,138 | 64,804 | 68,600 | 99.0 | 2.2% | 35.8 |
| United States | 3,531,905 | 281,421,906 | 308,745,538 | 329,725,481 | 93.3 | 17.2% | 38.4 |

Source: U.S. Census Bureau American Community Survey 2021 5-Year Estimates. Land Area data from U.S. Census Bureau QuickFacts 2020. Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents."

#### 7.1.1.2 Employment and Economic Conditions

A high labor force participation rate combined with a low unemployment rate can indicate a robust job market. Labor force and employment rates, summarized in Table 7.1-2, vary between the counties in the Project Region. Gloucester County, New Jersey, had the highest labor force participation rate (67.0%) and a relatively low unemployment rate. Meanwhile, San Patricio County, Texas had a relatively low labor force participation rate (58.6%) and a relatively low unemployment rate.

### Table 7.1-2. Labor Force and Employment

| | Total Population 16 Years and Over | Labor Force Participation Rate | Annual Average Unemployment Rate |
|---|---|---|---|
| State of New Jersey | 7,489,289 | 65.6% | 5.4% |
| Atlantic County | 224,620 | 61.9% | 9.8% |
| Burlington County | 381,560 | 65.9% | 5.6% |
| Camden County | 418,498 | 65.6% | 7.0% |
| Cape May County | 81,385 | 56.6% | 9.2% |
| Gloucester County | 247,169 | 65.0% | 6.3% |
| Monmouth County | 528,640 | 66.4% | 5.8% |
| Ocean County | 505,122 | 59.7% | 6.3% |
| Salem County | 52,240 | 60.3% | 7.6% |
| State of New York | 16,210,453 | 62.5% | 5.4% |
| Albany County | 263,455 | 63.2% | 4.4% |
| Kings County | 2,102,166 | 63.8% | 10.3% |
| Richmond County | 399,911 | 58.4% | 8.9% |
| State of Texas | 22,934,023 | 64.6% | 4.5% |
| San Patricio County | 52,948 | 61.4% | 8.7% |
| State of Virginia | 6,980,718 | 65.2% | 3.0% |
| Portsmouth County (City) | 76,958 | 64.7% | 6.5% |
| United States | 267,057,693 | 63.0% | 5.4% |

Sources: U.S. Census Bureau American Community Survey 2021 5-Year Estimates Table DP03 (Total Population 1 Years and Over & Labor Force Participation Rate). 2021 U.S. Bureau of Labor Statistics (Unemployment Rate; statewide figures are seasonally adjusted). Note: The numbers shown from 2021 are likely to have been impacted by the COVID-19 pandemic. Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents."

As summarized in Table 7.1-3, Kings County, New York, had the highest gross domestic product (GDP) of the Project Region, $ 92.3 billion in 2021, followed by Monmouth County, New Jersey, with a GDP of $34.2 billion. San Patricio County, Texas had the lowest GDP ($2.6 billion) in 2021 and experienced the largest change in GDP between 2017 and 2021 (+17.6%). All states and counties within the Project Region experienced an overall increase in GDP between 2017 and 2021.

### Table 7.1-3. Gross Domestic Product (GDP)

| | Real GDP (In Millions of Chained 2012 Dollars) | | 2017-2021 Percent Change | % of U.S. GDP | |
|---|---|---|---|---|---|
| | 2017 | 2021 | | 2017 | 2021 |
| State of New Jersey | $537,578.6 | $566,893.2 | 5.5% | 3.0% | 3.0% |
| Atlantic County | $12,141.2 | $12,407.0 | 2.2% | 0.1% | 0.1% |
| Burlington County | $25,639.0 | $27,362.0 | 6.7% | 0.1% | 0.1% |
| Camden County | $22,280.5 | $23,305.5 | 4.6% | 0.1% | 0.1% |
| Cape May County | $4,907.2 | $5,021.0 | 2.3% | 0.03% | 0.03% |
| Gloucester County | $13,236.6 | $14,008.6 | 5.8% | 0.1% | 0.1% |
| Monmouth County | $32,102.7 | $34,219.3 | 6.6% | 0.2% | 0.2% |
| Ocean County | $19,931.7 | $20,496.9 | 2.8% | 0.1% | 0.1% |
| Salem County | $4,745.9 | $5,231.8 | 10.2% | 0.03% | 0.03% |
| State of New York | $1,419,112.1 | $1,514,779.2 | 6.7% | 7.9% | 7.8% |
| Albany County | $28,215.2 | $30,337.3 | 7.5% | 0.2% | 0.2% |
| Kings County | $79,900.3 | $92,299.8 | 15.5% | 0.4% | 0.5% |
| Richmond County | $13,922.7 | $14,805.7 | 6.3% | 0.1% | 0.1% |
| State of Virginia | $467,362.0 | $505,351.0 | 8.1% | 2.6% | 2.6% |
| Portsmouth County (City) | $5,266.9 | $5,616.0 | 6.6% | 0.03% | 0.03% |
| State of Texas | $1,659,453.3 | $1,815,063.6 | 9.4% | 9.3% | 9.4% |
| San Patricio County | $2,179.4 | $2,563.9 | 17.6% | 0.01% | 0.01% |
| United States | $17,920,692.7 | $19,398,168.9 | 8.2% | 100% | 100% |

Source: Bureau of Economic Analysis, "CAGDP1 County and MSA gross domestic product (GDP) summary" (accessed August 18, 2023). Note: The numbers shown from 2021 are likely to have been impacted by the COVID-19 pandemic. Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents."

Income trends within the Project Region are summarized in Table 7.1-4. Apart from Cape May and Monmouth Counties in New Jersey, most counties had lower per capita incomes than their statewide per capita income. Salem County, New Jersey experienced the lowest gain in per capita income from 2018 to 2021 (2.7%), while Cape May County, New Jersey had the highest gain (38.9%).

### Table 7.1-4. Income Trends

| | Income 2018 | Per Capita Income 2021 | 2018-2021 Percent Change |
|---|---|---|---|
| State of New Jersey | $40,895 | $47,338 | 15.8% |
| Atlantic County | $31,366 | $36,514 | 16.4% |
| Burlington County | $41,517 | $46,401 | 11.8% |
| Camden County | $34,280 | $39,948 | 16.5% |

| | Income 2018 | Per Capita Income 2021 | 2018-2021 Percent Change |
|---|---|---|---|
| Cape May County | $38,496 | $53,482 | 38.9% |
| Gloucester County | $37,888 | $43, 483 | 14.8% |
| Monmouth County | $48,959 | $58,398 | 19.3% |
| Ocean County | $34,784 | $39,055 | 12.3% |
| Salem County | $32,526 | $33,408 | 2.7% |
| State of New York | $37,470 | $43,078 | 15.0% |
| Albany County | $36,454 | $41,711 | 14.4% |
| Kings County | $31,984 | $39,536 | 23.6% |
| Richmond County | $34,987 | $38,678 | 10.5% |
| State of Texas | $30,143 | $34,717 | 15.2% |
| San Patricio County | $25,281 | $29,522 | 16.8% |
| State of Virginia | $37,763 | $43,756 | 15.9% |
| Portsmouth County (City) | $25,179 | $31,317 | 24.4% |
| United States | $32,621 | $38,332 | 17.5% |

Source: U.S. Census Bureau American Community Survey 5-Year Estimates 2018 and 2021, Table DP03 Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents." The numbers shown from 2021 are likely to have been impacted by the COVID-19 pandemic.

Industry employment sectors by county within the Project Region are included in Table 7.1-5. Sectors related to the Project, like manufacturing, transportation/warehouse/utilities, and construction, are all moderately sized industry sectors across the Project Region. The largest employment sector for all geographies is Educational Services and Health Care and Social Assistance. Professional, Scientific, Management, Administration, and Waste Management Services is most counties' second-largest industry sector, followed by Retail Trade.

## Table 7.1-5. Employment Industry Sectors

| Industry Sector | State of New Jersey | Atlantic County | Burlington County | Camden County | Cape May County | Gloucester County | Monmouth County | Ocean County | Salem County | State of New York | Albany County | Kings County | Richmond County | State of Texas | San Patricio County | State of Virginia | Portsmouth County | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Educational Services, and Health Care, and Social Assistance | 24.0% | 25.9% | 25.9% | 24.5% | 29.0% | 29.1% | 24.7% | 29.3% | 23.7% | 29.7% | 28.3% | 30.4% | 31.9% | 21.7% | 20.3% | 22.3% | 27.0% | 23.4% |
| Professional, Scientific, Mgmt., Admin., and Waste Management Services | 14.2% | 10.4% | 13.8% | 12.9% | 9.2% | 11.2% | 16.0% | 11.0% | 10.2% | 13.0% | 13.5% | 15.9% | 12.8% | 12.5% | 6.9% | 16.9% | 8.8% | 12.3% |
| Retail Trade | 11.0% | 11.6% | 11.9% | 13.6% | 9.8% | 10.8% | 10.8% | 13.7% | 8.6% | 9.8% | 10.9% | 8.8% | 8.8% | 11.1% | 10.5% | 9.6% | 12.8% | 11.0% |
| Finance, Insurance, Real Estate, Rental and Leasing | 8.9% | 6.2% | 8.2% | 7.9% | 7.6% | 8.2% | 10.9% | 6.9% | 6.9% | 8.1% | 7.1% | 7.8% | 7.9% | 7.0% | 3.7% | 6.4% | 5.4% | 6.8% |
| Manufacturing | 8.2% | 5.7% | 7.2% | 7.4% | 6.1% | 7.4% | 5.5% | 4.6% | 12.3% | 5.8% | 6.2% | 2.8% | 2.8% | 8.6% | 7.7% | 7.0% | 12.5% | 10.0% |
| Arts, Entertain., Recreation, Accommodation & Food Services | 6.5% | 16.3% | 5.8% | 7.1% | 8.3% | 5.8% | 6.6% | 7.7% | 5.7% | 7.4% | 7.6% | 7.6% | 6.5% | 8.2% | 7.4% | 7.9% | 5.3% | 8.2% |

| Industry Sector | State of New Jersey | Atlantic County | Burlington County | Camden County | Cape May County | Gloucester County | Monmouth County | Ocean County | Salem County | State of New York | Albany County | Kings County | Richmond County | State of Texas | San Patricio County | State of Virginia | Portsmouth County | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transport, Warehouse, and Utilities | 6.4% | 4.7% | 5.7% | 6.9% | 3.4% | 6.8% | 4.8% | 5.1% | 9.1% | 5.5% | 4.2% | 6.1% | 7.9% | 6.5% | 5.7% | 4.7% | 6.7% | 5.9% |
| Construction | 6.1% | 6.7% | 6.2% | 5.9% | 10.2% | 6.6% | 6.4% | 7.5% | 7.2% | 5.7% | 2.9% | 4.5% | 6.5% | 8.5% | 14.2% | 6.4% | 7.4% | 6.8% |
| Public Admin. | 4.4% | 5.3% | 6.1% | 5.7% | 6.6% | 4.9% | 4.3% | 6.0% | 5.0% | 4.8% | 11.7% | 4.1% | 6.0% | 4.2% | 7.8% | 8.7% | 6.0% | 4.8% |
| Other Services, Except Public Admin. | 4.0% | 3.0% | 3.2% | 4.1% | 4.0% | 3.4% | 4.2% | 3.8% | 5.0% | 4.4% | 3.0% | 4.9% | 4.1% | 4.9% | 4.7% | 5.2% | 5.6% | 4.5% |
| Agriculture, Forestry, Fishing, Hunting, and Mining | 3.4% | 0.9% | 0.6% | 0.2% | 1.4% | 0.4% | 0.2% | 0.3% | 0.6% | 0.5% | 0.7% | 0.1% | 0.1% | 2.2% | 7.9% | 0.8% | 0.1% | 1.5% |
| Wholesale Trade | 2.8% | 1.5% | 3.1% | 1.8% | 2.8% | 3.3% | 2.0% | 2.3% | 4.1% | 2.0% | 1.3% | 1.8% | 1.2% | 2.4% | 2.5% | 1.6% | 1.6% | 2.3% |
| Information | 2.7% | 1.2% | 2.3% | 2.2% | 1.7% | 1.4% | 3.5% | 1.8% | 1.1% | 2.7% | 2.0% | 5.2% | 2.9% | 1.5% | 0.1% | 1.8% | 0.2% | 1.8% |

Source: North American Industry Classification System (NAICS) Sector Employment from U.S. Census Bureau American Community Survey 2021 1-Year Estimates, Table DP03. Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents." The numbers shown from 2021 are likely to have been impacted by the COVID-19 pandemic.

Ocean-related employment and economic indicators of counties within the Project Region are presented in Table 7.1-6. These data describe six economic sectors based on North American Industry Classification System (NAICS) codes that depend on oceans and the Great Lakes. Ocean Economy sectors include Tourism and Recreation, Ship and Boat Building, Offshore Mineral Extraction, Marine Transportation, Marine Construction, and Living Resources (NOAA Office For Coastal Management, Economics: National Ocean Watch 2020). The Ocean Economy accounts for similar portions of total GDP, employment, and wages in New Jersey, New York (except for Albany County), Virginia, and Texas. The Ocean Economy's largest relative employment was in Portsmouth County (city), Virginia, accounting for 35% of all jobs and over 42% of all wages. Tourism and Recreation was the largest sector of the overall Ocean Economy in all Project Region counties besides Salem County, New Jersey, and Albany County, New York.

## Table 7.1-6. Ocean-Related Economy and Employment

| | Total Ocean Economy GDP (in millions) | Ocean Economy as Percent of Total GDP | Individuals Employed in Ocean Economy (Including Self-Employed) | Ocean Economy Employment as a Percent of Total Employment | Ocean Economy Wages as a % Of Total Economy | Number of Ocean Economy Establish-ments | Percent of Ocean Economy Employment in Tourism and Recreation |
|---|---|---|---|---|---|---|---|
| New Jersey | $11,068.6 | 1.8% | 154,826 | 4% | 2.4% | 9,376 | 49.8% |
| Atlantic County | $436.9 | 3.2% | 8,165 | 8% | 3.9% | 676 | 95% |
| Burlington County | 1,808.0 | 6.2% | 13,723 | 7% | 7.9% | 67 | 0.0% |
| Camden County | $334.9 | 1.2% | 3,528 | 2% | 1.7% | 179 | 27.5% |
| Cape May County | $536.9 | 14.3% | 8,873 | 24% | 16.8% | 1,049 | 91.9% |
| Gloucester County | $458.0 | 3.5% | 9,832 | 9% | 6.2% | 138 | 77.8% |
| Monmouth County | $709.0 | 2% | 15,519 | 6% | 2.5% | 1,405 | 96.2% |
| Ocean County | $619.7 | 3.3% | 12,499 | 8% | 4.0% | 1,232 | 94.6% |
| Salem County | $100.9 | 3.5% | 1,738 | 9% | 6.2% | 70 | 12.7% |
| New York | $21,205.7 | 1.2% | 257,012 | 3% | 1.5% | 24,416 | 92.3% |
| Albany County | $27.9 | 0.1% | 486 | 0% | 0.2% | 36 | 0% |
| Kings County | $1,946.9 | 2.0% | 28,566 | 4% | 2.2% | 3,493 | 85.1% |
| Richmond County | $344.4 | 2.0% | 5,794 | 5% | 2.6% | 902 | 94.5% |

| | Total Ocean Economy GDP (in millions) | Ocean Economy as Percent of Total GDP | Individuals Employed in Ocean Economy (Including Self-Employed) | Ocean Economy Employment as a Percent of Total Employment | Ocean Economy Wages as a % Of Total Economy | Number of Ocean Economy Establish-ments | Percent of Ocean Economy Employment in Tourism and Recreation |
|---|---|---|---|---|---|---|---|
| State of Virginia | $8,961.2 | 1.6% | 123,073 | 3% | 2.5% | 4,133 | 78.5% |
| Portsmouth County (City) | $1,223.8 | 20.4% | 15,172 | 35% | 42.2% | 197 | 81.2% |
| State of Texas | $46,601.8 | 2.6% | 162,881 | 1% | 2.3% | 6,066 | 40.0% |
| San Patricio County | $483.1 | 20.9% | 4,258 | 23% | 23.6% | 157 | 68.2% |

Source: National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management, Economics: National Ocean Watch (ENOW) 2020. Note: Self-employment data for 2020 is unavailable due to COVID-19 delays.

#### 7.1.1.3 Housing

Data on housing characteristics, including housing availability and housing affordability characteristics, are presented in Tables 7.1-7 and 7.1-8. Atlantic County, New Jersey, had a 19.9% total housing vacancy rate, the highest rate of all counties in the Project Region and more than double the State of New Jersey vacancy rate. San Patricio County, Texas had the second-highest total housing vacancy rate (18.3%). Gloucester County, New Jersey had the lowest total housing vacancy rate (6.1%). All counties had significant vacant housing stock classified as "For Rent" or "Other Vacant," indicating potential latent housing supply available for non-local construction workers interested in renting. The data on vacant housing characteristics also demonstrates the popularity of coastal counties as summer vacation destinations. Atlantic County, for instance, had a high percentage of seasonal and recreational units compared to other types of vacant housing.

Table 7.1-9 shows indicators of housing affordability for homeowners and renters. The value of homes is significantly higher in the New York and New Jersey areas surrounding New York City than in other areas in the Project Region. This results in a greater housing burden for homeowners in these areas. Richmond County, New York had the highest median home value ($575,500) and the highest rate (17.1%) of homeowners with a mortgage cost burden of 30% or greater of household income. Meanwhile, San Patricio County, Texas had the lowest median home value of $141,900 and the lowest rate of unaffordable housing units owned by homeowners (4.7%).

Housing affordability for renters is more varied throughout the Project Region counties. While Kings County, New York had the highest median gross rent ($1,582), Ocean County, New Jersey had the highest rate of cost-burdened units (61.0%). In contrast, Salem County, New Jersey had the lowest median gross rent ($1,064) within the Project Region, while Albany County, New York had the lowest rate of cost-burdened rental units (43.5%). This may indicate that other factors (e.g., wages, local housing policies, or types of housing available) and likely a combination of these factors affect renters' housing affordability more directly than actual housing costs.

## Table 7.1-7. Housing Availability Characteristics

| | Total Housing Units | Total Housing Vacancy Rate | Homeowner Vacancy Rate | Rental Vacancy Rate |
|---|---|---|---|---|
| State of New Jersey | 3,738,342 | 9.1% | 1.2% | 4.1% |
| Atlantic County | 131,505 | 19.9% | 2.3% | 6.3% |
| Burlington County | 184,042 | 6.3% | 1.4% | 4.8% |
| Camden County | 211,830 | 7.0% | 1.2% | 4.5% |
| Cape May County | 99,567 | 57.8% | 2.5% | 33.0% |
| Gloucester County | 116,500 | 6.1% | 1.0% | 3.4% |
| Monmouth County | 267,799 | 8.3% | 0.9% | 3.2% |
| Ocean County | 292,546 | 18.7% | 1.4% | 3.0% |
| Salem County | 27,727 | 10.7% | 1.4% | 6.6% |
| State of New York | 8,449,178 | 10.9% | 1.3% | 4.0% |
| Albany County | 145,388 | 10.0% | 1.6% | 5.5% |
| Kings County | 1,067,820 | 7.7% | 1.4% | 3.2% |
| Richmond County | 183,011 | 7.3% | 2.3% | 6.1% |
| State of Virginia | 3,596,100 | 9.6% | 1.2% | 5.2% |
| Portsmouth County (City) | 42,934 | 10.2% | 3.3% | 5.0% |
| State of Texas | 11,433,880 | 10.4% | 1.3% | 7.6% |
| San Patricio County | 29,165 | 18.3% | 1.6% | 4.5% |

Source: U.S. Census Bureau American Community Survey 2021 5-Year Estimates Table DP04. Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents.”

## Table 7.1-8. Vacant Housing Characteristics

| | Total | For Rent | Rented, Not Occupied | For Sale Only | Sold, Not Occupied | For Seasonal, Recreation, or Occasional Use | For Migrant Workers | Other Vacant |
|---|---|---|---|---|---|---|---|---|
| New Jersey | 281,646 | 45,927 | 7,974 | 15,487 | 12,592 | 124,784 | 220 | 74,662 |
| Atlantic County | 19,915 | 731 | 0 | 1,051 | 690 | 15,213 | 0 | 2,230 |
| % Distribution | 7.0% | 1.5% | - | 6.7% | 5.4% | 12.1% | - | 2.9% |
| Burlington County | 11,642 | 2,148 | 752 | 1,887 | 682 | 576 | 0 | 5,597 |
| % Distribution | 4.1% | 4.6% | 9.4% | 12.1% | 5.4% | 0.4% | - | 7.4% |
| Camden County | 14,891 | 3,274 | 314 | 1,601 | 814 | 462 | 0 | 8,426 |
| % Distribution | 5.2% | 7.1% | 3.9% | 10.3% | 6.4% | 3.7% | - | 11.2% |
| Cape May County | 57,596 | 4,559 | 83 | 853 | 183 | 50,519 | 67 | 1332 |
| % Distribution | 20.4% | 9.9% | 1.0% | 5.5% | 1.4% | 40.4% | 30.4% | 1.7% |
| Gloucester County | 7,210 | 772 | 213 | 848 | 519 | 298 | 0 | 4,560 |
| % Distribution | 2.5% | 1.6% | 2.6% | 5.4% | 4.1% | 0.2% | - | 6.1% |
| Monmouth County | 22,230 | 2,058 | 551 | 1,619 | 1,185 | 11,580 | 0 | 5,237 |
| % Distribution | 7.8% | 4.4% | 6.9% | 10.4% | 9.4% | 9.2% | - | 7.0% |
| Ocean County | 54,817 | 1,486 | 260 | 2,641 | 1,651 | 39,521 | 40 | 9,218 |
| % Distribution | 19.4% | 3.2% | 3.2% | 17.0% | 13.1% | 31.6% | 18.1% | 12.3% |
| Salem County | 2,974 | 510 | 14 | 247 | 198 | 147 | 0 | 1,858 |
| % Distribution | 1.0% | 1.1% | 0.1% | 1.5% | 1.5% | 0.1% | - | 2.4% |
| New York | 877,895 | 150,909 | 43,463 | 41,493 | 44,011 | 296,595 | 1,395 | 300,029 |
| Albany County | 14,627 | 4,083 | 517 | 231 | 504 | 1,859 | 0 | 7,433 |
| % Distribution | 1.6% | 2.7% | 1.1% | 0.5% | 1.1% | 0.6% | - | 2.4% |
| King County | 82,712 | 22,912 | 5,883 | 4,513 | 4,777 | 8,910 | 118 | 35,599 |

| | Total | For Rent | Rented, Not Occupied | For Sale Only | Sold, Not Occupied | For Seasonal, Recreation, or Occasional Use | For Migrant Workers | Other Vacant |
|---|---|---|---|---|---|---|---|---|
| % Distribution | 9.4% | 15.1% | 13.5% | 10.8% | 10.8% | 3.0% | 8.4% | 11.8% |
| Richmond County | 13,392 | 3,506 | 511 | 1,778 | 998 | 759 | 0 | 5,840 |
| % Distribution | 1.5% | 2.3% | 1.1% | 4.2% | 2.2% | 0.2% | - | 1.9% |
| State of Virginia | 320,868 | 53,478 | 20,503 | 18,005 | 15,196 | 75,590 | 944 | 137,152 |
| Portsmouth County (City) | 2,479 | 358 | 142 | 224 | 225 | 553 | 0 | 977 |
| % Distribution | 7.7% | 6.6% | 0.6% | 1.2% | 1.4% | 0.7% | - | 0.7% |
| State of Texas | 1,071,573 | 284,570 | 43,687 | 64,609 | 54,148 | 184,909 | 1,266 | 438,384 |
| San Patricio County | 5,357 | 381 | 114 | 253 | 46 | 1,135 | 29 | 3,399 |
| % Distribution | 0.4% | 0.1% | 0.2% | 0.3% | .08% | .06% | 2.2% | 0.7% |

Source: U.S. Census Bureau American Community Survey 2021 5-Year Estimates. Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents."

## Table 7.1-9. Housing Affordability Characteristics

| | Median Home Value | Occupied Housing Units with a Mortgage | | Occupied Housing Units without a Mortgage | | Occupied Rental Units | | % of Total Housing Units Housing cost Burdened |
|---|---|---|---|---|---|---|---|---|
| | | Median Monthly Cost for Homeowner | % of Housing Units Housing Cost Burdened | Median Monthly Cost for Homeowner | % of Housing Units Housing Cost Burdened | Median Monthly Gross Rent | % of Housing Units Housing Cost Burdened | |
| State of New Jersey | $355,700 | $2,560 | 33.5% | $1,102 | 22.9% | $1,436 | 50.6% | 33.0% |
| Atlantic County | $222,600 | $1,999 | 38.0% | $917 | 25.0% | $1,175 | 58.5% | 32.2% |
| Burlington County | $270,000 | $2,207 | 29.0% | $967 | 18.8% | $1,444 | 49.0% | 28.8% |
| Camden County | $211,400 | $1,989 | 30.3% | $1,007 | 22.8% | $1,169 | 55.3% | 33.7% |
| Cape May County | $318,600 | $1,963 | 36.2% | $829 | 20.0% | $1,197 | 58.7% | 14.6% |
| Gloucester County | $232,800 | $2,148 | 26.3% | $946 | 20.3% | $1,301 | 53.3% | 27.6% |
| Monmouth County | $454,000 | $2,777 | 30.9% | $1,186 | 23.0% | $1,523 | 52.6% | 30.6% |
| Ocean County | $298,800 | $2,122 | 36.5% | $816 | 23.4% | $1,538 | 61.0% | 29.4% |
| Salem County | $187,400 | $1,899 | 32.7% | $847 | 20.9% | $1,064 | 60.1% | 32.3% |
| State of New York | $340,600 | $2,267 | 32.6% | $826 | 18.8% | $1,390 | 51.6% | 32.8% |

| | Median Home Value | Occupied Housing Units with a Mortgage | | Occupied Housing Units without a Mortgage | | Occupied Rental Units | | % of Total Housing Units Housing cost Burdened |
|---|---|---|---|---|---|---|---|---|
| | | Median Monthly Cost for Homeowner | % of Housing Units Housing Cost Burdened | Median Monthly Cost for Homeowner | % of Housing Units Housing Cost Burdened | Median Monthly Gross Rent | % of Housing Units Housing Cost Burdened | |
| Albany County | $235,200 | $1,113 | 22.8% | $664 | 10.0% | $1,140 | 43.5% | 25.3% |
| King County | $767,500 | $3,099 | 46.0% | $971 | 22.6% | $1,582 | 52.6% | 42.4% |
| Richmond County | $575,500 | $2,687 | 41.0% | $977 | 20.8% | $1,445 | 53.6% | 36.0% |
| State of Virginia | $295,500 | $1,891 | 25.1% | $501 | 10.2% | $1,326 | 47.2% | 26.9% |
| Portsmouth County (City) | $182,700 | $1,524 | 35.8% | $579 | 20.8% | $1,116 | 55.8% | 36.1% |
| State of Texas | $202,600 | $1,747 | 26.7% | $557 | 12.8% | $1,146 | 48.7% | 26.8% |
| San Patricio County | $141,900 | $1,579 | 19.0% | $486 | 11.6% | $1,134 | 49.3% | 19.8% |

Source: U.S. Census Bureau American Community Survey 2021 5-Year Estimates. Note: Portsmouth County (City) is an independent city considered a primary administrative division of the State of Virginia. The United States Census Bureau classifies independent cities as "county equivalents." The US Department of Housing and Urban Development (HUD) considers a household cost burdened if they spend 30% or more of their household income on housing costs.

### 7.1.2 Potential Socioeconomic Effects and Proposed Environmental Protection Measures

This section addresses the potential direct or indirect socioeconomic and environmental effects of the potential IPFs associated with the construction, O&M, and decommissioning of the proposed Project. Overall, the Project is anticipated to generate economic benefits, including job creation and economic stimulus to the Project Region. The potential IPFs related to specific Project phases are presented in Table 7.1-10.

**Table 7.1-10. Impact Producing Factors**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Workforce Recruiting and Training Programs | ● | ● | ● |
| Workforce Hiring | ● | ● | ● |
| Procurement of Certain Construction or Maintenance Materials | ● | ● | ● |
| Vessel charters | ● | ● | ● |
| Port Utilization | ● | ● | ● |
| Housing | ● | ● | ● |
| Temporary Accommodations | ● | | ● |

Atlantic Shores is working to maximize the Project's positive socioeconomic and environmental effects and minimize negative effects by consulting with stakeholders to identify potential issues, thoroughly investigating them, and devising strategies to avoid or minimize them.

Any potential negative socioeconomic effects resulting from the Project are expected to be limited in time and scope as they will predominantly occur from temporary conditions associated with construction activities. Onshore construction will be planned to minimize direct negative effects on the Project Region during the summer tourist season (i.e., Memorial Day through Labor Day). It is anticipated that any housing demand created by workers supporting the Project would be absorbed by the local market (see Section 7.1.2.6 and 7.1.2.7 for additional information on housing and temporary accommodations). Positive socioeconomic effects are expected to outlast any potential negative socioeconomic effects over the life of the Project.

Anticipated positive socioeconomic effects resulting from the Project include job creation and economic stimulus to the Project Region. The assumptions regarding what opportunities would occur locally were developed by Atlantic Shores in coordination with over 50 potential suppliers to the Project (both in and outside of New Jersey and New York) for the major strategic work packages through a formal competitive process designed to optimize local opportunities in the Project supply chain. As a result of this effort, a broad range of suppliers were identified from New Jersey and New York that will provide a large proportion of the Project development, construction, and O&M materials. As a result of this effort, it is anticipated that the Project will provide significant positive socioeconomic effects within the Project Region. Examples of local opportunities associated with each phase of the Project are as follows:

- **Development**: Project development activities include a wide variety of local opportunities, including technical and professional services; real estate services, marine operations, charter, and crewing of Jones Act compliant vessels, including survey vessels; interconnection and ROW development; and local initiatives including forming and maintaining key local partnerships, fostering New Jersey and New York offshore wind research and innovation, and targeted corporate philanthropy.
- **Manufacturing and Assembly Works**: The Project will attract a broad range of new manufacturing, equipment assembly, and marshaling opportunities to the Project Region. These opportunities will require the construction and commissioning of new facilities using materials and manufacturing equipment sourced from within the Project Region, but also requiring multi-modal means of transport within the Project Region for imported goods, including local ports, rail, and highways.
- **Installation of Offshore Equipment:** Local opportunities for the wind turbine generator (WTG) and foundation installations will include onshore staff for project management and engineering; component marshaling, including stevedoring, waste removal provisions, and security; fabrication and installation of sea-fastening facilities; marine operations; charter and crewing of Jones Act compliant vessels including survey vessels, barges, tugs and crew transfer vessels (CTVs); vessel crews and vessel operations including pilots, shipping agents, and port fees; fuel bunkering services; environmental protection and oversight services (e.g., noise mitigation, protected species, emergency containment, etc.); welders and steel fabricators; scour protection (including procurement of locally sourced rock); and food, lodging, and transportation of workforce.
- **Electrical Infrastructure**: The design, procurement, and installation of the Project electrical grid components for the offshore substations (OSS), onshore substations or converter stations and associated onshore interconnection cable routes, and landfall sites will require specialized electrical equipment (e.g., transformers, power quality equipment, switchgear, and control enclosures) from within the Project Region; onshore and offshore staff and support services, component marshaling; offshore supporting vessels and crew; and skilled installation technicians.
- **O&M**: Atlantic Shores will conduct O&M using existing facilities and ports. O&M of the Project will provide permanent jobs in technical service, marine operations, vessel crew, data analysis, offshore asset monitoring, preventative maintenance, and repair, as well as create economic activity for a wide range of subcontractors, including shipyards, spare part producers and vessel and harbor services.

A detailed economic Input-Output (I-O) model was developed by Atlantic Shores using the IMPLAN[52] online analysis tool to analyze and estimate the potential labor and economic effects of the planned spending and local opportunities in the Project Region. Using the projected local spending patterns for the Project described above, the I-O model estimates anticipated changes to local industry or commodity revenues in the Project Region due to that spending and the resulting increases in local supply chain and business-to-business transactions. The primary or "direct" effects on the local economy represent the initial effects felt in the Project Region from the new local spending, such as the number of jobs created or the total amount of sales or production. The secondary or "indirect" effects are changes in inter-industry transactions in the Project Region when supplying industries respond to increased demands from the directly affected industries. The tertiary or "induced" effects reflect changes in local household spending in the Project Region that result from income changes in the directly and indirectly affected industry sectors.

A planned schedule for the Project is provided in Table 7.1-11 to provide context for the anticipated duration of the jobs, the timeline of job creation, and other associated economic benefits. Atlantic Shores anticipates the Project's development phase through to financial close (the Final Investment Decision or "FID") to be five years. Following that, the Project's construction phase through to the final Commercial Operation Date (COD) is anticipated to be three years. The operation phase of the Project is anticipated to be 30 years, followed by a 3-year decommissioning period. Therefore, the Project's total duration is anticipated to be approximately 41 years.

### Table 7.1-11. Anticipated Project Schedule

| Phase | Start | End | Duration (Years) |
|---|---|---|---|
| Development | 2020 | 2025 | 5 |
| Construction | 2025 | 2028 | 3 |
| Operations | 2029 | 2059 | 30 |
| Decommissioning | 2059 | 2062 | 3 |

Notes: Table 4.1-1 of Volume I Project Information provides a detailed construction schedule. Atlantic Shores' Lease Agreement OCS-A 0549 includes a 25-year operating term, which may be extended or modified following applicable regulations in 30 CFR Part 585.

To estimate the direct, indirect, and induced labor force and other economic effects on the Project Region that result from the development, construction, operations, and decommissioning of the Project, Atlantic Shores relied upon the schedule assumptions as outlined in Table 7.1-11 and a capacity assumption of 2,355 MW (15 MW turbines, 157 positions). For this socioeconomic analysis, it was assumed that New Jersey and New York would each receive half of the total Project capacity (i.e., 1,117.5 MW for each state). However, the amount allocated to each state depends on future Offshore Renewable Energy Credit (OREC) solicitations in each state.

[52] IMPLAN is an industry-standard regional I-O modelling tool that assembles annual data sets from validated government and industry sources including the U.S. Bureau of Economic Analysis, (BEA) the U.S. Census Bureau, and the Bureau of Labor Statistics (BLS). All annual data sets used in this analysis are current to reporting year 2019. The IMPLAN software applies deflators to the 2019 data to provide results for current year of analysis (2020). The IMPLAN application and supporting documentation may be accessed at: https://www.implan.com/

#### 7.1.2.1 Workforce Recruiting and Training Programs

This IPF section focuses on the direct effect of workforce training programs on local communities during the development and construction, O&M, and decommissioning phases. Atlantic Shores is committed to maximizing the amount of recruiting and hiring from programs targeted at training and providing talent to the offshore wind industry from local New Jersey and New York communities. Atlantic Shores is committed to supporting numerous workforce training initiatives throughout the Project's lifecycle. These initiatives, which are detailed further in this section, are targeted to provide training and opportunities for students from low-income backgrounds, minority and women-owned business enterprises (MWBEs), and veterans (see Section 7.2 for additional information on how the proposed Project provides opportunities to benefit environmental justice and disadvantaged communities directly).

Atlantic Shores supports workforce development and research initiatives. These initiatives substantially impact the viability of the offshore wind industry in New Jersey and New York. Atlantic Shores is committed to supporting research and development initiatives in the following ways:

- Provide flexible grants and scholarships in support of industry growth (e.g., New Jersey WIND Institute and others).
- Sponsor events supporting the offshore wind industry, which will help build education and awareness and help share important research and development findings.
- Support New Jersey and New York-based training programs to bolster recruitment efforts and create meaningful, high-paying jobs in the Project Region.
- Support the development of offshore wind certificate programs at community colleges in the Project Region.
- Collaborate on research projects that support the development of innovative and environmentally sustainable offshore wind development.

Atlantic Shores is committed to partnering with the Rowan College Burlington County Workforce Development Institute to leverage existing workforce programs that will have a direct benefit to the offshore wind industry and supply chain, including the following:

- The Energy Industry Fundamentals Program: Students in this program are trained in the operations components of the energy industry, safety procedures, and transmission, all of which are critical for a vast array of jobs in the offshore wind industry. All Energy Industry Fundamentals students are women and/or people of color. Atlantic Shores will work to recruit from this program as part of its commitment to diversity and inclusion initiatives, focusing on training programs and hiring practices.
- The Supply Chain, Transportation, Logistics, and Distribution Program: Students in the program learn skills that support transportation, operations management,

manufacturing, and international logistics to build a critical talent pool to support the landside logistics of a robust offshore wind supply chain.

- The Manufacturing Machinist and Industrial Maintenance Program: Students in this program build skills necessary for advanced manufacturing and for the O&M of heavy equipment. As component manufacturers and others establish themselves in the State, Atlantic Shores is actively supporting the development of a robust workforce to provide a pipeline of capable workers.

In addition, Atlantic Shores will provide other initiatives designed to facilitate meeting the long-term O&M requirements of the Project:

- Contribute to scholarship programs to support and prepare students for careers in the renewable energy field.
- Contribute funds to the Science, Technology, Engineering, Arts, and Mathematics (STEAM) programming with the Boys and Girls Clubs and other educational institutions within the Project Region.
- Partner with the Chambers of Commerce within the Project Region to increase opportunities for MWBEs.
- Provide access to Atlantic Shores' parent company (i.e., Shell) training and job programs.
- Coordinate with the Department of Labor.
- Support industry conferences and WTG supplier training programs.
- Foster university outreach, innovation, and research.
- Fund and support construction industry training programs for veterans, specifically 'Helmets2Hardhats', which trains veterans for jobs in the construction industry.

#### 7.1.2.2 Workforce Hiring

This IPF section focuses on the direct effect of workforce hiring on local New Jersey and New York communities during the development and construction, O&M, and decommissioning phases. During the construction phase, Atlantic Shores will be directly hiring a diverse range of trades and skills in fabrication, component assembly, and construction/installation. Specific trade unions will include ironworkers, carpenters (e.g., pile drivers, dock builders, millwrights), operating engineers, laborers, and electricians. The Project is expected to create approximately 24,000 direct full-time equivalents (FTE) jobs, 12,000 indirect FTE jobs, and 14,000 induced FTE jobs.[53] Detailed job creation totals for the Project's various phases, expressed as FTEs, and other types of workforce information, including the type of activity, occupation, wages, and salaries, and required education and training levels for the

[53] Job totals are preliminary estimates only. Totals have been rounded to the nearest thousand and therefore do not match up with the FTE job values presented in the following tables which are calculated based on Project size.

estimated direct, indirect, and induced employment created the Project are provided in Tables 7.1-12 through 17. The results in Table 7.1-12 are provided in two sections, including tabulation by two-digit North American Industry Classification System (NAICS) industry sector divisions and further summarized in the second part of the table by 6-digit NAICS codes, the most detailed level of NAICS classification. Almost half (49.1%) of the estimated direct jobs in the development and construction phases will be within the construction sector (NAICS Sector 23), principally in heavy and marine construction, power sector works, and fabrication of manufacturing and industrial buildings. Of the remaining jobs, approximately a third (33.4%) will be within the manufacturing sector (NAICS Sectors 31-33), principally associated with the manufacturing of monopiles and nacelle assembly. Other important industries directly affected by the development and construction phases include professional services (NAICS Sector 54) for engineering, environmental and other technical studies (9.6%) and transport and warehousing logistics (NAICS Sector 48-49) for marine vessels, harbor services, trucking, and warehousing (7.3%).

### Table 7.1-12. Total Direct Employment FTEs in New Jersey – Development and Construction Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 23: Construction | 49.1% | 2,368 | 2,368 |
| Sector 31-33: Manufacturing | 33.4% | 1,610 | 1,610 |
| Sector 54: Professional Services | 9.6% | 464 | 464 |
| Sector 48-49: Transport. and Warehousing | 7.3% | 350 | 350 |
| Sector 56: Administrative Management | 0.6% | 29 | 29 |
| Sector 42: Wholesale Trade | 0.1% | 3 | 3 |
| **Total** | **100%** | **4,824** | **4,824** |
| **NAICS 6-Digit Industry Classification** | **Percent** | **NJ FTE (1,117.5 MW)** | **NY FTE (1,117.5 MW)** |
| 332312 - Fabricated Structural Steel | 27.7% | 1,337 | 1,337 |
| 237130 - Power lines and structures | 24.5% | 1,182 | 1,182 |
| 236210 - Industrial building construction | 12.9% | 622 | 622 |
| 237990 - Heavy and marine construction | 11.7% | 563 | 563 |
| 541330 - Engineering services | 5.8% | 278 | 278 |
| 333611 - Wind turbine services | 5.5% | 265 | 265 |
| 488310 - Port and harbor operations | 4.8% | 233 | 233 |
| 541611 - Professional management | 3.8% | 184 | 184 |
| 483211 - Offshore construction vessels | 2.1% | 103 | 103 |
| 561599 - Travel and accommodations | 0.6% | 29 | 29 |
| 484121 - Freight trucking | 0.3% | 16 | 16 |
| 336611 - Ship building and repairing | 0.2% | 9 | 9 |
| 423830 - Industrial equipment wholesalers | 0.1% | 3 | 3 |
| **Total** | **100%** | **4,824** | **4,824** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year).

The Project is expected to fill workforce needs where possible through contracting with New Jersey and New York-based companies and employees. Atlantic Shores will use New Jersey trade unions for construction through a six-union Memorandum of Understanding (MOU) executed with its major suppliers. This labor agreement is the first of its kind, a monumental moment in developer/labor relations, and a positive step forward in workforce development in the clean energy market. Local manufacturing will produce and assemble Project components, including monopile fabrication, transition piece platform fabrication and final assembly, wind turbine nacelle assembly, and wind turbine blade finishing. Local unions that signed the MOU are the UBCJA (carpenters, divers, dock builders, and piledrivers), LIUNA (laborers), IBEW (electricians), IUOE (operating engineers), ironworkers, and union millwrights. The MOU is modeled after a National Construction Alliance (NCA) Agreement on which the trades mentioned above are signed at an international level and are key contractors already doing offshore and in-shore work associated with offshore wind development. The list of contractors on this agreement continues to grow, which signals the contractors' support of this type of agreement. Atlantic Shores plans to acquire a similar agreement and/or comply with the labor standards BOEM and the State of New York set forth.

The Atlantic Shores union labor agreement is important for many reasons. It demonstrates its commitment to using union labor and employers wherever possible. It shows the company's strong commitment to training residents and tradespeople and the unions' willingness to be creative partners in meeting the growing needs of the industry. New Jersey and New York are poised to be the leaders in clean energy job creation, and the Project demonstrates what good corporate partnership looks like in this new economy.

During the O&M phase, Atlantic Shores will be directly hiring a range of trades skilled in offshore wind operations. These include a staff of technicians, engineers, and managers. Estimated direct job creation during the operations phase of the Project is summarized in Table 7.1-13; estimates are provided in two sections, including tabulation by 2-digit NAICS industry sector divisions and 6-digit NAICS codes. The operations phase is anticipated to be 30 years, including the constructed wind facility's operations and maintenance (O&M).[54] Operations will result in approximately 6,685 FTE jobs over the operations phase or approximately 223 FTE jobs annually for each state.

Wind turbine servicing (included in the manufacturing sector, NAICS Sectors 31-33) is estimated to create 58.8% of the total estimated direct jobs in the operation phase. Other important industries directly affected by the operations phase include professional services (NAICS Sector 54) for engineering, environmental and other technical studies (13.1%), construction (NAICS Sector 23) for heavy marine installation and service to the operational turbines and foundations (11.3%), and port and harbor logistics (NAICS Sector 48-49) for the and crew transfer vessels and other harbor services (11.3%).

[54] Atlantic Shores' Lease Agreement OCS-A 0549 includes a 25-year operating term, which may be extended or otherwise modified in accordance with applicable regulations in 30 CFR Part 585.

## Table 7.1-13. Total Direct Employment FTEs in New Jersey – Operations Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 31-33: Manufacturing | 58.8% | 3,931 | 3,931 |
| Sector 54: Professional Services | 15.7% | 1,050 | 1,050 |
| Sector 23: Construction | 14.5% | 969 | 969 |
| Sector 48-49: Transport. and Warehousing | 9.2% | 614 | 614 |
| Sector 42: Wholesale Trade | 1.8% | 120 | 120 |
| **Total** | **100%** | **6,685** | **6,685** |
| **NAICS 6-Digit Industry Classification** | **Percent** | **NJ FTE (1,117.5 MW)** | **NY FTE (1,117.5 MW)** |
| 333611 - Wind turbine services | 58.8% | 3,931 | 3,931 |
| 541611 - Professional management | 13.1% | 876 | 876 |
| 237990 - Heavy and marine construction | 11.3% | 755 | 755 |
| 488310 - Port and harbor operations | 9.0% | 602 | 602 |
| 541330 - Engineering services | 2.5% | 167 | 167 |
| 237130 - Power lines and structures | 1.7% | 114 | 114 |
| 423930 - Recyclable material wholesalers | 1.8% | 120 | 120 |
| 236210 - Industrial building construction | 1.4% | 93 | 93 |
| 483211 - Offshore construction vessels | 0.3% | 20 | 20 |
| 325120 - Industrial Gas Manufacturing | 0.1% | 7 | 7 |
| **Total** | **100%** | **6,685** | **6,685** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year).

Once operational, the Project will be supported by existing O&M facilities. A workforce will be required for planned periodic maintenance within the Offshore Project Area, including the export cables and periodic maintenance and repairs to in-water and other Project components. Atlantic Shores expects that these jobs will be filled by New Jersey and New York residents, with the existing local maritime and fishing industry supporting some vessel-related needs of the Project. The number of workers at the O&M facilities will fluctuate seasonally and depend on the final engineering design and service strategy.

During the decommissioning phase, Atlantic Shores will hire trades, technical, and management professionals as the construction workforce. Specific trade unions will include ironworkers, carpenters (e.g., pile drivers, dock builders, millwrights), operating engineers, laborers, and electricians. Estimated direct job creation during the decommissioning phase of the Project is summarized in Table 7.1-14; estimates are provided in two sections, including tabulation by 2-digit NAICS industry sector divisions and 6-digit NAICS codes. The decommissioning phase is three years following the completion of operations and includes the removal and proper disposal or recycling of all installed equipment. Decommissioning will result in approximately 504 total FTE jobs for each state, New Jersey and New York.

Wind turbine servicing (included in the manufacturing sector, NAICS Sectors 31-33) is estimated to create 58.8% of the total estimated direct jobs in the decommissioning phase.

Other important industries directly affected by the decommissioning phase include professional services (NAICS Sector 54) for engineering, environmental and other technical studies (13.1%), construction (NAICS Sector 23) for heavy marine installation and service to the operational turbines and foundations (11.3%), and port and harbor logistics (NAICS Sector 48-49) for the and crew transfer vessels and other harbor services (11.3%).

### Table 7.1-14. Total Direct Employment FTEs in New Jersey –Decommissioning Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 31-33: Manufacturing | 58.8% | 296 | 296 |
| Sector 54: Professional Services | 15.7% | 79 | 79 |
| Sector 23: Construction | 14.5% | 73 | 73 |
| Sector 48-49: Transport. and Warehousing | 9.2% | 47 | 47 |
| Sector 42: Wholesale Trade | 1.8% | 9 | 9 |
| **Total** | **100%** | **504** | **504** |
| **NAICS 6-Digit Industry Classification** | **Percent** | **NJ FTE (1,117.5 MW)** | **NY FTE (1,117.5 MW)** |
| 333611 - Wind turbine services | 58.8% | 296 | 296 |
| 541611 - Professional management | 13.1% | 66 | 66 |
| 237990 - Heavy and marine construction | 11.3% | 57 | 57 |
| 488310 - Port and harbor operations | 9.0% | 45 | 45 |
| 541330 - Engineering services | 2.5% | 13 | 13 |
| 423930 - Recyclable material wholesalers | 1.8% | 9 | 9 |
| 237130 - Power lines and structures | 1.7% | 8 | 8 |
| 236210 - Industrial building construction | 1.4% | 7 | 7 |
| 483211 - Offshore construction vessels | 0.3% | 2 | 2 |
| 325120 - Industrial Gas Manufacturing | 0.1% | 1 | 1 |
| **Total** | **100%** | **504** | **504** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year).

Because of anticipated growth in the offshore wind industry over the 30-year lifecycle of the Project, a larger share of trained workers is likely to be available from the local workforce at the time of decommissioning. However, some highly specialized workforce needs during decommissioning may still require temporary relocation to the Project Region. The economic effects of decommissioning, particularly in proximity to the ports, are expected to be similar and generally consistent with construction. Some local businesses involved in decommissioning may differ from those used during construction, such as those specializing in large-scale recycling, sorting, and transportation of offshore wind construction and demolition materials and disposal.

Indirect jobs are anticipated to be created in other support sectors servicing the direct construction, manufacturing, and professional services jobs. The indirect jobs are primarily in management services, wholesale trade, and transportation but also include jobs within real estate, finance and insurance, and other New Jersey and New York industries that will benefit from increased economic activities.

A summary of estimated indirect job creation in New Jersey and New York during each phase (i.e., development and construction, operations, and decommissioning) of the Project is presented in Tables 7.1-15 through Table 7.1-17; two-digit NAICS industry sector divisions organize results. The management of companies and enterprises (NAICS Sector 55), which are activities that are typically provided in-house for the oversight of organizations, is estimated to provide 26.5% of all new indirect jobs. Other important industries indirectly affected by the Project include wholesale trade (NAICS Sector 42), transportation (NAICS Sectors 48-49), professional services (NAICS Sector 54), and manufacturing (NAICS Sectors 31-33).

### Table 7.1-15. Total Indirect Employment FTEs – Development and Construction Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 55: Management | 26.5% | 755 | 755 |
| Sector 42: Wholesale Trade | 18.1% | 516 | 516 |
| Sector 48-49: Transportation | 13.6% | 387 | 387 |
| Sector 54: Professional Services | 9.4% | 267 | 267 |
| Sector 31-33: Manufacturing | 6.1% | 175 | 175 |
| Sector 53: Real Estate | 5.6% | 158 | 158 |
| Sector 52: Finance and Insurance | 5.5% | 157 | 157 |
| Sector 92: Public Administration | 3.1% | 89 | 89 |
| **Total** | **100%** | **2,503** | **2,503** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

### Table 7.1-16. Total Indirect Employment FTEs – Operations Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 55: Management | 26.5% | 940 | 940 |
| Sector 42: Wholesale Trade | 18.1% | 642 | 642 |
| Sector 48-49: Transportation | 13.6% | 482 | 482 |
| Sector 54: Professional Services | 9.4% | 332 | 332 |
| Sector 31-33: Manufacturing | 6.1% | 218 | 218 |
| Sector 53: Real Estate | 5.6% | 198 | 198 |
| Sector 52: Finance and Insurance | 5.5% | 195 | 195 |
| Sector 92: Public Administration | 3.1% | 111 | 111 |
| **Total** | **100%** | **3,117** | **3,117** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

### Table 7.1-16. Total Indirect Employment FTEs – Decommissioning Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 55: Management | 26.5% | 71 | 71 |
| Sector 42: Wholesale Trade | 18.1% | 48 | 48 |
| Sector 48-49: Transportation | 13.6% | 36 | 36 |
| Sector 54: Professional Services | 9.4% | 25 | 25 |
| Sector 31-33: Manufacturing | 6.1% | 16 | 16 |
| Sector 53: Real Estate | 5.6% | 15 | 15 |
| Sector 52: Finance and Insurance | 5.5% | 15 | 15 |
| Sector 92: Public Administration | 3.1% | 8 | 8 |
| **Total** | **100%** | **235** | **235** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

Induced jobs created by the expenditure of wages will be in sectors such as health care and social assistance, retail trade, and accommodation and food services, which will also benefit from the thousands of jobs created during the Project. Estimated induced job creation during each phase of the Project is summarized in Table 7.1-17- 7.1-19, tabulated by two-digit NAICS industry sector divisions. Induced jobs are those created through increases in income to households, resulting in more broad-based job development, especially in those industries that serve individuals and families. Health care and social services (NAICS Sector 62) account for 21.4% of the new estimated induced jobs. Other important industries affected by the induced effects of the Project include retail trade (NAICS Sector 44-45), general services (NAICS Sectors 81), and accommodations and food services (NAICS Sector 72).

### Table 7.1-17. Total Induced Employment FTEs – Development and Construction Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 62: Health Care and Social Assist. | 21.4% | 685 | 685 |
| Sector 44-45: Retail Trade | 14.8% | 475 | 475 |
| Sector 81: General Services | 10.6% | 340 | 340 |
| Sector 72: Accommodation and Food Svcs. | 9.5% | 306 | 306 |
| Sector 55: Management | 8.8% | 282 | 282 |
| Sector 52: Finance and Insurance | 7.9% | 255 | 255 |
| Sector 53: Real Estate | 5.3% | 169 | 169 |
| Sector 48-49: Transportation | 4.1% | 132 | 132 |
| Sector 61: Educational Services | 3.9% | 127 | 127 |
| Sector 71: Arts and Recreation | 3.3% | 104 | 104 |
| **Total** | **100%** | **2,876** | **2,876** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

### Table 7.1-18. Total Induced Employment FTEs – Operations Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 62: Health Care and Social Assist. | 21.4% | 951 | 951 |
| Sector 44-45: Retail Trade | 14.8% | 659 | 659 |
| Sector 81: General Services | 10.6% | 471 | 471 |
| Sector 72: Accommodation and Food Svcs. | 9.5% | 425 | 425 |
| Sector 55: Management | 8.8% | 391 | 391 |
| Sector 52: Finance and Insurance | 7.9% | 354 | 354 |
| Sector 53: Real Estate | 5.3% | 235 | 235 |
| Sector 48-49: Transportation | 4.1% | 184 | 184 |
| Sector 61: Educational Services | 3.9% | 175 | 175 |
| Sector 71: Arts and Recreation | 3.3% | 145 | 145 |
| **Total** | **100%** | **3,990** | **3,990** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

### Table 7.1-19. Total Induced Employment FTEs – Decommissioning Phase

| NAICS 2-Digit Industry Sector | Percent | NJ FTE (1,117.5 MW) | NY FTE (1,117.5 MW) |
|---|---|---|---|
| Sector 62: Health Care and Social Assist. | 21.4% | 72 | 72 |
| Sector 44-45: Retail Trade | 14.8% | 49 | 49 |
| Sector 81: General Services | 10.6% | 35 | 35 |
| Sector 72: Accommodation and Food Svcs. | 9.5% | 32 | 32 |
| Sector 55: Management | 8.8% | 30 | 30 |
| Sector 52: Finance and Insurance | 7.9% | 27 | 27 |
| Sector 53: Real Estate | 5.3% | 18 | 18 |
| Sector 48-49: Transportation | 4.1% | 14 | 14 |
| Sector 61: Educational Services | 3.9% | 13 | 13 |
| Sector 71: Arts and Recreation | 3.3% | 11 | 11 |
| **Total** | **100%** | **301** | **301** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Note: Job numbers are preliminary estimates only. Full-time equivalent (FTE) employment assumes 40 hours a week (2,080 per year). Total refers to that of all FTE. For brevity, only the top sectors are presented in the table.

Cross-industry occupation types (identified with its Bureau of Labor Statistics Occupation Code) created through the direct effects of the Project are provided in Table 7.1-20. The table presents the average percentage of the total direct jobs created by the Project for each occupation (Percent), the average hourly rate (Avg. Rate), the New Jersey and New York wage percentile of the average hourly rate (NJ/ NY PCTL), and the Location Quotient (LOC QE). The average hourly rate is calculated by dividing the FTE-adjusted wages and salaries by the average estimated total hours worked by each occupation.

The NJ and NY PCTL is the hourly wage percentile of the average hourly rate for New Jersey and New York by occupation, as provided by the U.S. Bureau of Labor Statistics.[55] As seen in Table 7.1-15, the specific occupations created by the Project tend to provide above-average wages and salaries compared to the national average. The LOC QE represents the ratio of an occupation's share of employment in each area to that occupation's share of employment in the United States as a whole. For example, an occupation that makes up 10% of employment in a specific metropolitan area compared with 2% of U.S. employment would have a location quotient of 5 for the area in question. The results presented in Table 7.1-20 indicate that many of the anticipated jobs from the Project are from sectors currently below national employment rates in New Jersey and New York, such as production, construction/extraction, architecture and engineering, and installation, maintenance, and repair. Therefore, the Project will potentially increase opportunities for new employment in these sectors, leading to new avenues for economic growth in the Project Region.

### Table 7.1-20. Cross-Industry Occupation Direct Effects

| BLS Occupation Code | Percent | Avg. Rate | NJ PCTL | NY PCTL | NJ LOC QE | NY LOC QE |
|---|---|---|---|---|---|---|
| 51-0000 Production | 28.3% | $36.16 | 90 PCTL | 90 PCTL | 0.68 | 0.55 |
| 47-0000 Construction and Extraction | 15.9% | $33.03 | 50 PCTL | 75 PCTL | 0.7 | 0.89 |
| 43-0000 Office and Administration | 11.5% | $36.12 | 90 PCTL | 90 PCTL | 1.05 | 1.05 |
| 17-0000 Architecture and Engineering | 10.2% | $65.47 | 75 PCTL | 75 PCTL | 0.72 | 0.64 |
| 11-0000 Management | 7.2% | $91.19 | 90 PCTL | 75 PCTL | 0.97 | 0.96 |
| 13-0000 Business and Financial | 6.9% | $57.58 | 75 PCTL | 75 PCTL | 1.1 | 1.15 |
| 53-0000 Transportation | 6.6% | $36.33 | 90 PCTL | 90 PCTL | 1.29 | 0.78 |
| 49-0000 Installation, Maintenance, and Repair | 5.5% | $38.20 | 75 PCTL | 75 PCTL | 0.87 | 0.86 |
| 41-0000 Sales and Related | 3.1% | $48.33 | 90 PCTL | 90 PCTL | 1 | 0.97 |
| 15-0000 Computer and Mathematical | 2.3% | $68.78 | 75 PCTL | 75 PCTL | 1.14 | 0.92 |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Notes: Percentages do not add to 100%. For brevity, only the top results are presented in the table. Job numbers are preliminary estimates only.

Estimated education needs for occupations the Project requires are summarized in Table 7.1-21. Over one-third (38.9%) of the new jobs require only a high school diploma or equivalent (GED), indicating that the Project will provide new opportunities for people generally left behind in the current job market, where a bachelor's degree or associate degree is often required as a minimum level of education.

[55] May 2019 OES Estimates. Occupational Employment Statistics (OES) Survey. Bureau of Labor Statistics, Department of Labor. www.bls.gov/oes

### Table 7.1-21. Cross-Industry Occupation Direct Effects – Education Requirements

| Description | Percent |
|---|---|
| High School Diploma or equivalent (GED) | 38.9% |
| Bachelor's Degree | 15.7% |
| Post-Secondary Certificate | 12.6% |
| Less than a High School Diploma | 11.3% |
| Associate's degree (or other 2-year degree) | 7.5% |
| Some College Courses | 7.3% |
| Master's Degree | 3.6% |
| Post-Baccalaureate Certificate | 1.3% |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019. Percentages do not add to 100%. For brevity, only the top results are presented in the table.

Estimated labor income and value-added impacts for each phase of the Project are summarized in Tables 7.1-22 through 7.1-24. Labor income represents the total value of all employment income paid throughout each phase of the Project. Labor income reflects the sum of employee compensation (i.e., wages and benefits) and proprietor income (i.e., payments received by self-employed individuals or unincorporated business owners). Value added represents the difference between project output and the cost of intermediate project inputs throughout each phase of the Project. In other words, it is the Project's contribution to GDP. Overall, the Project is expected to create significant ripple effects in the New Jersey and New York state economies throughout its lifetime, contributing $937.9 million in labor income and $1.3 billion in value added.

### Table 7.1-22. Economic Impact Measures: Direct Value Added & Labor Income ($ Million)

| | NJ (1,117.5 MW) | | NY (1,117.5 MW) | |
|---|---|---|---|---|
| **Phase** | **Labor Income** | **Value Added** | **Labor Income** | **Value Added** |
| Development | $73.0 | $97.5 | $73.0 | $97.5 |
| Construction | $198.3 | $277.8 | $198.3 | $277.8 |
| Operations | $194.9 | $260.4 | $194.9 | $260.4 |
| Decommissioning | $2.8 | $3.5 | $2.8 | $3.5 |
| **Total** | **$468.9** | **$639.1** | **$468.9** | **$639.1** |

Notes: Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019.

### Table 7.1-23. Economic Impact Measures: Indirect Value Added & Labor Income ($ Million)

| Phase | NJ (1,117.5 MW) | | NY (1,117.5 MW) | |
|---|---|---|---|---|
| | Labor Income | Value Added | Labor Income | Value Added |
| Development | $37.0 | $49.4 | $37.0 | $49.4 |
| Construction | $100.5 | $140.9 | $100.5 | $140.9 |
| Operations | $98.8 | $132.0 | $98.8 | $132.0 |
| Decommissioning | $1.4 | $1.8 | $1.4 | $1.8 |
| **Total** | **$237.8** | **$324.1** | **$237.8** | **$324.1** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019.

### Table 7.1-24. Economic Impact Measures: Induced Value Added & Labor Income ($ Million)

| Phase | NJ (1,117.5 MW) | | NY (1,117.5 MW) | |
|---|---|---|---|---|
| | Labor Income | Value Added | Labor Income | Value Added |
| Development | $40.7 | $54.3 | $40.7 | $54.3 |
| Construction | $110.6 | $154.9 | $110.6 | $154.9 |
| Operations | $108.7 | $145.2 | $108.7 | $145.2 |
| Decommissioning | $1.6 | $1.9 | $1.6 | $1.9 |
| **Total** | **$261.5** | **$356.4** | **$261.5** | **$356.4** |

Source: IMPLAN modeling tool drawing from validated government and industry sources, including the U.S. Bureau of Economic Analysis, the U.S. Census Bureau, and the Bureau of Labor Statistics. 2019.

### 7.1.2.3 Procurement of Certain Construction or Maintenance Materials

To the extent practicable, construction materials and other supplies will be sourced from within the Project Region, including vessel provisioning and servicing and certain fabrication and assembly work. Suppliers will be selected based on their industry expertise, track record, financial strength, ability to deliver viable products within the targeted schedule, and current presence or plans for localizing activities in New York and New Jersey. This IPF section focuses on the direct effect of the procurement of construction or maintenance materials on local communities during construction, O&M, and decommissioning.

Effects associated with material sourcing are anticipated to have a stimulating effect on the Project Region's economy. Atlantic Shores will procure construction and maintenance materials and services through commitments with local suppliers (e.g., foundation fabrication and assembly, wind turbine nacelle assembly, and building portions of O&M vessels). The O&M phase of the Project will require the purchase and use of machinery and equipment for the planned O&M services. Over the life of the Project's long-term procurement for preventive maintenance of onshore and offshore facilities will require accessing local suppliers to the maximum extent practicable. It is also assumed, however, that some highly specialized equipment or parts may need to be acquired outside of New York and New Jersey during the 30-year lifecycle.

#### 7.1.2.4 Vessel Charters

This IPF section focuses on the direct effect that utilization of vessel charters will have on local communities during the Project's development, construction, O&M, and decommissioning. Offshore construction will utilize vessels from in-state, other U.S.-flagged vessels, and a limited number of foreign vessels where U.S. vessels do not exist or are unavailable. The Project will require the transport of crew transfer vessels (CTVs) from ports and staging areas onshore for pre-construction studies and surveys and during construction. Atlantic Shores will use local charters for transporting some survey, construction, and installation workers, as well as for transportation of some equipment and materials depending on the transport capacity of local contractors, equipment and material manufacturers, and product suppliers.

During the O&M and decommissioning phases of the Project, it is anticipated that Atlantic Shores will continue using local providers to provide support services, fuel, and storage space. Additional opportunities for area marine services, including tug and other vessel charters, dockage, fueling, inspection/repairs, and other port and harbor services, are also anticipated as part of routine O&M procedures.

#### 7.1.2.5 Port Utilization

Atlantic Shores will maximize the use of local New Jersey and New York ports during the construction of the Project. Atlantic Shores will contribute to making the region a hub for offshore wind by using and developing ports across New Jersey and New York, as summarized in Table 4.10-2 of Volume I. This IPF section evaluates the ports that may be used during construction activities associated with the Project. These facilities occur in New Jersey and New York. The use of ports during the Project is described in Table 7.1-25.

**Table 7.1-25. Use of Ports During Construction of the Project**

| Port | Location | Anticipated Use |
|---|---|---|
| New Jersey Wind Port | Salem County, New Jersey | Will play a key role as the Project's onshore staging area, marshaling activities, and as a major fabrication center for Project components. Construction activities will provide job opportunities within the marine trades and offshore wind-affiliated industries, particularly those influenced by seasonal hiring. Opportunities for marine trades include tug and other vessel charters, dockage, fueling, inspection/repairs, provisioning, and crew work. Once it is in operation, this port will service wind projects across the Eastern seaboard. |
| Paulsboro Marine Terminal | Gloucester County, New Jersey | Paulsboro will serve as the foundation manufacturing center for Atlantic Shores. Atlantic Shores is supporting the expanded growth of the EEW facilities, allowing for the supply of steel plates and other components, manufacturing foundation components, staging, and transport from the port to offshore wind sites. |
| Repauno Port & Rail Terminal | Gloucester County, New Jersey | Atlantic Shores may use this port temporarily during project construction, only as an alternative site if needed. Repauno Port & Rail Terminal features a new multi-purpose dock with an approximately 40-ft (12-m) draft capable of handling various products. |

| Port | Location | Anticipated Use |
|---|---|---|
| Port of Albany | Albany County, New York | Atlantic Shores may use this port temporarily during project construction. Staging/Pre-Assembly Activities may include those required to construct WTG, piled and gravity foundations, and offshore cables. |
| Port of Coeymans Marine Terminal | Albany County, New York | Atlantic Shores may use this port during project construction. Staging/Pre-Assembly Activities may include those required for WTG, piled and gravity foundations, and offshore cables. |
| Arthur Kill Terminal | Richmond County, New York | Atlantic Shores may use this port during project construction. Staging/Pre-Assembly Activities include those required for WTG, including full tower assembly, OSS, piled, suction bucket, gravity foundations, and offshore cables. |
| Ingleside | San Patricio County, Texas | Atlantic Shores may use this port during project construction. Staging/Pre-Assembly Activities include those required for OSS and foundations. |
| Portsmouth Marine Terminal | Portsmouth County (City), Virginia | Atlantic Shores may use this port during project construction. Staging/Pre-Assembly Activities include those required for WTG, OSS, foundations, and offshore cables. |

**Note**: Atlantic Shores' use of port facilities will be consistent with their current and planned uses.

Atlantic Shores will likely establish a long-term CTV base at the O&M facility in Atlantic City. If Atlantic Shores employs an SOV-based O&M strategy, those SOVs would likely be operated out of existing ports in New York or New Jersey or another industrial port identified in Table 7.5-1 that has suitable water depths and quayside facilities to support an SOV. During decommissioning, all Project components are expected to be transported from their installation location to the selected port. Components will be unloaded by crane to onshore transport vehicles and sent to predetermined storage or disposal locations.

#### 7.1.2.6 Housing

This IPF section focuses on the direct effect of the Project's construction, O&M, and decommissioning on the availability and affordability of housing for local communities. Overall, the Project will benefit local economies and industries by hiring locally and sourcing materials locally from within the Project Region whenever practicable. This will have beneficial ripple effects on the housing market. Because Atlantic Shores emphasizes local hiring and the use of local suppliers, any increase in housing demand is expected to be limited to areas close to port locations, as opposed to increased demand on the Project Region as a whole. These ports are well-established in coastal communities adequately served by the existing housing supply adequately served by the existing housing supply and subject to the local policies that influence housing affordability. Based on existing housing availability and housing affordability data examined in Section 7.1.1.3, local housing markets will absorb any increase in workforce housing demand for the Project. The small number of personnel that may relocate to the Project Region permanently from other locations is not anticipated to affect housing availability or affordability.

#### 7.1.2.7 Temporary Accommodations

This IPF section focuses on the direct effect of temporary housing accommodations on local communities during the construction, O&M, and decommissioning of the Project.

Onshore construction will be planned to minimize effects on the Project Region during the summer tourist season (i.e., Memorial Day through Labor Day). The Project will utilize locations and construction schedules where and when seasonal use is a lower percentage of all housing, and therefore, housing units for rent or sale would be more available for short- or long-term use. For example, when lodging demand declines during the off-season for tourism, the Project may provide additional economic benefits to the local communities by replacing tourism demand with temporary Project demand for accommodations. This may include rentals for houses, apartments, and hotels/motels.

Once the Project is operational, the need for any temporary housing accommodations will be greatly reduced and dependent upon any need for temporarily housing skilled technicians or other trades unavailable from the local workforce. O&M is not anticipated to affect local housing demand for temporary accommodations such as hotels and motels. The need for temporary accommodation during decommissioning is anticipated to be similar to what will be needed during construction.

#### 7.1.2.8 Summary of Proposed Environmental Protection Measures

Most potential effects on demographics, employment, and economics are expected to be temporary and localized, as described in the previous sections. Potential socioeconomic effects from offshore wind energy projects predominantly result from construction activities. However, these effects are temporary. Atlantic Shores has already taken preliminary steps to maximize the positive economic benefits of the Project. Positive economic impacts are expected to outlast any potentially negative economic effects over the 30-year life of the Project. Negative effects will be minimized by consulting with stakeholders to identify potential issues, thoroughly investigating them, and devising strategies to avoid or minimize adverse effects. Beneficial effects spurred by the construction and O&M of the Project include job creation and economic stimulus to the Project Region. Onshore construction will be planned to minimize direct impacts on the Project Region during the summer tourist season, and it is anticipated that the local market will absorb any housing demand created by workers supporting the Project. Socioeconomic effects and benefits, where they occur, are expected to be concentrated in proximity to the ports hosting Project-related activities. The following provides a summary of proposed minimization and mitigation measures that Atlantic Shores will implement to maximize the positive economic benefits within the Project Region:

- Atlantic Shores conducted an IMPLAN economic impact analysis model to estimate the Project’s New Jersey and New York workforce numbers.
- A diverse and local workforce will be hired (to be recruited from local training programs).
- Workforce initiatives will be established to support minority and low-income populations, MWBEs, veterans, and disadvantaged communities.
- Atlantic Shores will participate in multiple local chambers of commerce supporting minority groups.
- Construction materials and other supplies will be locally sourced, including vessel provisioning and servicing and certain fabrication and assembly work, to the extent possible and practical.

- Vessels from in-state and other U.S.-flagged vessels will be used to the maximum extent practicable.
- Onshore construction will be scheduled to occur outside of summer tourist season (i.e., Memorial Day through Labor Day) and follow local noise ordinances.
- Local ports will be used to the maximum extent practicable.

## 7.2 Environmental Justice

This section includes an environmental justice (EJ) assessment to identify EJ areas and Disadvantaged Communities within the Atlantic Shores Project Region (Project Region) and evaluate the potential for significant and adverse disproportionate impacts resulting from the construction, operation and maintenance (O&M), and decommissioning of the proposed Project. This section also presents associated impact-producing factors (IPFs) and examines whether EJ areas and Disadvantaged Communities (DACs) will receive disproportionately low benefits from the Project.

For purposes of the assessment of environmental justice, the Project Region is the geographic area that encompasses those EJ areas and DACs and resources that could be affected by construction, O&M, and decommissioning of the Project. The New York, New Jersey, Virginia, and Texas regions are well prepared for coastal and maritime construction projects with plentiful port infrastructure and a robust and available workforce that will fill the employment needs of the Project. It is not anticipated that new housing or transportation infrastructure will be required to construct and operate the Project. Construction activities will occur offshore in the export cable corridors (ECC) and the Lease Area. Onshore project components include potential landfall sites, interconnection cable route options, Points of Interconnection (POI), onshore substations, and converter stations. Ports will serve as mustering points for offshore labor and staging areas for project components during the construction and O&M phases. Atlantic Shores identifies the representative ports evaluated in this section as facilities anticipated to support significant construction and O&M activities associated with the Project. These facilities occur in New Jersey, New York, Virginia, and Texas along the Atlantic Coast and the Gulf of Mexico. Once operational, the Project will be supported by existing O&M facilities. Finally, the analysis in this section also includes counties within the zone of visual influence, or digital surface model viewshed, of the Lease Area. For more information on Visual Resources, see Section 5.0.

### 7.2.1 Environmental Justice Area Identification

For this analysis, EJ areas are defined by their applicable state definitions per the Bureau of Ocean Energy Management's (BOEM) recently released Summary Environmental Justice Section of the Annotated EIS Outline Interim Process for Community Identification for Offshore Wind in the Atlantic. The state EJ definitions meet and exceed the Federal definition by including a more extensive group of communities based on lower percentage thresholds for EJ indicators. In New Jersey and Virginia, the state thresholds of poverty and minority populations exceed the Federal thresholds while also factoring in Limited English Proficiency or linguistically isolated communities. In New York, the state thresholds of poverty exceed Federal thresholds. A complete analysis of the Federal definition compared to the State of New Jersey, New York State, Commonwealth of Virginia, and State of Texas definitions and thresholds is found in Appendix II-R.

An additional consideration for identifying environmental justice communities is the historical presence of Native American nations on the lands within the Project Region according to BOEM's Summary Environmental Justice Section of the Annotated EIS Outline Interim Process for Community Identification for Offshore Wind in the Atlantic. While individuals from these nations may not actively reside in the local community, they may still have a vested interest in the area.

A summary of correspondence with stakeholders, including representatives of these residing Native American nations, is provided in Appendix I-A Stakeholder Outreach.

### 7.2.2 Disadvantaged Community Identification

Due to the recent Executive Order 14008 Tackling the Climate Crisis at Home and Abroad (2021), this analysis also considers Disadvantaged Communities (DACs) per BOEM's recently released Summary Environmental Justice Section of the Annotated EIS Outline Interim Process for Community Identification for Offshore Wind in the Atlantic. Within New Jersey, Virginia, and Texas, DACs in this analysis are based on the Federal definition. In New York, this analysis pulls from the State of New York's definition of DACs, which meets and exceeds the Federal definition by including more communities in the Project Region (based on additional environmental criteria and weighting that considers the population differences between New York City and the rest of New York State). Appendix II-R includes a complete analysis of the Federal definition of DACs compared to the States of New Jersey, New York, Virginia, and Texas definitions.

### 7.2.3 Affected Environment

The affected environment, or Project Region, consists of the communities in Atlantic, Burlington, Camden, Cape May, Gloucester, Monmouth, Ocean, and Salem counties in New Jersey, and Albany, Richmond, and Kings counties in New York. Construction, O&M, and decommissioning activities will take place based on the location of the proposed Project infrastructure and the availability of associated support facilities (e.g., ports, staging areas, etc.). These Project infrastructure and support facility locations occur in Gloucester, Monmouth, Ocean, and Salem counties in New Jersey; Albany, Kings, and Richmond counties in New York; Portsmouth County in Virgina; and San Patricio County in Texas. Counties within the zone of visual influence, or digital surface model viewshed, of the Lease Area are included in this analysis and include Atlantic, Burlington, Camden, Cape May, Monmouth, and Ocean counties in New Jersey. Population and demographic data used in the EJ assessment was obtained from the Census Bureau, the U.S. EPA's Environmental Justice Screening and Mapping Tool (v2017), and information provided by State authorities. Data used in the DACs assessment was obtained from the Climate and Economic Justice Screening Tool (released November 22, 2022) and the New York State Climate Justice Working Group data (released March 27, 2023).

Table 7.2-1 identifies EJ areas and DACs in the Project Region based on Federal and State EJ and DACs indicators and thresholds, specifically the number of EJ census blocks and DACs census tracts within the county. Figures 7.2-1 (Sheets 1 -12) and Figures 7.2-2 (Sheets 1-12) provide maps of EJ census block groups and DACs census tracts within each county of the Project Region along with the onshore project components, representative ports, and the zone of visual influence surrounding the Lease Area.

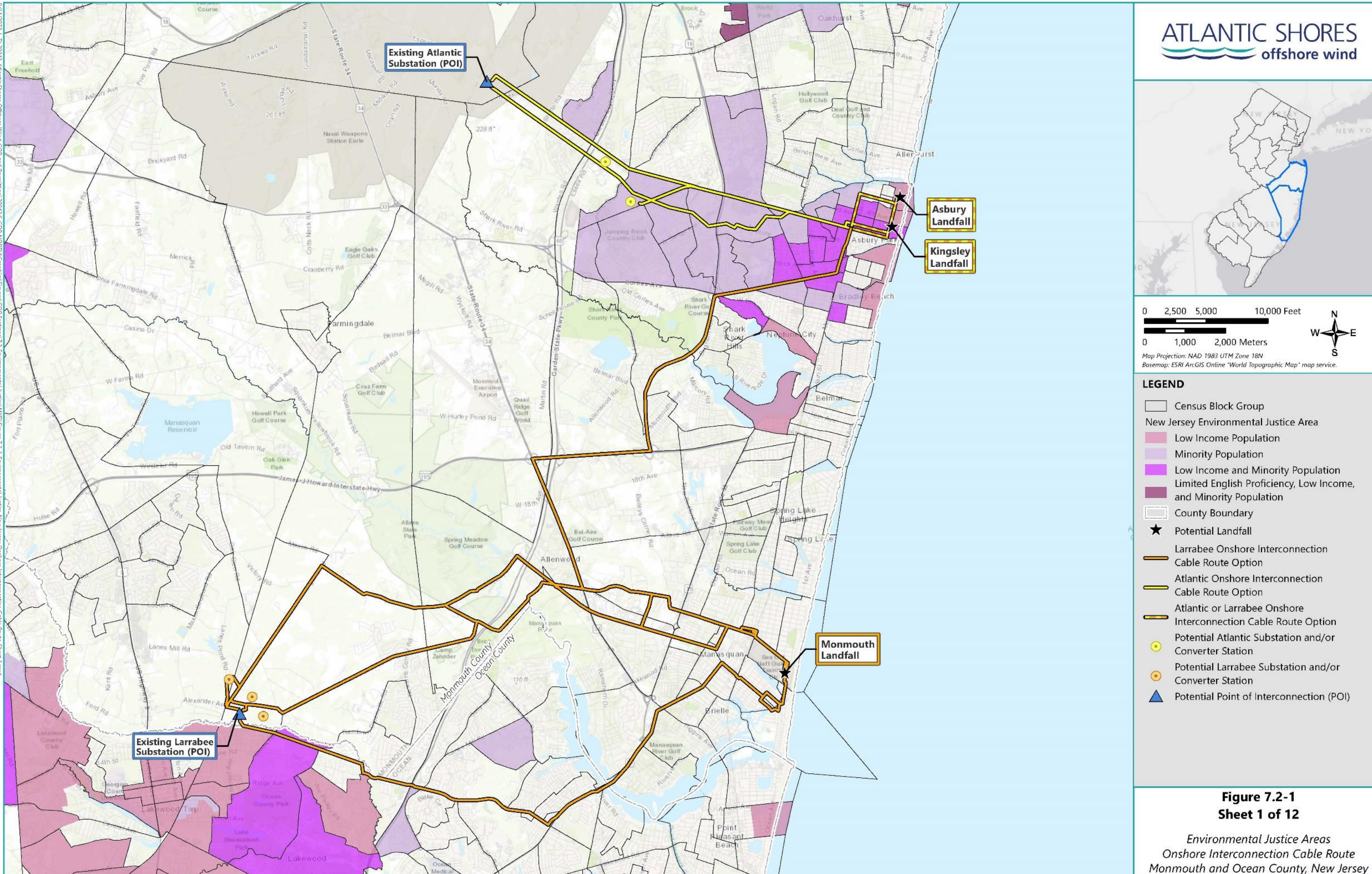
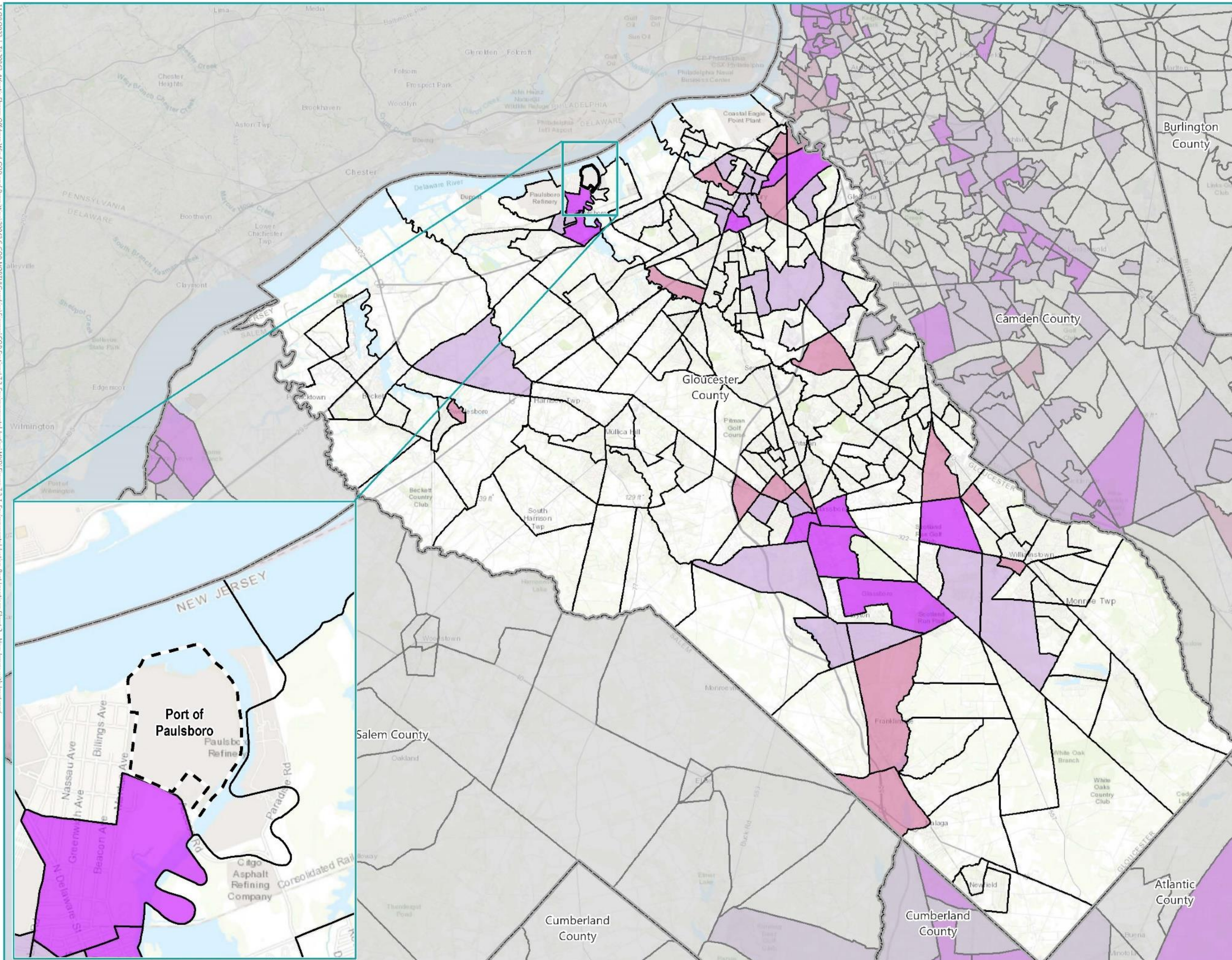



**Figure 7.2-1**
**Sheet 1 of 12**

*Environmental Justice Areas*
*Onshore Interconnection Cable Route*
*Monmouth and Ocean County, New Jersey*




ATLANTIC SHORES offshore wind

0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

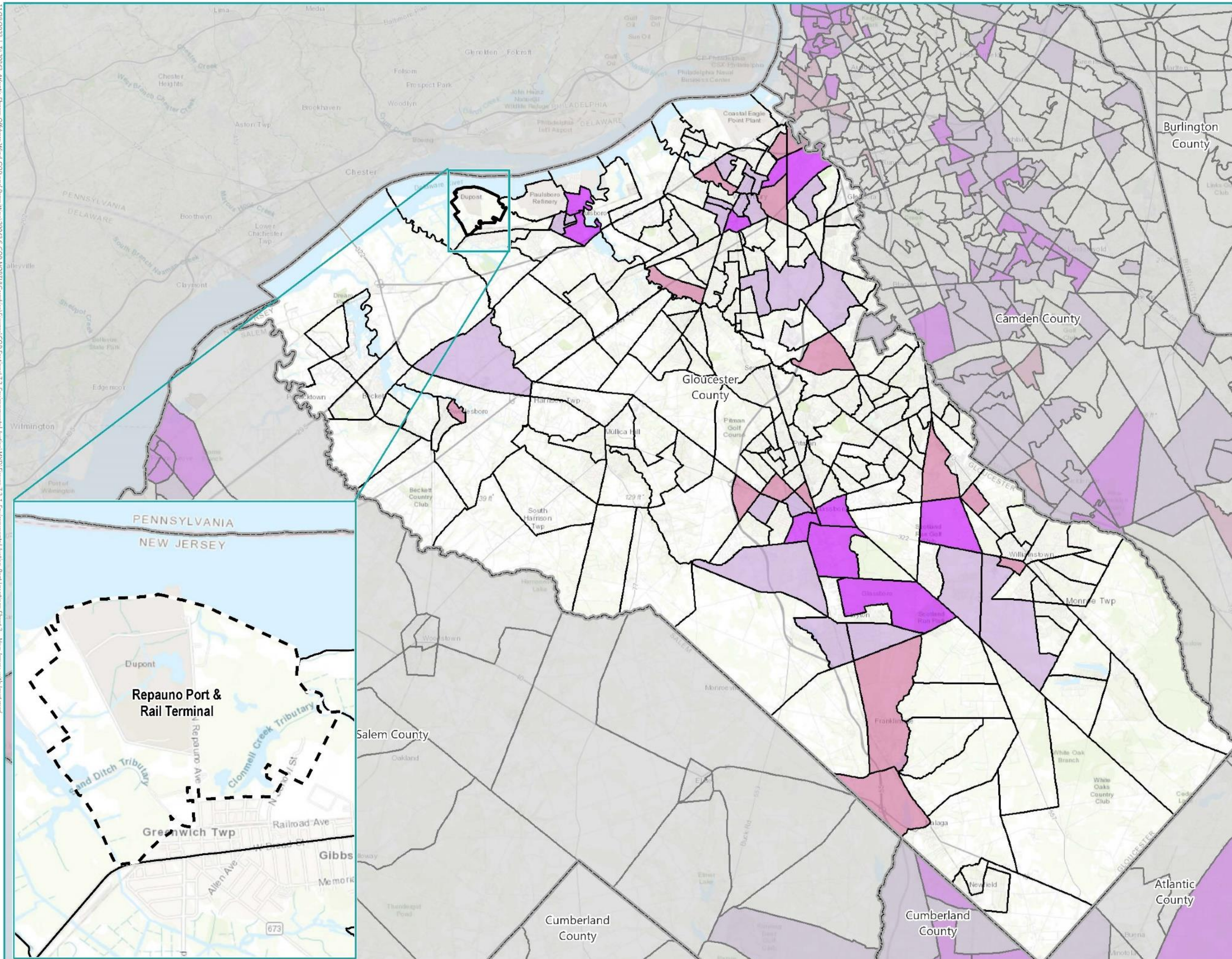
- Port Parcel
- Census Block Group

New Jersey Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 2 of 12**
*Environmental Justice Area*
*Paulsboro Marine Terminal*
*Paulsboro Township, Gloucester County*
*New Jersey*





0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Port Parcel
- Census Block Group

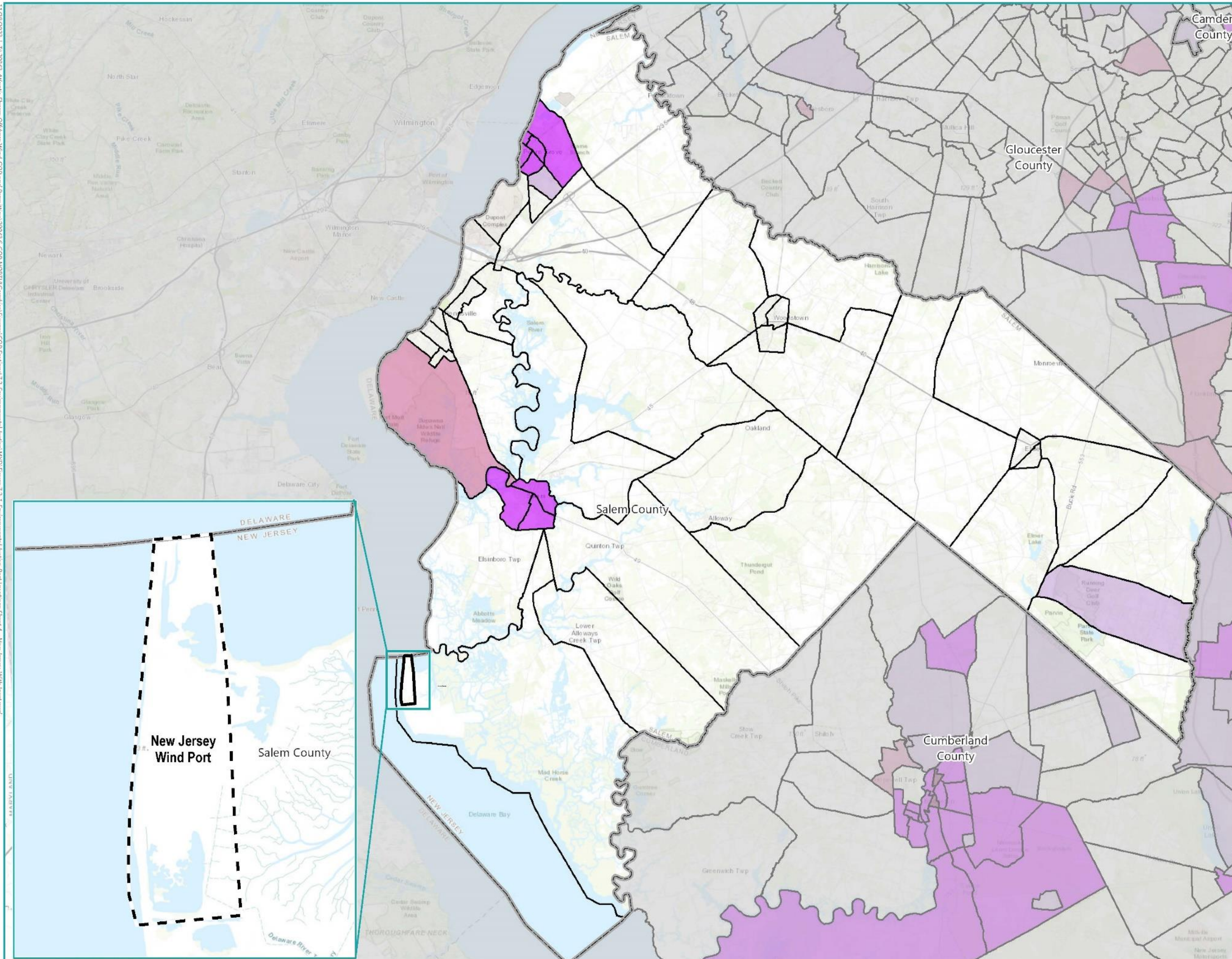
New Jersey Environmental Justice Area

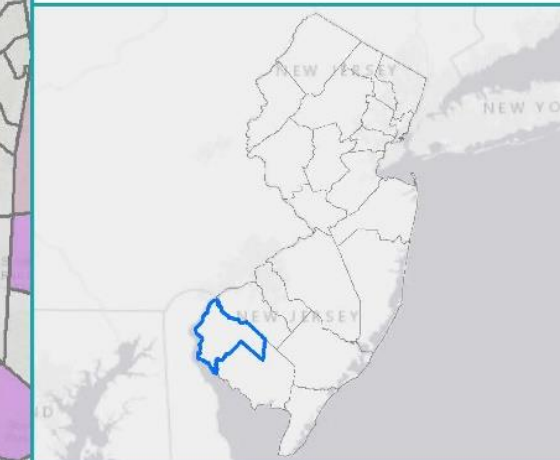
- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 3 of 12**
*Environmental Justice Area*
*Repauno Port & Rail Terminal*
*Gibbstown, Gloucester County*
*New Jersey*

ATLANTIC SHORES offshore wind




0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

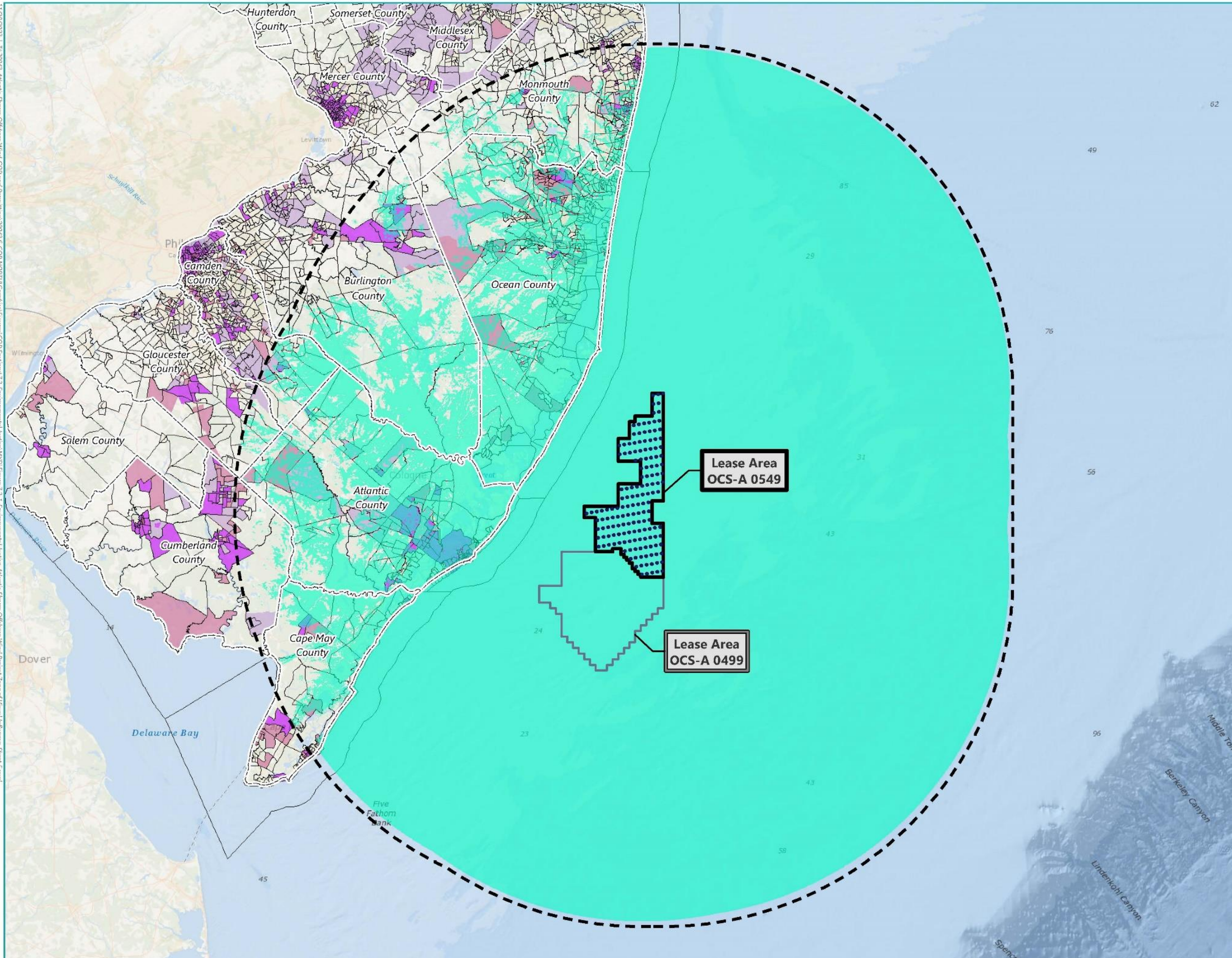
**LEGEND**

- Port Parcel
- Census Block Group
- New Jersey Environmental Justice Area
- Low Income Population
- Minority Population
- Low Income and Minority Population
- Limited English Proficiency, Low Income,
- County Boundary

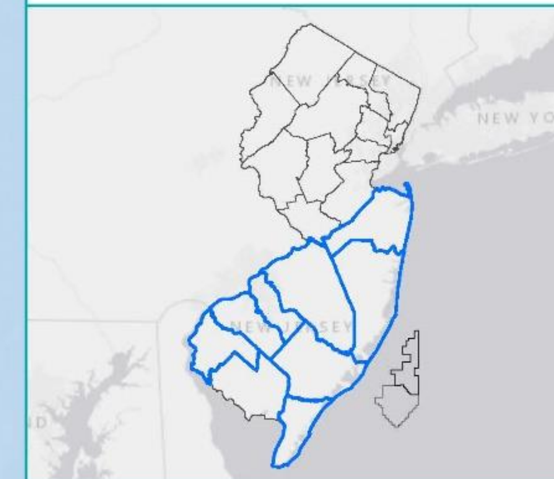
**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 4 of 12**
*Environmental Justice Area*
*New Jersey Wind Port*
*Lower Alloways Creek Township, Salem County*
*New Jersey*

11/20/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-1 Environmental Justice Atlantic Shores Offshore Wind Project Zone of Visual Influence Sheet 5.mxd




ATLANTIC SHORES offshore wind




0 5 10 20 Miles

0 10 20 Kilometers

N W E S

Map Projection: NAD 1983 UTM Zone 18N (Meters)
Basemap: World Ocean Base, Esri

**LEGEND**

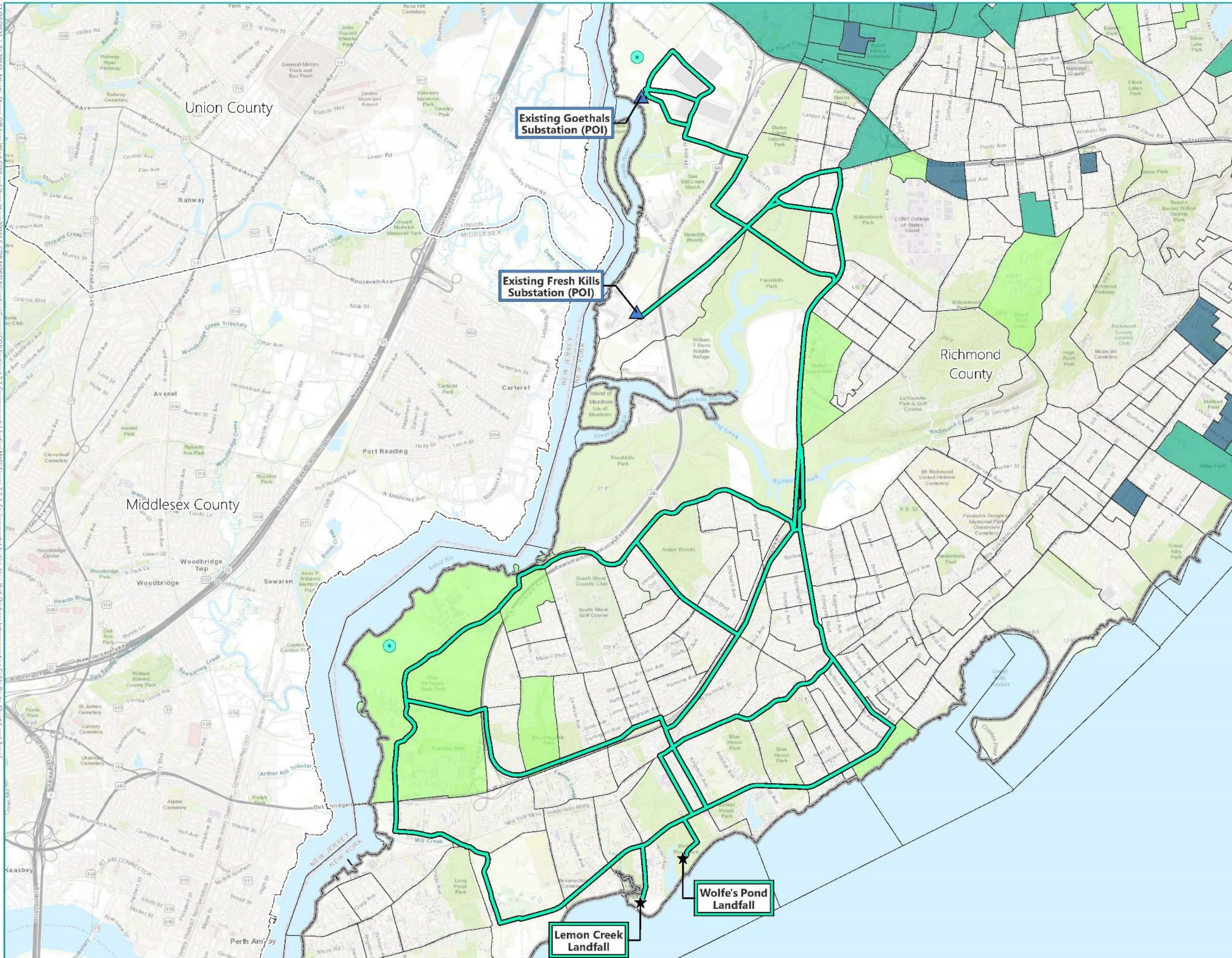
- Wind Turbine Generator
- 40nm Visual Study Area
- Zone of Visual Influence (DSM Viewshed Analysis)
- Census Block Group

New Jersey Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- Limited English Proficiency, Low Income,
- Lease Area OCS-A 0549

**Figure 7.2-1**
**Sheet 5 of 12**
*Environmental Justice Areas - Atlantic Shores Offshore Wind Zone of Visual Influence Atlantic, Burlington, Camden, Cape May, Monmouth and Salem County, New Jersey*

ATLANTIC SHORES offshore wind




0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

N W E S

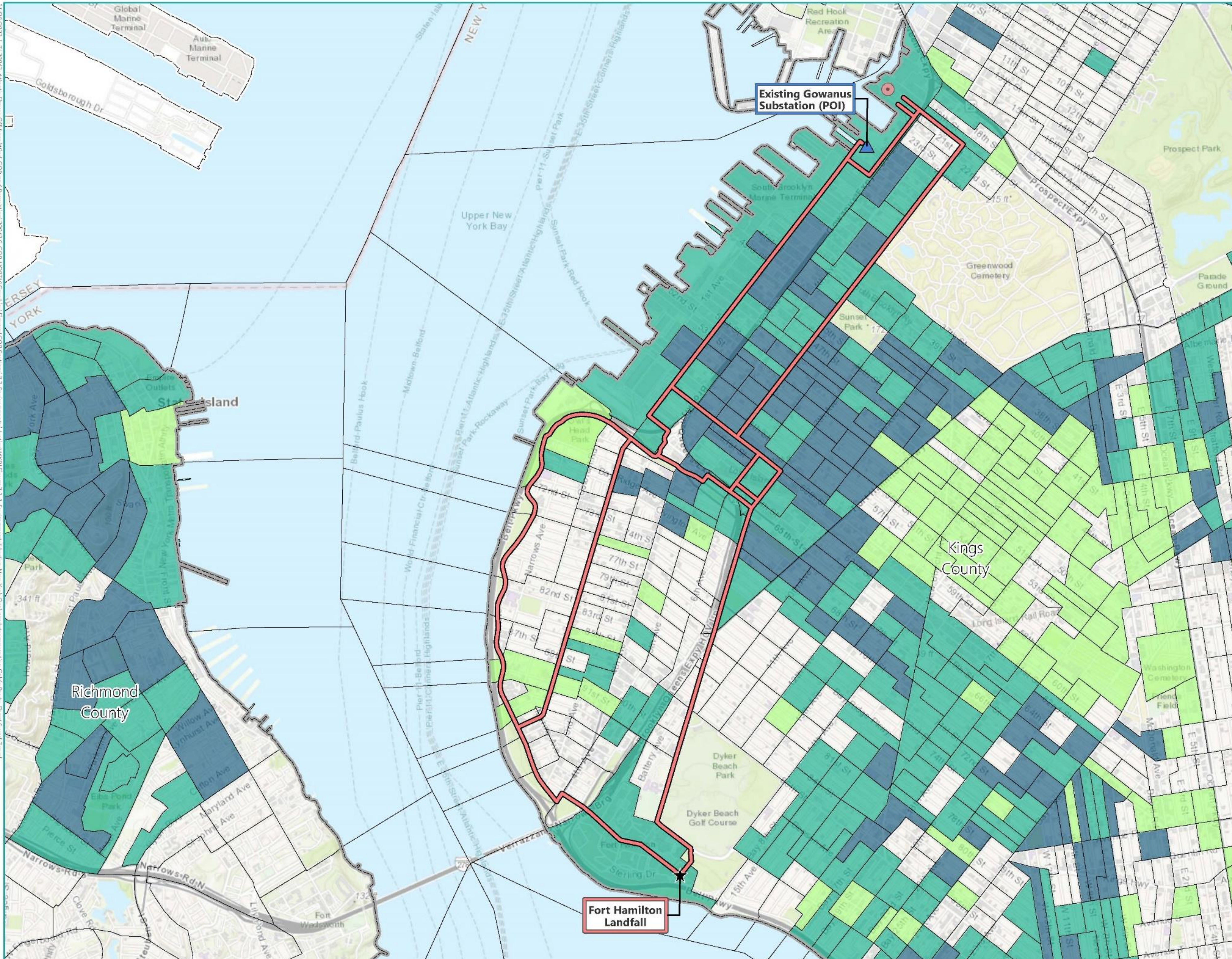
*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Census Block Group
- New York Environmental Justice Area
  - Low Income Population
  - Minority Population
  - Low Income and Minority Population
- Potential Landfall Site
- Fresh Kills and/or Goethals Onshore Interconnection Route Option
- Potential Fresh Kills/Goethals Substation and/or Converter Station
- Potential Point of Interconnection (POI)

**Figure 7.2-1**
**Sheet 6 of 12**

*Environmental Justice Areas*
*Onshore Interconnection Cable Route*
*Richmond and Kings County, New York*




ATLANTIC SHORES offshore wind

0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

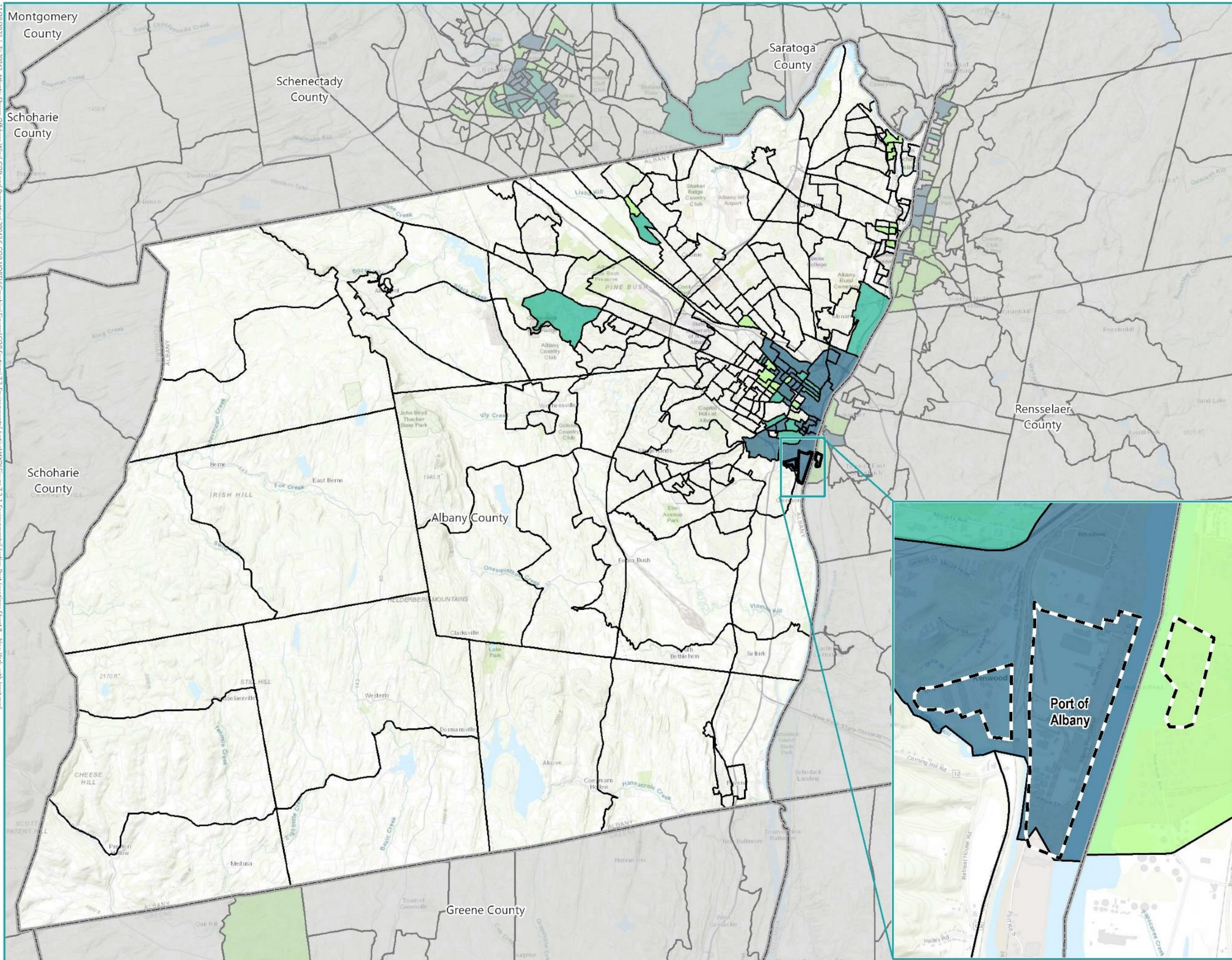
**LEGEND**

- Census Block Group
- New York Environmental Justice Area
- Low Income Population
- Minority Population
- Low Income and Minority Population
- Potential Landfall Site
- Gowanus Onshore Interconnection Route Option
- Potential Gowanus Substation and/or Converter Station
- Potential Point of Interconnection (POI)

**Figure 7.2-1**
**Sheet 7 of 12**

*Environmental Justice Areas*
*Onshore Interconnection Cable Route*
*Richmond and Kings County, New York*

11/20/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-1 Environmental Justice New York Onshore Interconnection Cable Route Sheet 6 and 7.mxd




0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Port Parcel
- Census Block Group

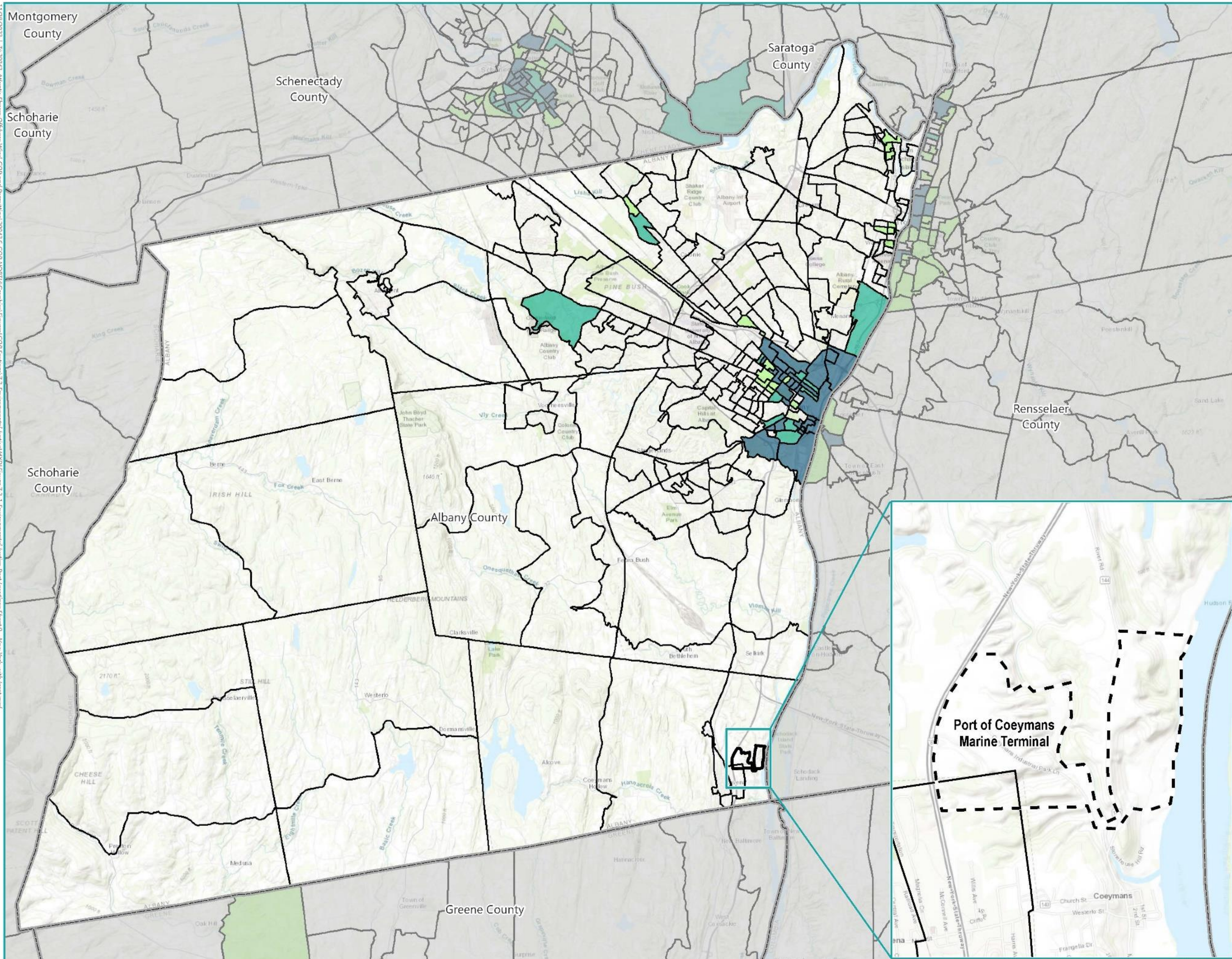
New York Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 8 of 12**
*Environmental Justice Area*
*Port of Albany*
*City of Albany, Albany County*
*New York*

11/28/2023 | T:\20431 Atlantic Shores Offshore Wind COP and Permitting\20431G COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-1 Environmental Justice Port Locations Sheet 8 - New York with inset.mxd




ATLANTIC SHORES offshore wind

0 5,000 10,000 20,000 Feet
0 2,000 4,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

- Port Parcel
- Census Block Group

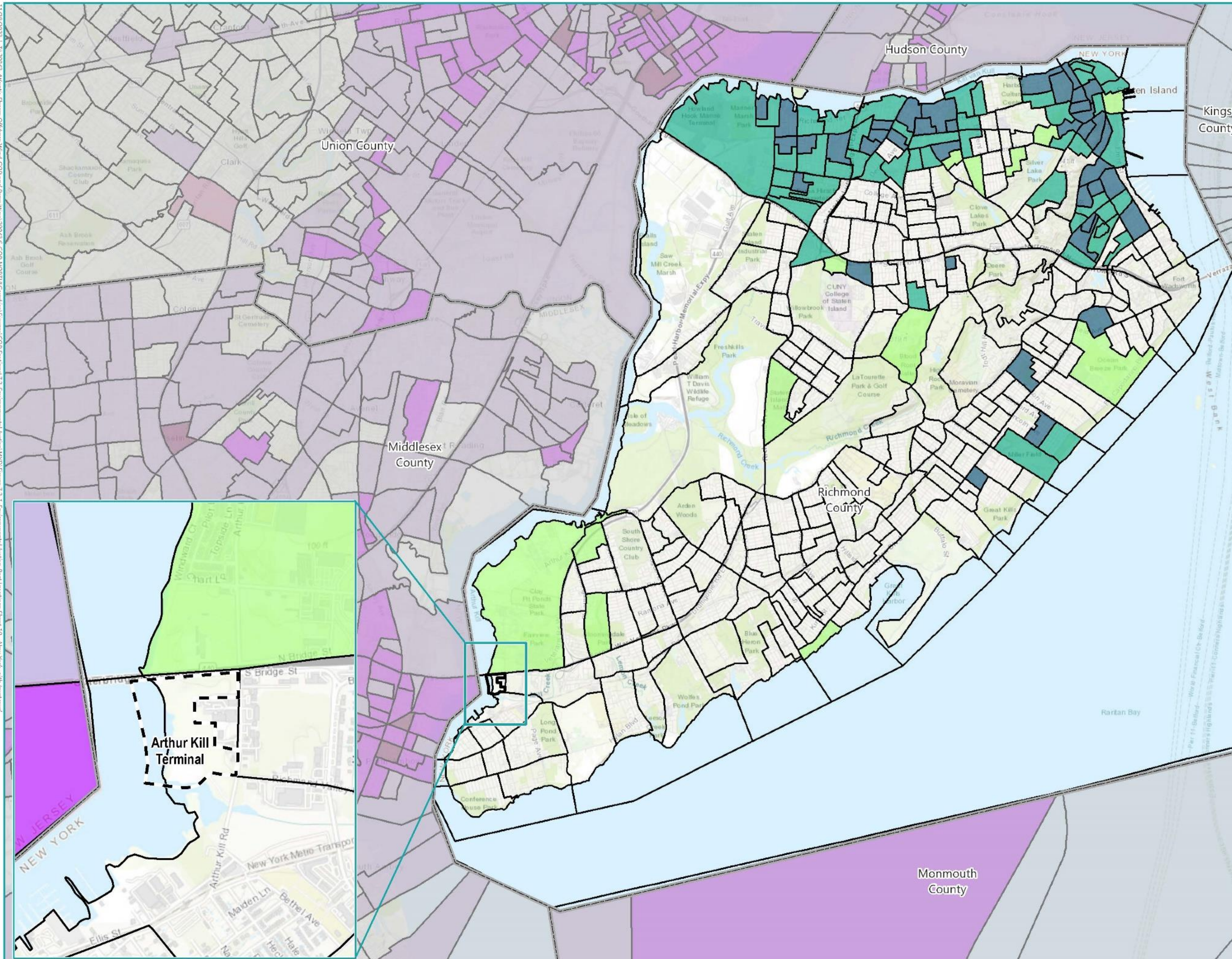
New York Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 9 of 12**
*Environmental Justice Area*
*Port of Coeymans Marine Terminal*
*Town of Coeymans, Albany County*
*New York*

11/28/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-1 Environmental Justice Port Locations Sheet 10 New York with inset.mxd




ATLANTIC SHORES offshore wind

0 2,500 5,000 10,000 Feet

0 1,000 2,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

- Port Parcel
- Census Block Group

New Jersey Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- Limited English Proficiency, Low Income,

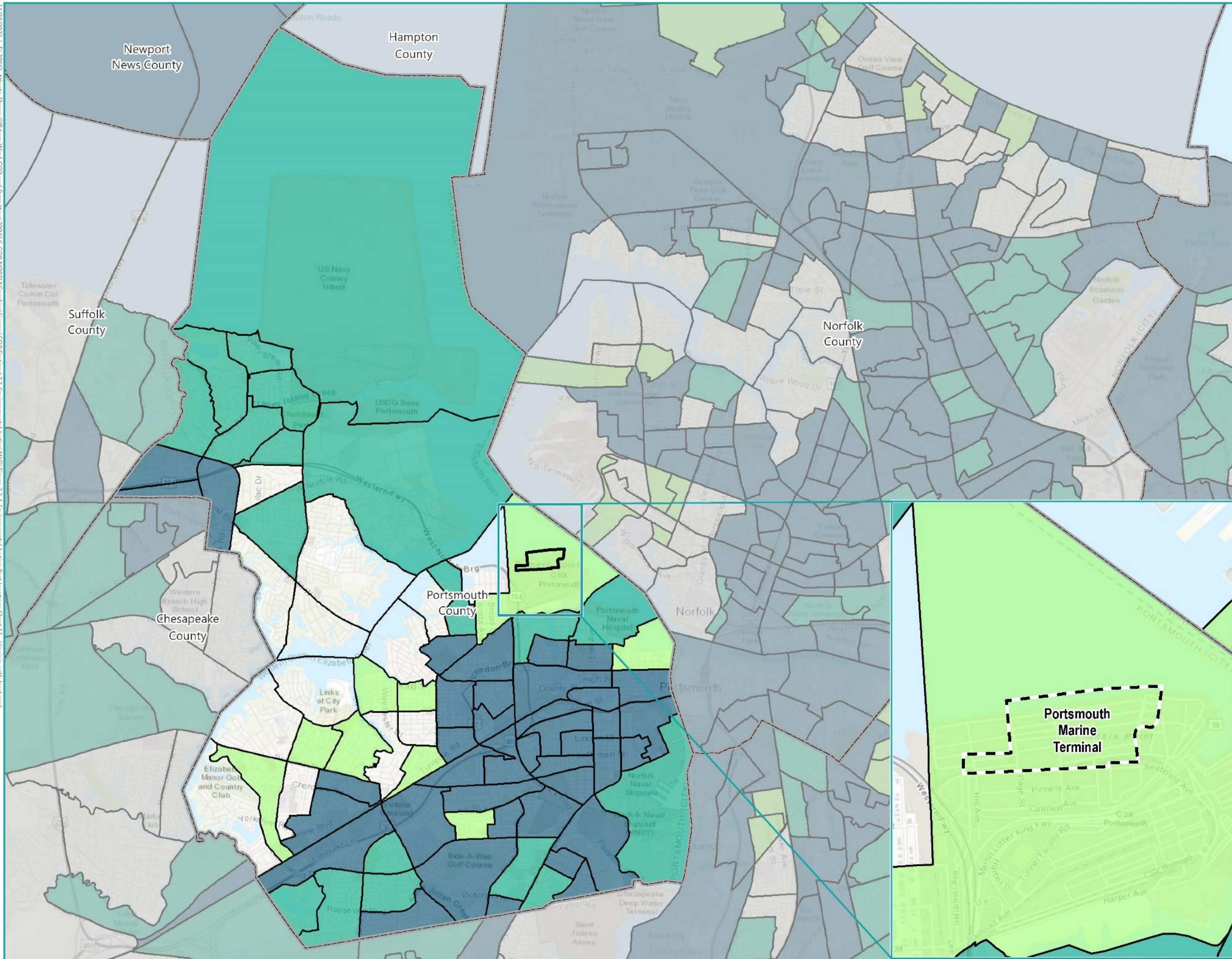
New York Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

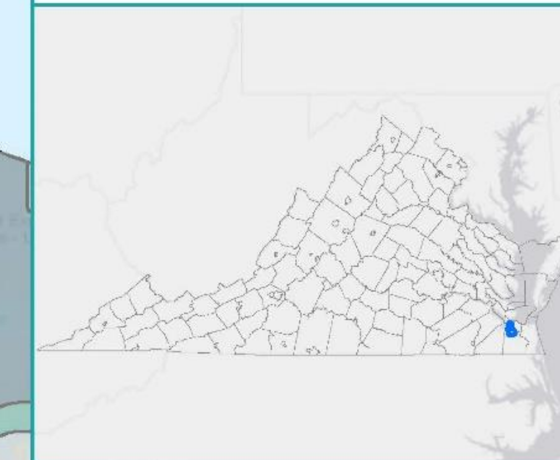
**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 10 of 12**
*Environmental Justice Area*
*Arthur Kill Terminal*
*Staten Island, Richmond County*
*New York*

11/28/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-1 Environmental Justice Port Locations Sheet 11 - Virginia with Inset.mxd




ATLANTIC SHORES offshore wind



0 2,500 5,000 10,000 Feet

0 1,000 2,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

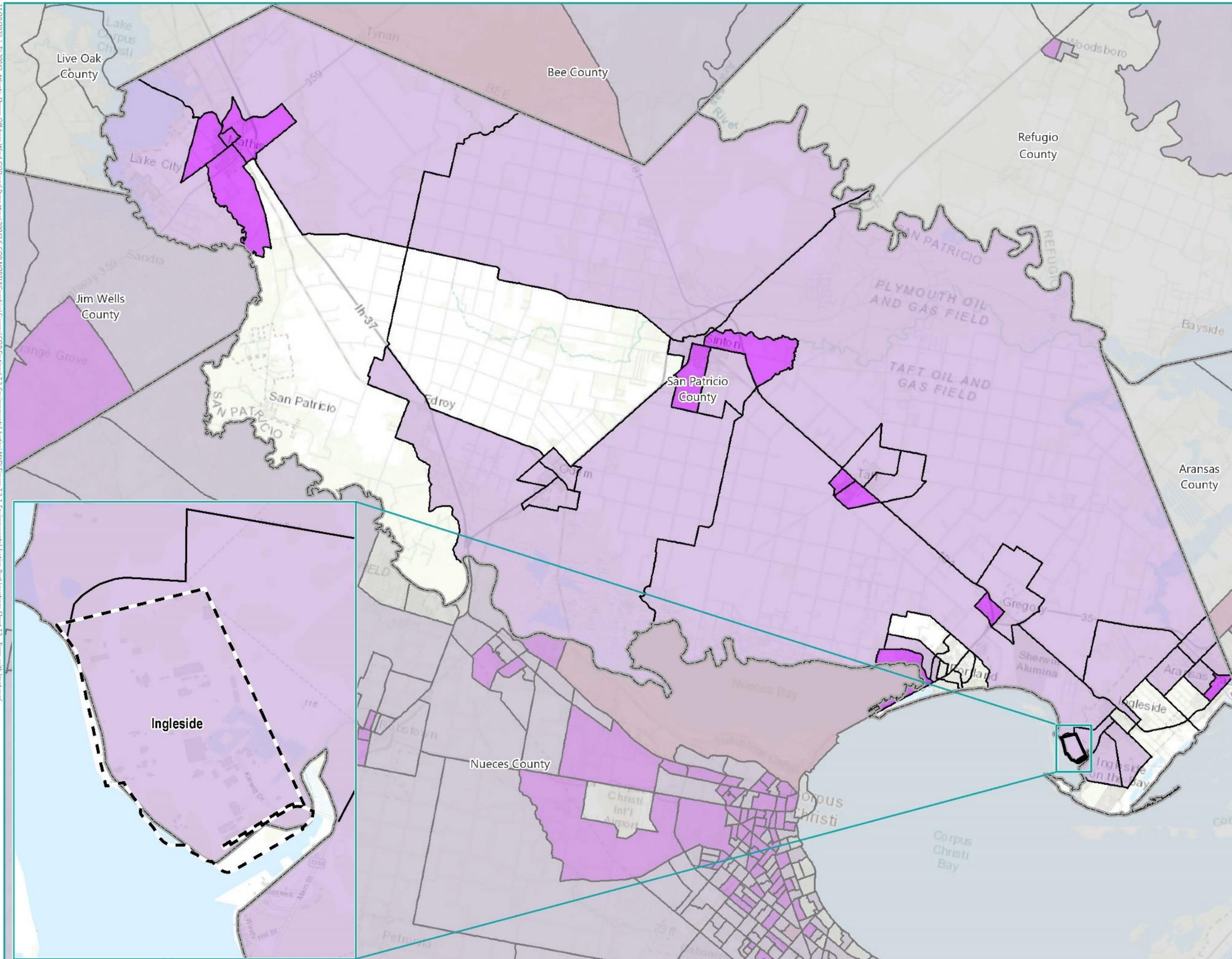
- Port Parcel
- Census Block Group

Virginia Environmental Justice Area

- Low Income Population
- Minority Population
- Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 11 of 12**
*Environmental Justice Area*
*Portsmouth Marine Terminal*
*City of Portsmouth, Portsmouth County*
*Virginia*




ATLANTIC SHORES offshore wind

0 7,000 14,000 28,000 Feet

0 2,000 4,000 Meters

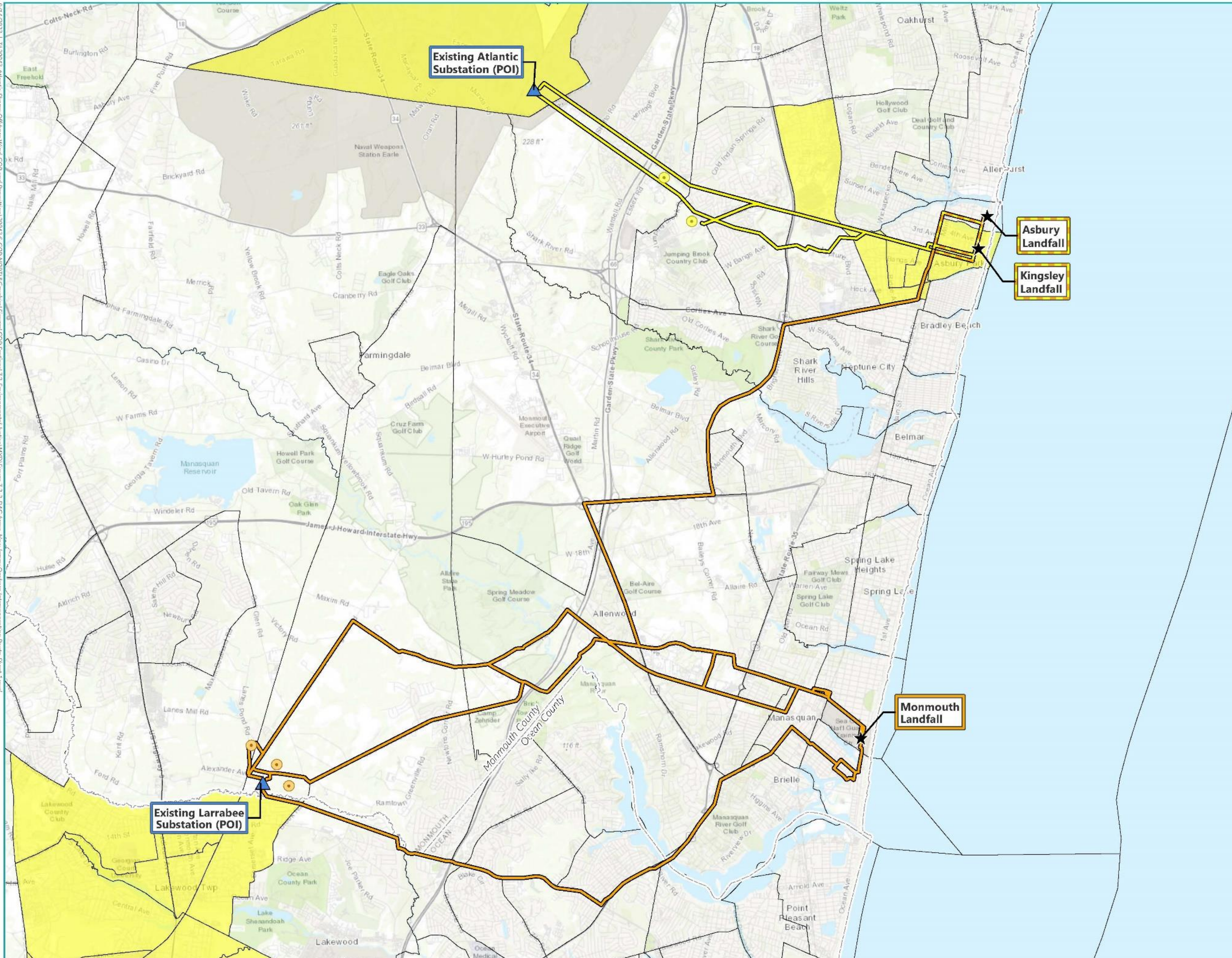
Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

- Port Parcel
- Census Block Group
- Texas Environmental Justice Area
  - Low Income Population
  - Minority Population
  - Low Income and Minority Population
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-1**
**Sheet 12 of 12**
*Environmental Justice Area*
*Kiewitt (Ingleside, TX)*
*City of Ingleside, San Patricio County*
*Texas*




0 2,500 5,000 10,000 Feet

0 1,000 2,000 Meters

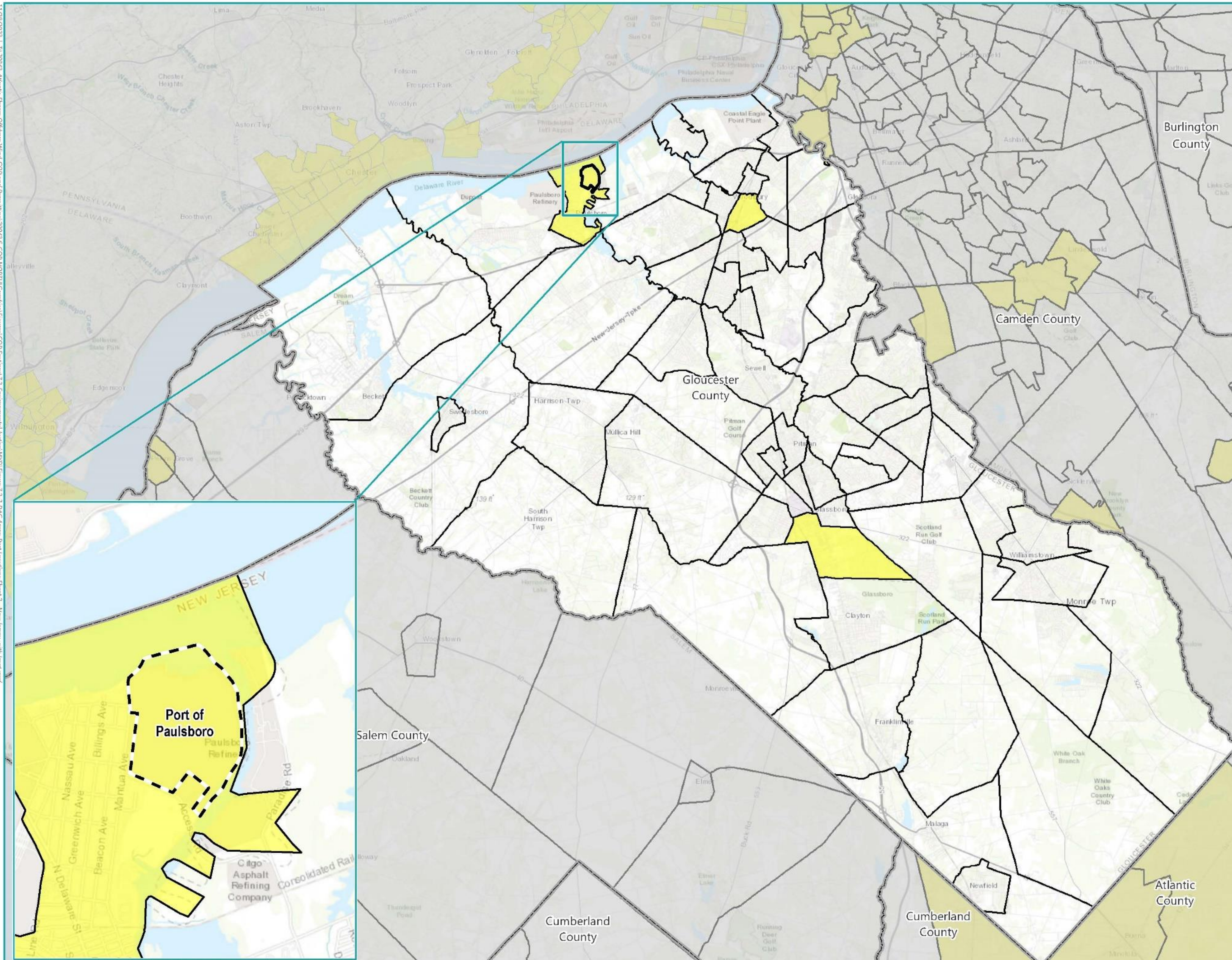
*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Census Tract
- Federal Disadvantaged Community
- County Boundary
- Potential Landfall
- Larrabee Onshore Interconnection Cable Route Option
- Atlantic Onshore Interconnection Cable Route Option
- Atlantic or Larrabee Onshore Interconnection Cable Route Option
- Potential Atlantic Substation and/or Converter Station
- Potential Larrabee Substation and/or Converter Station
- Potential Point of Interconnection (POI)

**Figure 7.2-2**
**Sheet 1 of 12**

*Disadvantaged Communities*
*Onshore Interconnection Cable Route*
*Monmouth and Ocean County, New Jersey*




ATLANTIC SHORES offshore wind

0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

N W E S

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

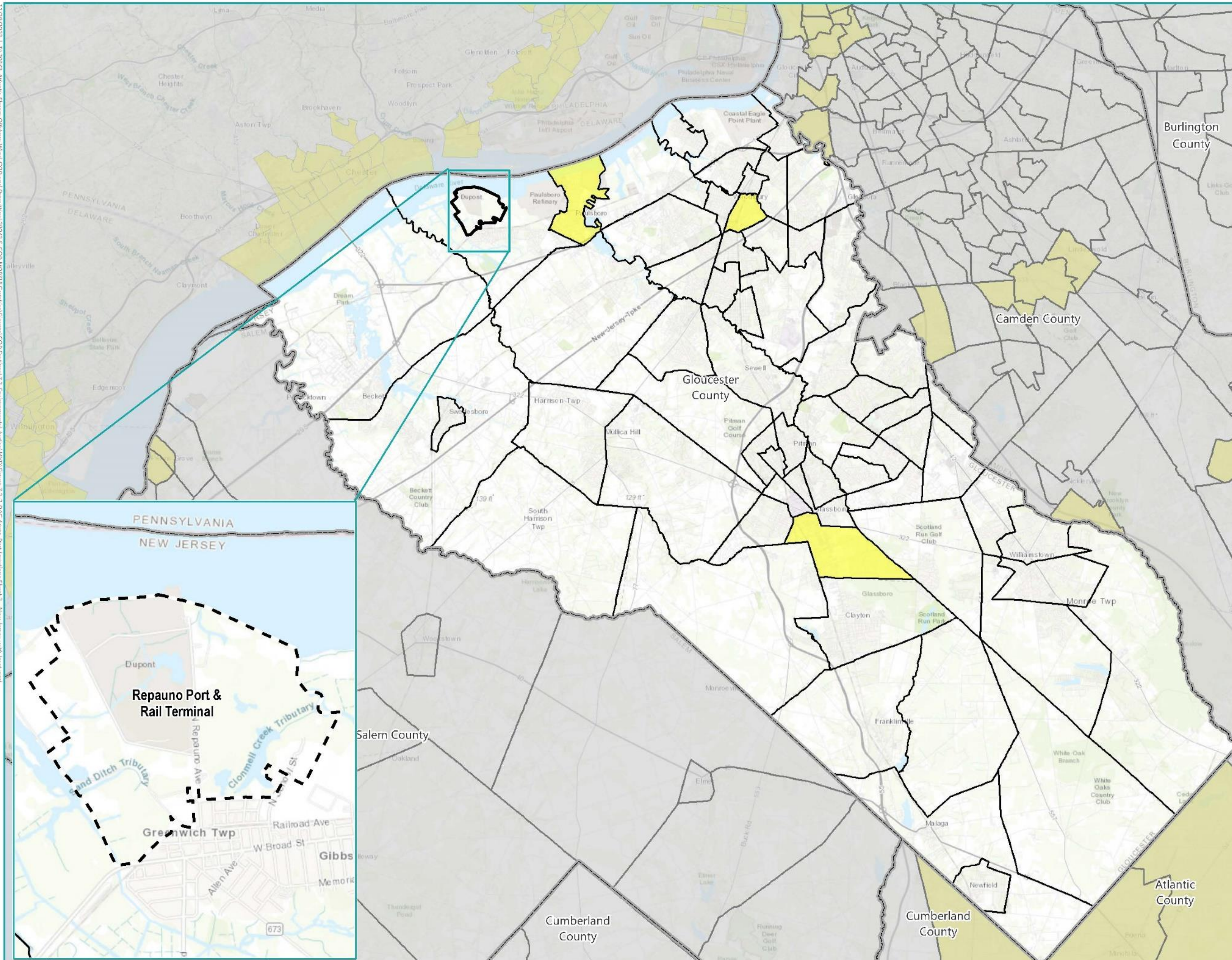
**LEGEND**

- Port Parcel
- Census Tract
- Federal Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 2 of 12**
*Disadvantaged Communities*
*Paulsboro Marine Terminal*
*Paulsboro Township, Gloucester County*
*New Jersey*

11/28/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-2 DAC Areas Port Locations Sheet 2 New Jersey with Inset.mxd




ATLANTIC SHORES offshore wind


0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

N S E W

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Port Parcel
- Census Tract
- Federal Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 3 of 12**
*Disadvantaged Communities*
*Repauno Port & Rail Terminal*
*Gibbstown, Gloucester County*
*New Jersey*

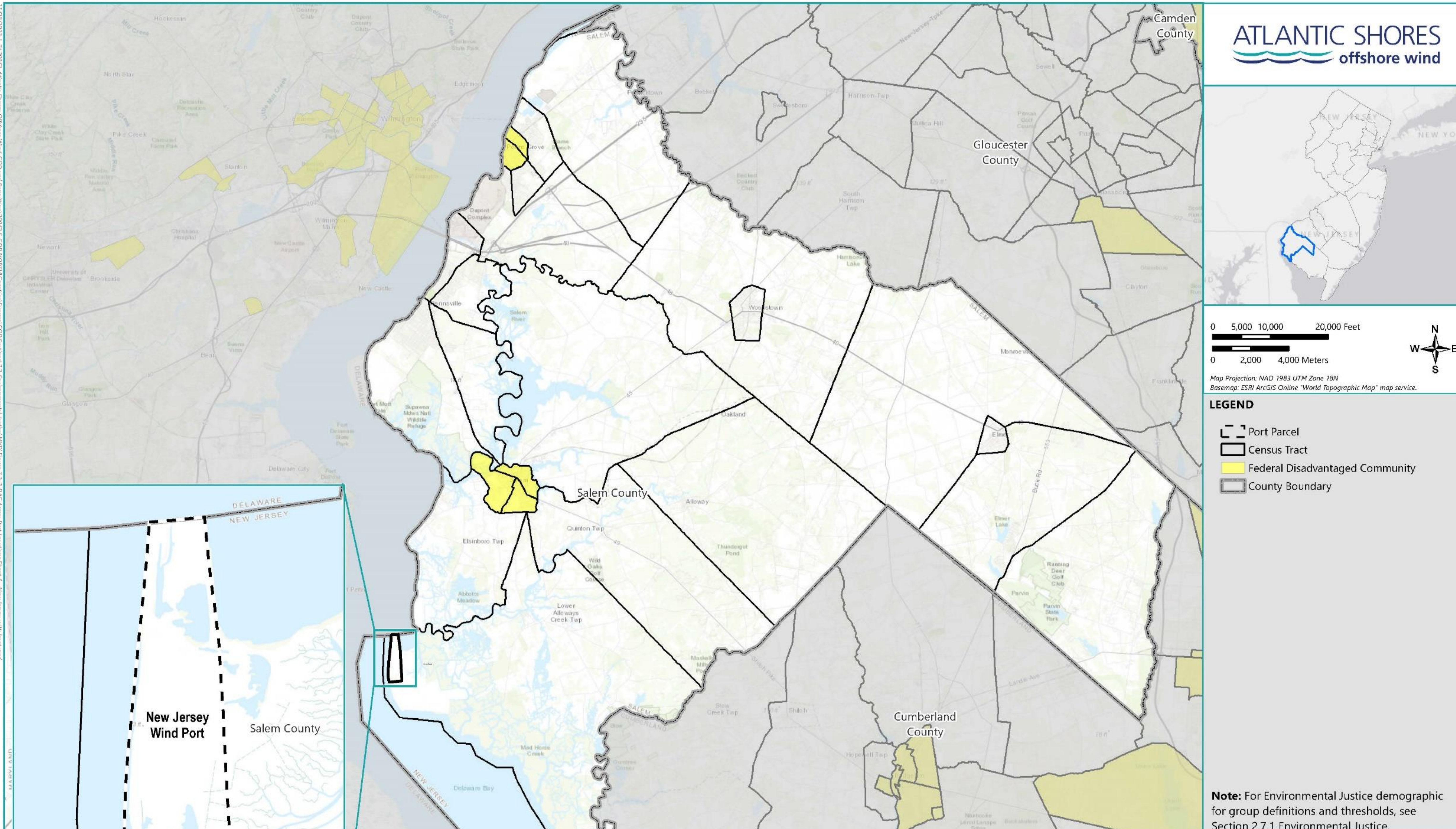



**Figure 7.2-2**
**Sheet 4 of 12**
*Disadvantaged Communities*
*New Jersey Wind Port*
*Lower Alloways Creek Township, Salem County*
*New Jersey*

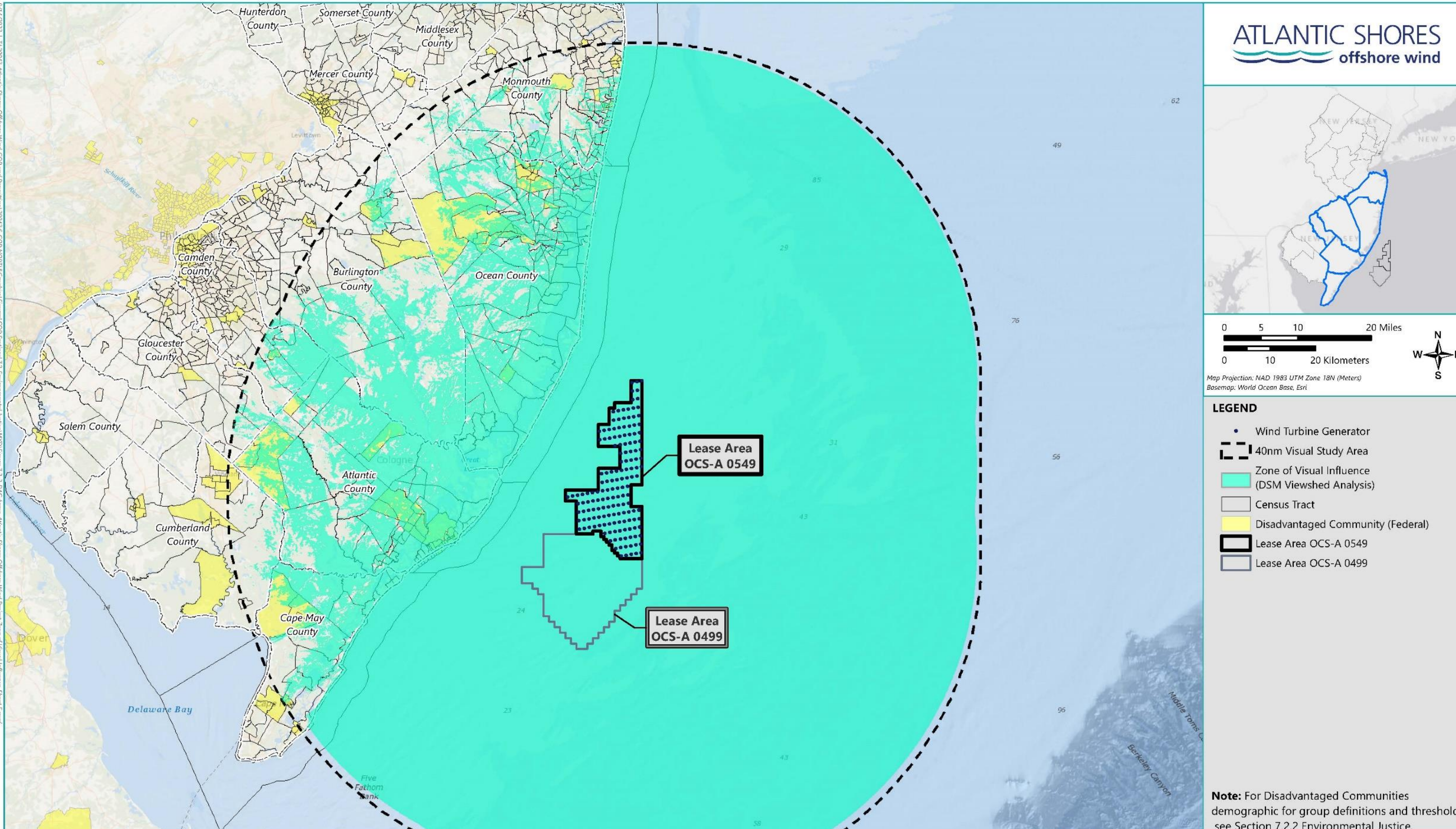
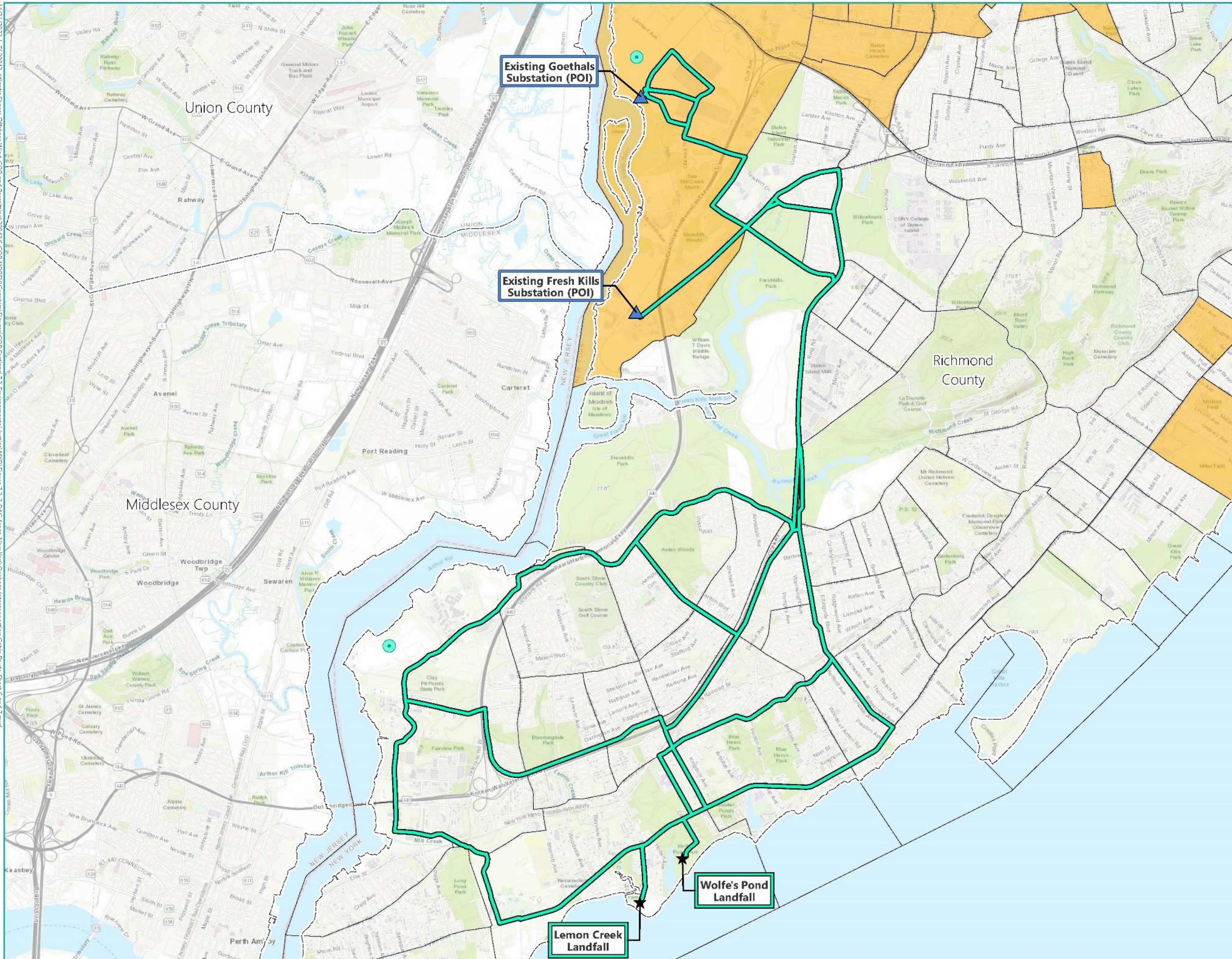



**Figure 7.2-2**
**Sheet 5 of 12**

*Disadvantaged Communities - Atlantic Shores Offshore Wind Zone of Visual Influence Atlantic, Burlington, Camden, Cape May, Monmouth and Salem County, New Jersey*

11/21/2023 | T:\20043 Atlantic Shores Offshore Wind_COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-2_DAC Areas_New York Onshore Interconnection Cable Route_Sheet 6 and 7.mxd




ATLANTIC SHORES offshore wind

0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

N W E S

**LEGEND**

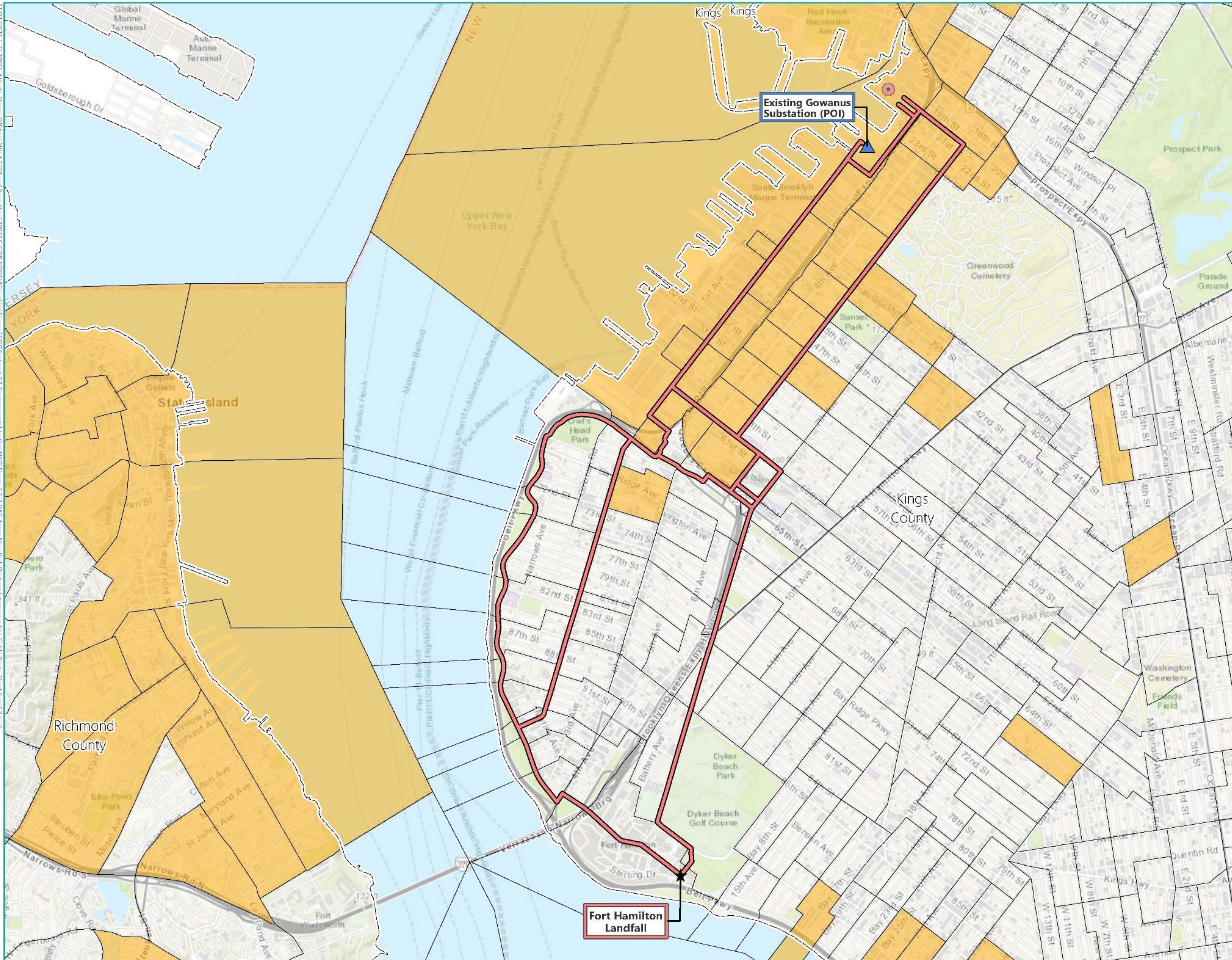
- Census Tract
- New York State Disadvantaged Communities
- Potential Landfall Site
- Fresh Kills and /or Geothals Onshore Interconnection Route Option
- Potential Fresh Kills/Goethals Substation and/or Converter Station
- Potential Point of Interconnection (POI)

**Note:** For Disadvantaged Communities demographic for group definitions and thresholds, see Section 7.2.2 Environmental Justice.

**Figure 7.2-2**
**Sheet 6 of 12**

*Disadvantaged Communities*
*Onshore Interconnection Cable Route*
*Richmond and Kings County, New York*

11/21/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-2 DAC Areas New York Onshore Interconnection Cable Route_Sheet 6 and 7.mxd




ATLANTIC SHORES offshore wind

0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

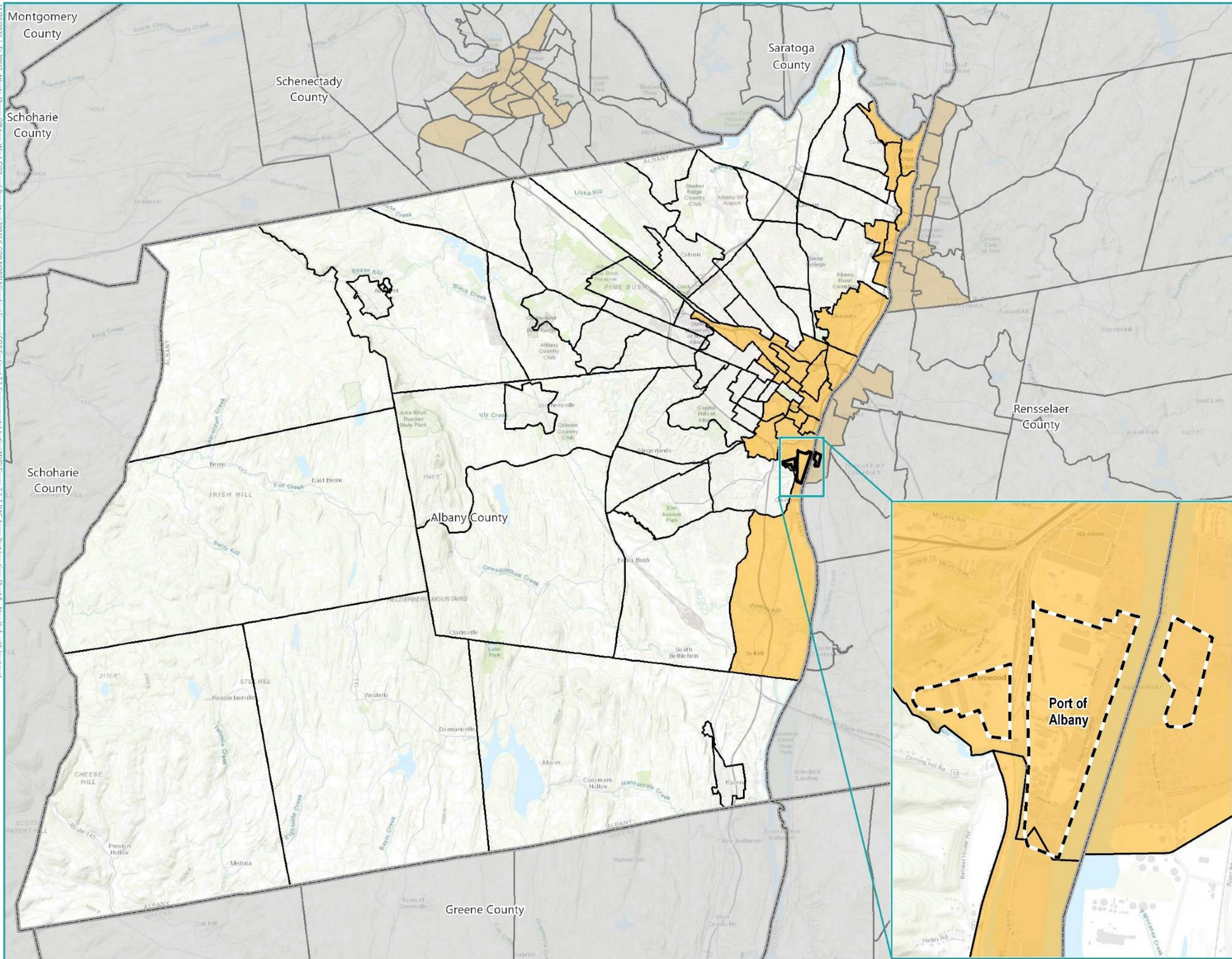
**LEGEND**

- Census Tract
- New York State Disadvantaged Communities
- Potential Landfall Site
- Gowanus Onshore Interconnection Route Option
- Potential Gowanus Substation and/or Converter Station
- Potential Point of Interconnection (POI)

**Note:** For Disadvantaged Communities demographic for group definitions and thresholds, see Section 7.2.2 Environmental Justice.

**Figure 7.2-2**
**Sheet 7 of 12**

*Disadvantaged Communities Onshore Interconnection Cable Route Richmond and Kings County, New York*




ATLANTIC SHORES offshore wind

0 5,000 10,000 20,000 Feet

0 2,000 4,000 Meters

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Port Parcel
- Census Tract
- New York State Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 8 of 12**
*Disadvantaged Communities*
*Port of Albany*
*City of Albany, Albany County*
*New York*

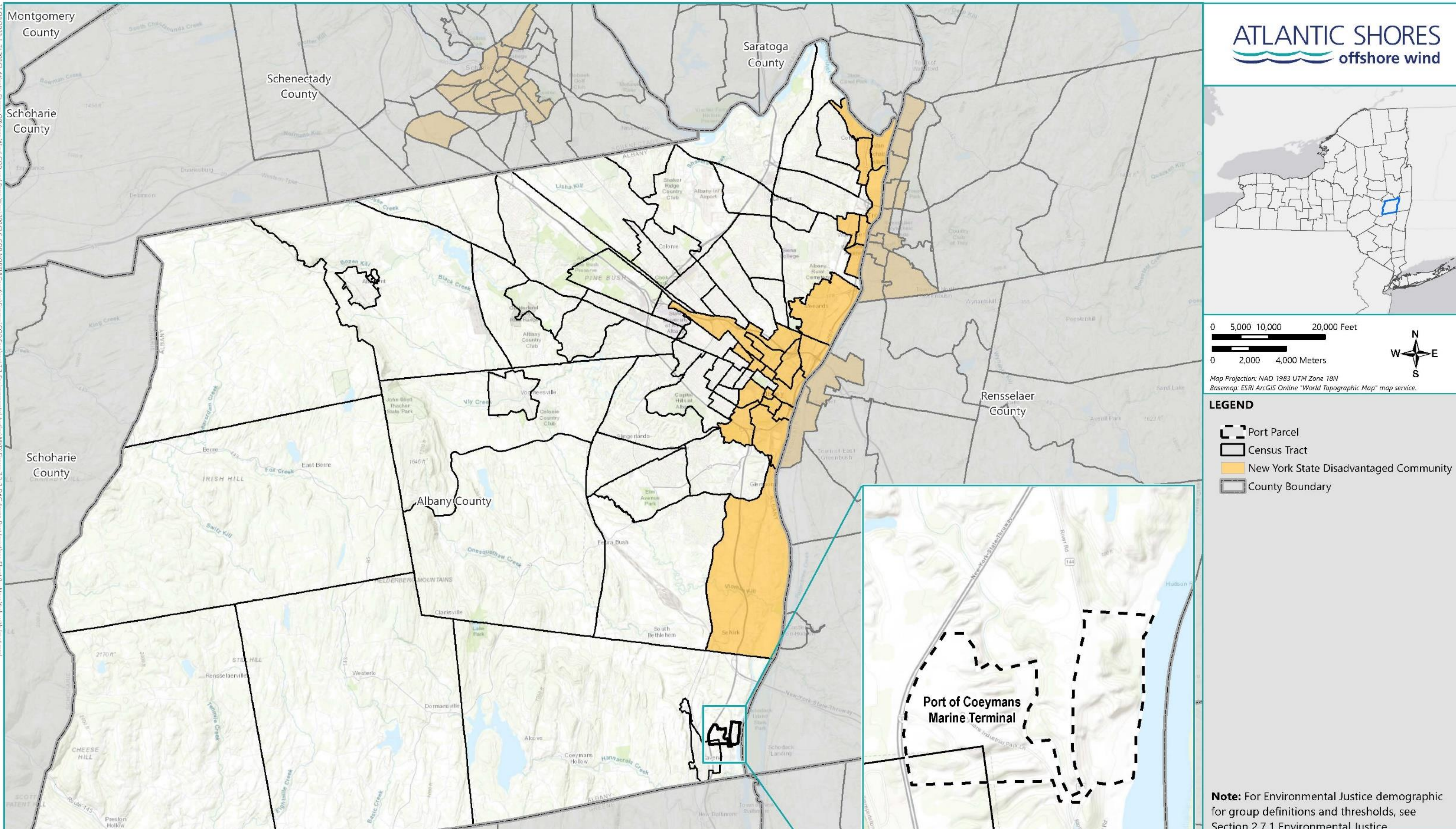
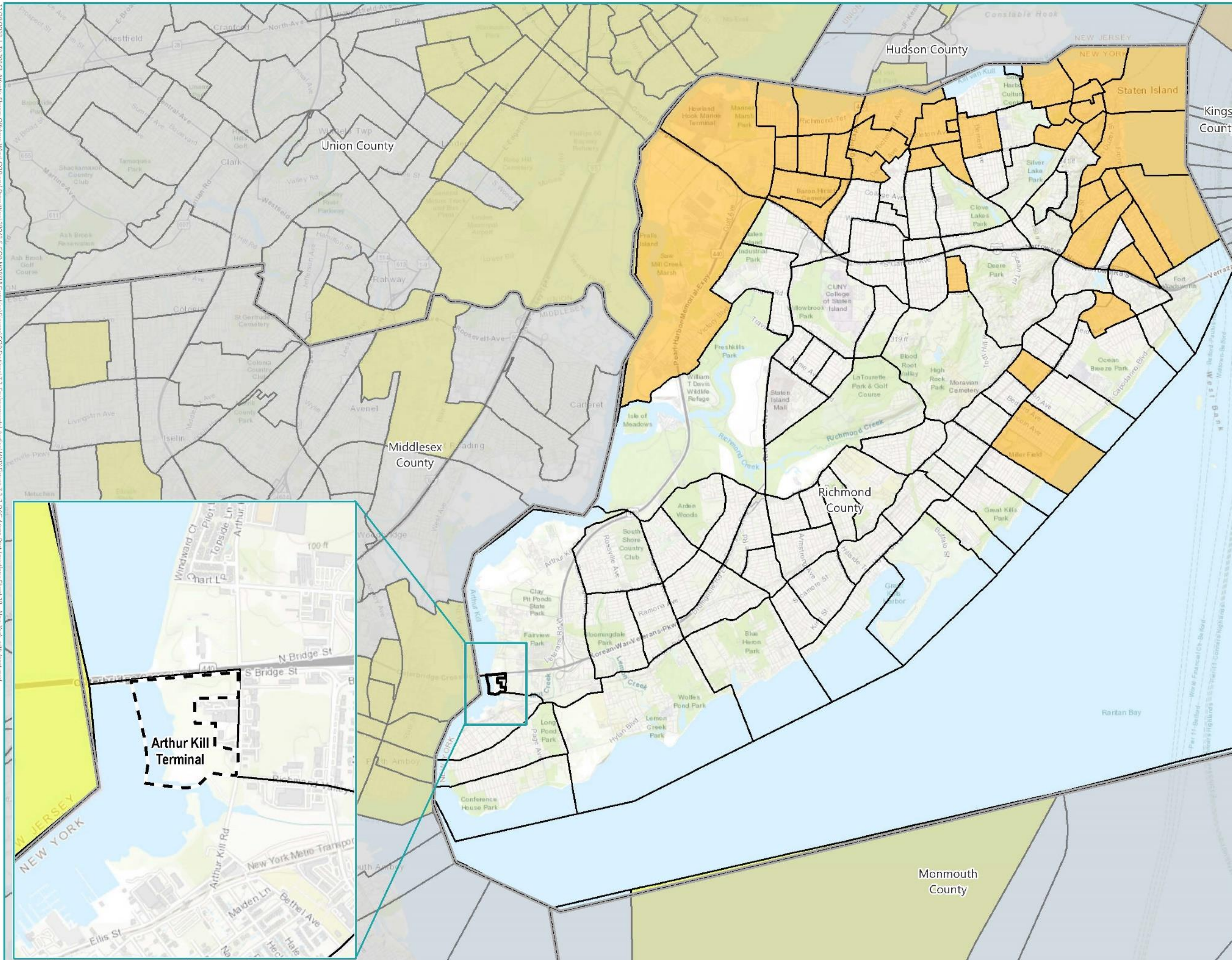



**Figure 7.2-2**
**Sheet 9 of 12**
*Disadvantaged Communities*
*Port of Coeymans Marine Terminal*
*Town of Coeymans, Albany County*
*New York*




ATLANTIC SHORES offshore wind

0 2,500 5,000 10,000 Feet

0 1,000 2,000 Meters

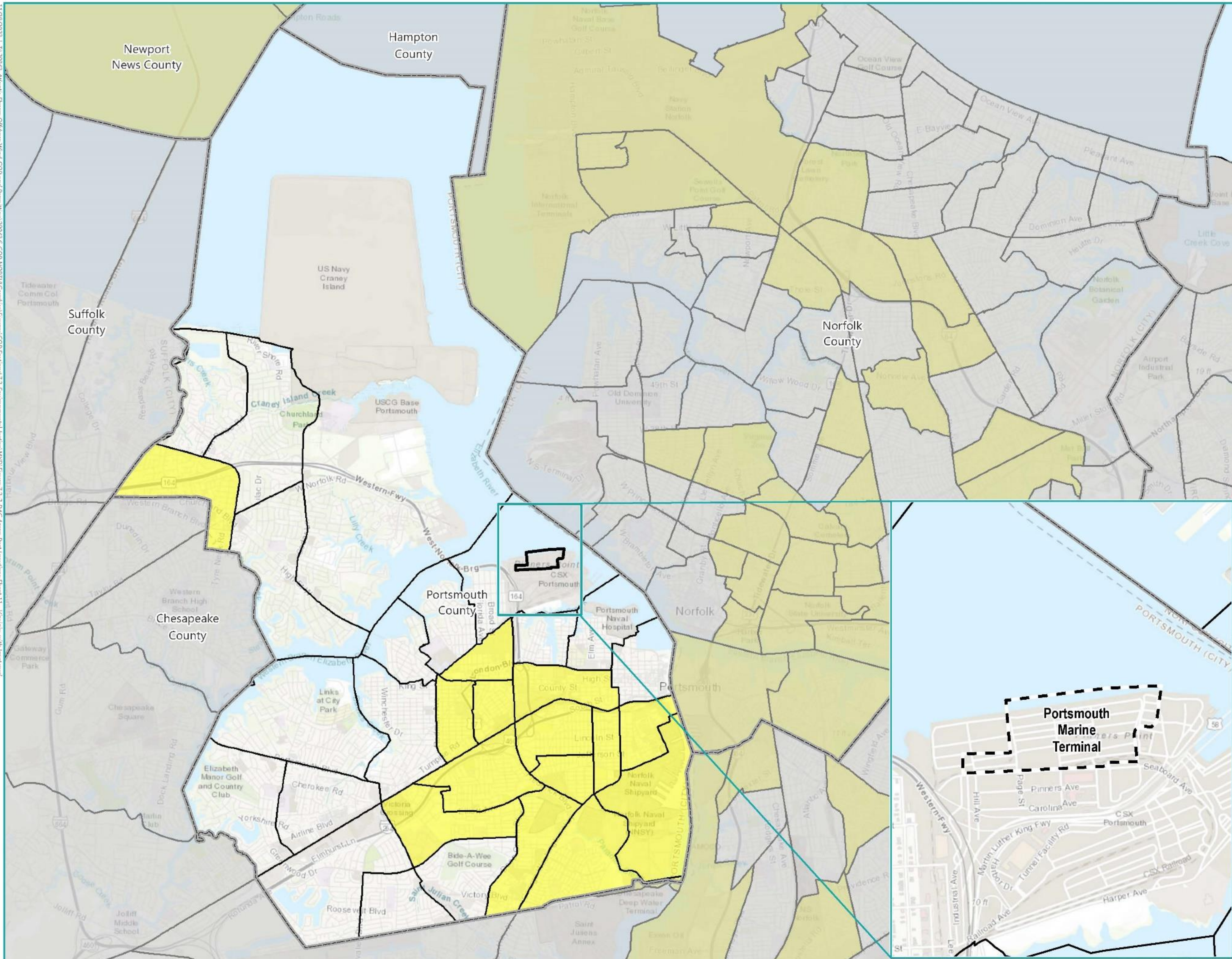
Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

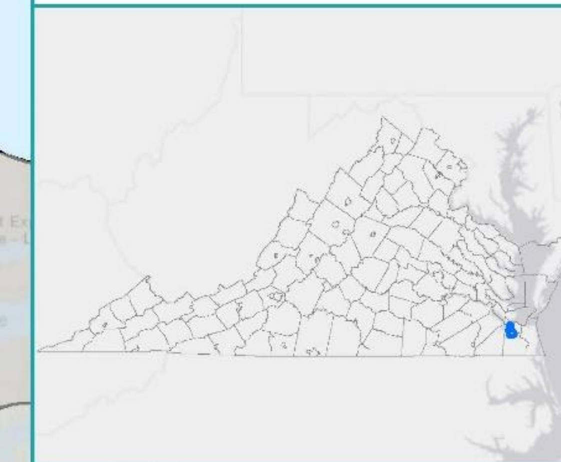
- Port Parcel
- Census Tract
- Federal Disadvantaged Community
- New York State Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 10 of 12**
*Disadvantaged Communities*
*Arthur Kill Terminal*
*Staten Island, Richmond County*
*New York*




ATLANTIC SHORES offshore wind



0 2,500 5,000 10,000 Feet

0 1,000 2,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Topographic Map" map service.

**LEGEND**

- Port Parcel
- Census Tract
- Federal Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 11 of 12**
*Disadvantaged Communities*
*Portsmouth Marine Terminal*
*City of Portsmouth, Portsmouth County*
*Virginia*

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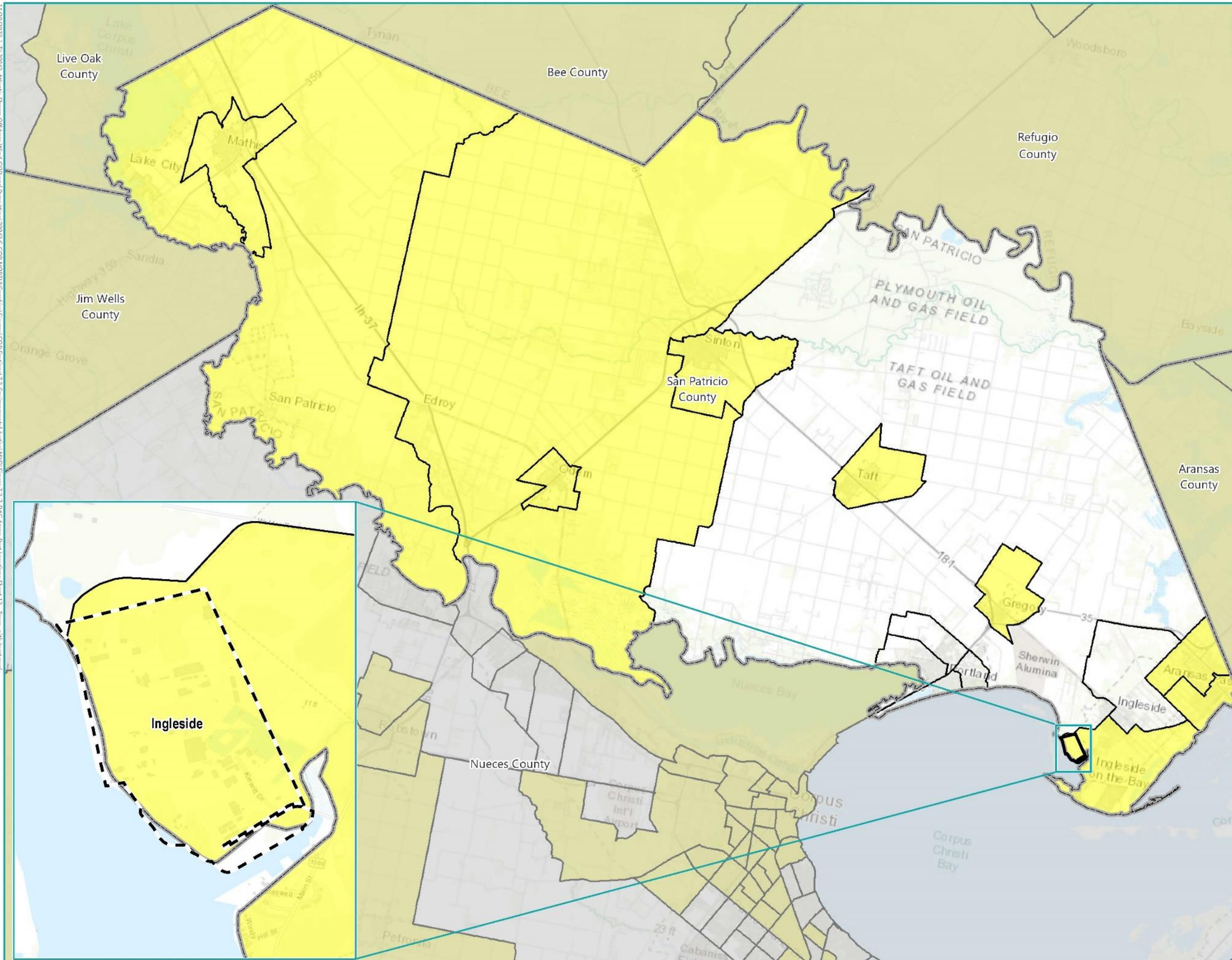
11/28/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\200436 COP NORTH\Graphics\Figures\COP Sections\7.2 Environmental Justice\MXD\Figure 7.2-2 DAC Areas Port Locations Sheet 12 Texas with Inset.mxd




ATLANTIC SHORES offshore wind

0 7,000 14,000 28,000 Feet
0 2,000 4,000 Meters
N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: ESRI ArcGIS Online "World Topographic Map" map service.*

**LEGEND**

- Port Parcel
- Census Tract
- Federal Disadvantaged Community
- County Boundary

**Note:** For Environmental Justice demographic for group definitions and thresholds, see Section 2.7.1 Environmental Justice.

**Figure 7.2-2**
**Sheet 12 of 12**
*Disadvantaged Communities*
*Kiewitt (Ingleside, TX)*
*City of Ingleside, San Patricio County*
*Texas*

## Table 7.2-1. Project Region, Environmental Justice (EJ Areas & Disadvantaged Communities (DACs)

| Counties | Potential Project Action | Number of EJ Areas (Census Block Groups) | Number of DACs (Census Tracts) |
|---|---|---|---|
| State of New Jersey | Onshore Interconnection Route Options, Landfall, Substation and Converter Station, Point of Interconnection, Ports, Zone of Visual Influence | 3,442 | 536 |
| Atlantic County | Existing (Proposed) Atlantic City O&M Facility, Zone of Visual Influence | 99 | 26 |
| Burlington County | Zone of Visual Influence | 110 | 9 |
| Camden County | Zone of Visual Influence | 189 | 33 |
| Cape May County | Zone of Visual Influence | 25 | 6 |
| Gloucester County | Paulsboro Marine Terminal, Rapauno Port, and Rail Terminal | 46 | 3 |
| Monmouth County | Onshore Interconnection Route Option, Monmouth Landfall, Asbury Landfall, Kingsley Landfall, Potential Substation and/orand Converter Stations (Asbury Avenue, Route 66, Lanes Pond Road, Randolph Road, and Brook Road Sites), Existing Larrabee Substation POI, Existing Atlantic Substation POI, Zone of Visual Influence | 105 | 16 |
| Ocean County | Onshore Interconnection Route Option, Zone of Visual Influence | 82 | 19 |
| Salem County | New Jersey Wind Port | 15 | 5 |
| State of New York | Onshore Interconnection Cable Route Options, Landfall, Substation and Converter Station, Points of Interconnection, Ports | 6,732 | 1,732 |
| Albany County | Port of Albany, Port of Coeymans Marine Terminal | 56 | 23 |
| Kings County | Onshore Interconnection Route Option, Fort Hamilton Landfall, Potential Substation and Converter Station (Sunset Industrial Park), Existing Gowanus Substation POI | 1,432 | 308 |
| Richmond County | Onshore Interconnection Route Option, Wolfe's Pond Landfall, Lemon Creek Landfall, Potential Substation and Converter Station (Fresh Kill Road, River Road), Existing Fresh Kills Substation POI, Existing Goethals Substation POI, Arthur Kill Terminal | 99 | 36 |
| State of Virginia | Portsmouth Marine Terminal | 3,124 | 449 |
| Portsmouth County (City) | Portsmouth Marine Terminal | 67 | 14 |
| State of Texas | Ingleside | 11,366 | 2,369 |
| San Patricio County | Ingleside | 34 | 10 |

### 7.2.4 Potential Impacts and Proposed Environmental Protection Measures

Atlantic Shores is committed to managing activities such that EJ areas and DACs will not bear disproportionately high or adverse effects resulting from the construction, O&M, and decommissioning of the Project. Additionally, Atlantic Shores is committed to managing activities such that EJ areas and DACs are not disproportionately excluded from receiving benefits from the Project. Atlantic Shores recognizes the opportunity to directly benefit EJ areas and DACs through thoughtful and targeted development choices and has taken steps to be inclusive in how the Project is developed, constructed, operated, and maintained. Negative effects will be minimized by consulting with stakeholders to identify potential issues, thoroughly investigating them, and devising strategies to avoid or minimize adverse effects. Potential socioeconomic impacts, both positive and negative, from offshore wind energy projects predominantly result from construction activities. However, these effects are localized, temporary, and short-term. Positive economic impacts are expected to outlast any potentially negative economic effects over the 30-year life of the Project. New housing or transportation infrastructure will not be needed to construct and operate the Project. Beneficial effects spurred by the construction and O&M of the Project include job creation and economic stimulus to the Project Region. Some of these jobs and economic stimulus could occur within EJ areas and DACs throughout the Project Region. Specific anticipated benefits from the Project for these EJ areas and DACs are further detailed in this section.

This section addresses the potential IPFs associated with the Project, which may have direct and indirect effects on Environmental Justice areas and DACs. The potential IPFs related to specific Project elements are presented in Table 7.2-2.

**Table 7.2-2. Environmental Justice Impact Producing Factors**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Workforce Training Programs | • | • | • |
| Workforce Hiring | • | • | • |
| Port Utilization | • | • | • |
| Installation and Maintenance of New Structures and Cables | • | | • |
| Vehicle Traffic | • | | • |
| Housing | • | • | • |
| Temporary Accommodations | • | | • |
| Air Emissions | • | • | • |
| In-Air Noise | • | • | • |
| Visual Resources | • | • | • |
| Commercial Fishing | • | • | • |

#### 7.2.4.1 Workforce Hiring and Training Program

Atlantic Shores is committed to recruiting, training, and hiring a diverse workforce that will enable the needs of the offshore wind workforce to be met by communities local to the Project.

This IPF section focuses on the direct benefits of workforce training programs on EJ areas and DACs during the Project's construction, O&M, and decommissioning. Atlantic Shores will support workforce training initiatives targeting minority and low-income populations, women, veterans, and underserved communities. Workforce development initiatives Atlantic Shores has committed to supporting include the following:

- Funding Science, Technology, Engineering, the Arts, and Mathematics (STEAM) programming with Boys and Girls Clubs within the Project Region. This initiative is committed to ending the cycle of poverty for residents by providing direct exposure and skill-building opportunities in technology, construction, and green energy innovation, which present the community with occupations paying self-sustaining wages.
- Supporting the development of offshore wind curricula and certificate programs at colleges within the Project Region. For example, Atlantic Shores will support the development of offshore wind curricula with Rutgers Future Scholars. Rutgers Future Scholars provides a path to college and even a tuition-free Rutgers University education to 200 first-generation, low-income, academically promising middle school students from New Brunswick, Piscataway, Newark, Camden, and Rahway, New Jersey.
- Contributing to scholarship programs within the Project Region. By providing scholarship funds, Atlantic Shores' support will specifically benefit students with demonstrated financial need. For example, Atlantic Shores will provide scholarship support for Rowan College students. Rowan College at Burlington County's Workforce Development Institute offers programs that prepare students for careers in renewable energy, many of which are women and people of color.
- Partnering with Chambers of Commerce within the Project Region to increase opportunities for minority- and women-owned business enterprises (MWBEs).
- Supporting and providing funding to construction industry training programs for veterans, specifically the Helmets2Hardhats program, which trains veterans for jobs in the construction industry.
- Collaborating with environmental organizations to research projects supporting innovative and environmentally sustainable offshore wind development. For example, Atlantic Shores will support the Ocean County College's Barnegat Bay Partnership, which is dedicated to helping restore, protect, and enhance the natural resources of the Barnegat Bay ecosystem. Several programs will be funded, including The Communications and Education Grants Program, Paddle for the Edge Program, and Barnegat Bay's wetland restoration program.

By participating in workforce training programs like the ones listed above, workers will continue to have employment opportunities in the Mid-Atlantic region as additional offshore wind projects proceed through development, and many of the acquired skills may translate to other marine, coastal, or port employment in the area.

### 7.2.4.2 Workforce Hiring

As further detailed in Section 7.1, Demographics, Employment, and Economics, the Project is expected to create approximately 24,000 direct full-time equivalent (FTE) jobs, 12,000 indirect FTE jobs, and 14,000 induced FTE jobs.[56] During the development and construction phase, direct jobs will primarily be in construction, manufacturing, professional services (e.g., engineering and general management), transport, and warehousing. During the O&M phase, direct jobs will primarily include technicians, engineers, and managers. During the decommissioning phase, the direct jobs will be similar to the construction workforce, with construction, technical, and management professionals. This IPF section focuses on the direct benefits of the hiring process on EJ areas and Disadvantaged Communities (DACs) during construction, O&M, and decommissioning of the Project.

Atlantic Shores is committed to hiring a diverse and local workforce and using local suppliers during Project construction, O&M, and decommissioning. A portion of this workforce could comprise residents of the EJ areas and DACs throughout the Project Region. Additionally, Atlantic Shores provides disadvantaged groups opportunities for safe, sustainable, well-paid jobs in the renewable energy industry via multiple investments to support Minority- and Women-owned Business Enterprise (MWBE) development. Atlantic Shores has pursued and will continue pursuing contracts with women- and minority-owned New York and New Jersey suppliers. To engage with minority and low-income populations and build awareness of opportunities in offshore wind, Atlantic Shores is an active member of several regions' chambers of commerce supporting minority groups. Atlantic Shores' choice of partnerships is intended to support diversity in workforce hiring among the Project EJ goals, such as the workforce-related initiatives listed in Section 7.1.4.1.

### 7.2.4.3 Port Utilization

Ports will serve as mustering points for offshore labor forces and staging areas for project components during construction and O&M phases. Ports evaluated in this section, along with Section 7.1 Demographics, Employment, and Economics, are representative of facilities that are anticipated by Atlantic Shores and its contractors to potentially support significant construction and O&M activities associated with the Project in New Jersey and New York (see Table 7.1-17 for a full list and description of anticipated utilization of these representative ports evaluated for this section).

Atlantic Shores will contribute to the regional hub for offshore wind by using ports where these activities are currently supported. Most large ports are existing marine facilities that experience significant vessel traffic for industrial, commercial fishing, and recreational purposes. Port facilities were selected partly because of their existing workforce and capacity to host Project-related activities. Project-related activities at these ports will be water-dependent marine industrial activities, and the Project is anticipated to have limited negative impacts on EJ areas of concern, DACs, and other communities surrounding the ports on land. These ports are well-established in coastal communities and adequately served by existing local and regional transportation networks and facilities. As noted previously, onshore construction, including any potential construction related to ports, is expected to be seasonally restricted to avoid adverse effects on residents and businesses during the peak tourist

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[56] Job totals are preliminary estimates only. Totals have been rounded to the nearest thousand.

season. This will reduce potential impacts on EJ areas and DACs that rely on tourism throughout the Project Region. Atlantic Shores is committed to managing port utilization such that EJ areas and DACs do not bear disproportionately high or adverse impacts from construction, O&M, and decommissioning.

The Project will create direct and indirect job opportunities at or near many ports, providing potential local benefits for individuals residing in nearby EJ areas and DACs. As further described in Section 7.1, Demographics, Employment, and Economics, the Project is expected to create approximately 24,000 direct FTE jobs, 12,000 indirect FTE jobs, and 14,000 induced FTE jobs.[57] Additional economic activity will be created for subcontractors, including shipyards, spare part producers, and vessel and harbor services. A portion of this workforce could comprise residents of the EJ areas or DACs throughout the Project Region.

#### 7.2.4.4 Installation Maintenance of New Structures and Cables

Atlantic Shores is committed to managing the installation and maintenance of new structures and cables such that EJ areas and DACs do not bear disproportionately high or adverse impacts. The installation and maintenance of new onshore interconnection cables and onshore substations may affect EJ areas and DACs through direct temporary access restrictions and disruptions to areas when these Project activities occur. This IPF section focuses on the temporary direct and indirect disturbances that will primarily occur during the construction, O&M, and decommissioning. To avoid unnecessary additional effects, onshore interconnection cables will travel underground primarily along existing roadway and utility rights-of-way (ROWs) to proposed onshore substations as described in Section 4.8 of Volume I. Easements and ROWs for private parcels will be acquired where necessary. From the proposed onshore substations, onshore interconnection cables will continue to the proposed points of interconnection (POI). Underground interconnection cable routes will primarily use existing linear infrastructure corridors to avoid and reduce neighborhood adverse impacts.

Before starting any onshore work, Atlantic Shores will coordinate with municipalities and work to inform members of the public (as may be required through the permitting process) regarding onshore construction locations and schedules, including interconnection cable routes. Onshore construction hours will adhere to local noise ordinances. While Atlantic Shores is not anticipating significant nighttime work, any nighttime work that may become necessary would be coordinated with the local authorities. Based on local permit requirements, Atlantic Shores expects construction to be seasonally restricted from Memorial Day to Labor Day, the peak summer season. A job-site safety program will also be implemented during construction to prevent public access to construction sites.

#### 7.2.4.5 Vehicle Traffic

Atlantic Shores is committed to managing vehicle traffic effects such that EJ areas and DACs do not bear any disproportionately high or adverse traffic impacts from construction or operation activities.

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[57] Job totals are preliminary estimates only. Totals have been rounded to the nearest thousand.

This IPF section focuses on the localized, short-term disturbances from Project-related vehicle traffic that could be expected to occur in or near EJ areas and DACs during construction and decommissioning.

Vehicle traffic could result in temporary detours to certain routes or restricted parking, which could affect EJ areas or DACs due to incremental increases in traffic volume, mainly during construction and concentrated along the interconnection cable routes and near the ports (see Section 7.9 Onshore Transportation and Traffic). For the most part, however, traffic impacts from these Project-related activities at these locations will be minimized. To avoid unnecessary additional impacts, onshore interconnection cables will primarily travel underground using trenchless installation techniques (e.g., HDD, jack-n-bore, etc.) along existing roadway, utility right-of-ways (ROWs), or bike paths to proposed onshore substations as described in Section 4.8 of Volume I. Easements and ROWs for private parcels will be acquired where necessary. Activities at ports will be water-dependent marine industrial activities, and the Project is anticipated to have limited negative traffic impacts on EJ areas of concern and other communities surrounding the ports on land. These ports are well-established in coastal communities and adequately served by existing local and regional transportation networks and facilities.

New transportation infrastructure will not be needed to construct and operate the Project, further reducing potential traffic effects. As noted, onshore construction is expected to be seasonally restricted to avoid adverse impacts on residents and businesses during the peak tourist season. This will reduce potential impacts on EJ areas and DACs that experience high traffic volumes related to tourism. Atlantic Shores is actively researching options to provide electric car infrastructure for certain communities within the Project Region, reducing localized air pollutant emissions.

As further described in Section 7.9 Onshore Transportation and Traffic, Atlantic Shores will work with police, fire departments, and state, county, and local municipalities as appropriate to develop a Traffic Management Plan (TMP) before construction to avoid and minimize traffic- and transportation-related effects. This includes EJ areas and DAC populations in proximity to the potential Onshore Project Components, as well as in the vicinity of ports. The TMP will be reviewed and approved by either NJDOT or NYSDOT for those portions of the route that cross or occupy state highway ROW and pertain to county and local roads. As noted previously, installation of the interconnection cable will generally occur within the existing roadway, railroad, and utility ROW to the maximum extent practicable to avoid adverse impacts. Best management practices for the TMP are expected to include traffic control measures such as signage, police details, lane closures, and detours. Additional specific traffic management strategies implemented by the Project may include alternate traffic routes, reduced speeds, signal adjustments, physical barriers, channeling devices, and alternate truck routes.

#### 7.2.4.6 Housing

This IPF section focuses on the direct effect of housing (both in terms of availability and affordability) on EJ areas and DACs during the construction, O&M, and decommissioning of the Project. Overall, the Project will benefit local economies and industries by hiring locally and sourcing materials locally from within the Project Region whenever practicable. This will have beneficial ripple effects on the housing market. Because Atlantic Shores emphasizes local hiring and the use of local suppliers, any increase in housing demand is expected to be limited to areas close to port locations, as opposed to increased demand on the Project Region as a whole. The Project is not anticipated to create adverse disproportionate housing impacts on EJ areas and DACs close to the port locations. These ports are well-established in coastal communities adequately served by the existing housing supply and subject to the local policies that influence housing affordability. Based on existing housing availability and housing affordability data examined in Section 7.1.1.3, local housing markets will absorb any increase in workforce housing demand for the Project. The small number of personnel that may relocate to the Project Region permanently is not anticipated to affect the availability or affordability of housing.

#### 7.2.4.7 Temporary Accommodations

This IPF section focuses on the direct effect of temporary housing accommodations on EJ areas and DACs during the construction, O&M, and decommissioning of the Project. Onshore construction will be planned to minimize effects on the Project Region during the summer tourist season (i.e., Memorial Day through Labor Day). This may reduce Project-related impacts that increase demand and competition for temporary housing, in turn increasing rental prices. The Project will utilize locations and construction schedules where and when seasonal use is a lower percentage of all housing, and therefore, housing units for rent or sale would be more available for short- or long-term use. When lodging demand declines, for example, during the off-season for tourism, the Project may provide additional economic benefits to the local communities by replacing tourism demand with temporary Project demand for accommodations. This may include rentals for houses, apartments, and hotels/motels.

The Project is not anticipated to adversely impact EJ areas and DACs from neighborhoods and areas within the Project Region. As discussed in Section 7.1 Demographics, Employment, and Economics, the operation of the Project greatly reduces the need for any temporary housing accommodations. The remaining housing needs depend upon any need for temporarily housing skilled technicians or other trades unavailable from the local workforce. O&M is not anticipated to affect local housing demand for temporary accommodations such as hotels and motels. The need for temporary accommodation during decommissioning is anticipated to occur at an equal level to what will be needed during construction.

#### 7.2.4.8 Air Emissions

This IPF section describes the potential effects that emissions associated with the construction, O&M, and decommissioning of the Project will have on EJ areas and DACs. This section also describes the benefits of avoiding air pollutant emissions associated with the Project.  With proper siting, design, construction, and operation, offshore wind facilities typically do not pose a risk of significant impacts on public health and safety; rather, offshore wind facilities provide benefits to public health by reducing greenhouse gas (GHG) emissions, hazardous air pollutants (HAPs) (e.g., mercury, acrolein, formaldehyde, and cadmium), and wastewater emissions associated with conventional energy production. The Project will be constructed following applicable State and Federal air quality and emissions standards, and Atlantic Shores is committed to developing and operating the Project safely and environmentally responsible.

While the Project's wind turbine generators (WTGs) will not generate air emissions, air emissions will result from Project-related activities. Most Project-related air emissions will result from internal combustion (i.e., fuel use for vehicles, vessels, or other mechanical work). However, emissions associated with the construction, O&M, and decommissioning of the Project will be predominantly localized to the offshore Lease Area or will have effects similar to existing onshore activities in the area and therefore are not anticipated to affect onshore local or regional air quality significantly. Furthermore, Atlantic Shores is committed to implementing best management practices (BMPs) and investigating the use of innovative tools and technologies to minimize air emissions from Project-related activities.

Overall, the Project will significantly decrease harmful air pollutant emissions region-wide by displacing electricity from fossil fuel power plants. The emissions reductions will occur at fossil fuel power plants that tend to be near population centers or upwind of population centers, including overburdened EJ areas and DACs. Project-related air emissions will predominately occur offshore, away from population centers. The Project will provide an overall environmental and public health benefit to populations in the area, including EJ areas and DACs, by generating clean and renewable energy without compromising the air quality of the greater area. Please see Section 3.1 for additional information on air quality.

#### 7.2.4.9 In-Air Noise

Atlantic Shores is committed to managing in-air noise effects such that EJ areas and DACs do not bear disproportionately high or adverse impacts from construction, O&M, and decommissioning. This IPF section focuses on the localized, short-term disturbances from Project-related in-air noise that could be expected to occur in or near EJ areas and DACs during construction, O&M, and decommissioning.

An onshore noise assessment is underway to analyze potential in-air sound level impacts from the construction and operation of the Project's onshore facilities. Atlantic Shores will ensure the Project complies with applicable noise regulations and does not have a negative effect on surrounding communities. Localized and short-term generation of in-air noise may occur during construction. Operational noise will emanate from the Project's onshore substation or converter station components. Operation of the onshore substations or converter stations may result in minor and localized noise generation.

Atlantic Shores proposes to adhere to seasonal construction restrictions in coastal regions during the peak tourist season to minimize the effects of temporary noise. To further minimize the effects of construction noise, Atlantic Shores will maintain strong communication and public outreach with adjacent stakeholders, including EJ areas and DACs, about the time and nature of construction activities. Construction-period mitigation measures, including those used near EJ areas and DACs, may include using quieter equipment, assuring the functionality of equipment, adding mufflers or noise-reducing features, using portable sound walls (i.e., temporary noise barriers), and replacing backup alarms on trucks and equipment with strobes, as allowed within Occupational Safety and Health Administration (OSHA) regulations. Please see Section 8.1 for additional information on in-air noise.

#### 7.2.4.10 Visual Resources

Atlantic Shores understands the importance of scenic ocean views to residents, tourists, and visitors to shore communities and is committed to minimizing adverse visual impacts to the maximum extent practicable. The Project components considered in the visual resources analysis include the WTGs, offshore substations, and onshore substations. This IPF section describes the potential visual effects of the Project and measures to avoid, minimize, or mitigate potential effects during construction, O&M, and decommissioning.

As described in Table 7.2.1 and depicted on Sheet 5 of Figure 7.2-1 and Sheet 5 of Figure 7.2-2, EJ areas and DACs are located within the "zone of visual influence". They may experience visual effects resulting from the Project. However, EJ areas and DACs will not be subject to more Project-related visual impacts than other populations in the zone of visual influence. EJ areas and DACs will not bear disproportionately high or adverse impacts on visual resources resulting from construction, O&M, and decommissioning.

The degree of project visibility will vary greatly depending on the distance of the viewer from the project, meteorological conditions, degree of screening from structures, vegetation, and curvature of the earth, visual acuity of the viewer, and the ability of the viewer to recognize the components of the Project. Atlantic Shores has developed environmental protection measures to effectively reduce the potential visual impacts, including siting larger offshore substations further from the coast to reduce their potential visibility and installing onshore interconnection cables underground rather than aboveground. Please see Section 5.0 for further information on visual resources and proposed minimization measures.

#### 7.2.4.11 Commercial Fishing

This IPF section describes the potential effects of construction, O&M, and decommissioning that the Project may have on EJ areas and DAC populations who work in commercial fishing-dependent jobs. This section also describes the anticipated benefits for EJ areas and DACs due to the Project. Potential effects related to commercial fishing include vessel traffic, the installation and maintenance of new structures and cables, and the presence of structures. Atlantic Shores is committed to managing activities such that EJ areas and DACs will not bear disproportionately high or adverse effects resulting from the construction, O&M, and decommissioning of the Project.

Vessels used for construction and O&M will operate primarily out of ports with little commercial fishing activity and competition for dockside and shoreside services. Activity within these ports is not expected to affect commercial fishing operations. Installation and maintenance of new structures and cables within the Lease Area will likely cause temporary disruptions to commercial fishing activities during construction, O&M, and decommissioning. It is anticipated that these activities will temporarily disrupt transit and access to fishing grounds that are in proximity to Project construction vessels and installation activities. Structures may affect navigation within the Lease Area by commercial fisheries. However, the Project layout has been developed to accommodate vessel transit to local ports and offshore fishing grounds and to avoid concentrated areas of fishing activity to the maximum extent practicable. Please see COP Volume II, Section 7.4, for further information on potential IPFs.

Atlantic Shores has conducted agency and stakeholder outreach (including with the fishing community) to provide information about the Project and better understand the potential impacts of the Project on commercial fishing operations (see COP Appendix A-1 Stakeholder Outreach for a full list of outreach activities). Atlantic Shores is continuously communicating and consulting with the fishing community- both commercial and recreational- to understand their concerns and create a development plan with as little impact on fishing as possible. As a result, Atlantic Shores developed a Fisheries Communication Plan (see COP Appendix II-S) to outline ways fishers can communicate concerns with the development team and a description of methods that Atlantic Shores will utilize to keep commercial fishers informed about the Project. See COP Section 7.4 for more information regarding the proposed methods to minimize Project effects.

In September 2020, Atlantic Shores distributed a formal Request for Interest (RFI) to identify fishing businesses with available docks and port real estate to support the Project. Atlantic Shores received strong responses from four local fishing companies, indicating that the fishing industry does find valuable economic opportunities in the offshore wind industry. Atlantic Shores continues to advance opportunities for local fishermen to work on the Project. See COP Section 7.4 for more information regarding advancing economic opportunities for local commercial fishing operations.

### 7.2.5 Summary of Proposed Environmental Protection Measures

Most potential impacts to EJ areas and DACs are expected to be positive benefits, including jobs and economic stimulus, contributing to Federal and State renewable energy investment goals for these communities. Atlantic Shores is committed to managing activities such that EJ areas and DACs will not bear disproportionately high or adverse impacts from construction, O&M, and decommissioning activities. Additionally, Atlantic Shores is committed to managing activities such that EJ areas and DACs are not disproportionately excluded from receiving Project benefits. Atlantic Shores has already taken preliminary steps to maximize the positive economic benefits of the Project for EJ areas and DACs. Additionally, Atlantic Shores recognizes the opportunity to directly benefit EJ areas and DACs through thoughtful and targeted development choices and has taken steps to be inclusive in how the Project is developed, constructed, and maintained. Negative effects will be minimized by consulting with stakeholders to identify potential issues, thoroughly investigating them, and devising strategies to avoid or minimize adverse effects. Potential socioeconomic impacts, both positive and negative, from offshore wind energy projects predominantly result from construction activities. However, these effects are localized, temporary, and short-term. New housing or transportation infrastructure will not be needed to construct and operate the Project. Beneficial effects spurred by the construction and O&M of the Project include job creation and economic stimulus to the Project Region. Some of these jobs and economic stimulus could occur within EJ areas and DACs throughout the Project Region. The following provides a summary of proposed minimization and mitigation measures that Atlantic Shores will implement to maximize the positive economic benefits for EJ areas and DACs within the Project Region:

- A workforce hiring program will be implemented and designed to benefit environmental justice communities.
- Project infrastructure, such as cables, will be installed to avoid disproportionate impacts on EJ areas and DACs.

- Atlantic Shores will support workforce initiatives that strongly focus on supporting minority and low-income populations, women, veterans, underserved communities, and local chambers of commerce supporting minority groups.
- A TMP will be developed for construction activities, and traffic monitoring will be conducted.
- Onshore construction will be phased to limit impacts to discrete areas and, therefore, will impact only a specific area for a short period. Atlantic Shores will adhere to seasonal construction restrictions in coordination with local authorities for certain portions of the onshore interconnection cable routes to avoid impacts during peak usage periods (e.g., summer shore season, generally from Memorial Day to Labor Day). Construction hours will also be developed following local noise ordinances. Atlantic Shores will update their website and coordinate with municipalities to inform members of the public of construction schedules. Local ports will be used to the maximum extent practicable.
- The Project will provide an overall environmental and public health benefit to populations in the area, including EJ areas and DACs, by generating clean and renewable energy without compromising the air quality of the greater area.
- Construction-period mitigation measures, including those used in or near EJ areas and DACs, may include using quieter equipment, assuring the functionality of equipment, adding mufflers or noise-reducing features, using portable sound walls (i.e., temporary noise barriers), and replacing backup alarms on trucks and equipment with strobes, as allowed within Occupational Safety and Health Administration (OSHA) regulations.
- Onshore interconnection cables, including those used in or near EJ areas and DACs, will be installed underground rather than on aboveground structures.
- Onshore substations/converter stations, including those used in or near EJ areas DACs, will be sited adjacent to existing utility infrastructure and, if possible, on parcels zoned for commercial or industrial use.
- Vegetative screening, including screening used in or near EJ areas and DACs, will be evaluated to reduce or minimize the moderate potential visual impacts associated with the proposed substation and converter station.
- Atlantic Shores distributed a formal RFI to identify fishing businesses, including those in EJ areas and DACs, with available docks and port real estate to support the Project.

## 7.3 Recreation And Tourism

This section describes recreation and tourism (including recreational fishing) in the Offshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning. Atlantic Shores recognizes that there are often concerns regarding how the presence of an offshore wind farm might influence recreation and tourism. Data from operating wind farms around the world and in the U.S. suggest that negative effects are minor and if they do occur, are temporary, and typically limited to the period of project construction (ICF 2012). Usually, wind farms have resulted in positive benefits to recreation and tourism over the lifetime of a project.

In particular, Atlantic Shores understands the importance of recreational fishing and is committed to ensuring coexistence with recreational fishermen within the Lease Area and along the Export Cable Corridors (ECC). Atlantic Shores has dedicated considerable resources to reach recreational fishermen and boaters. Atlantic Shores has developed a detailed Fisheries Communication Plan (see Appendix II-S) and has hired a Fisheries Liaison Officer (FLO) and a Recreational Fishing Industry Representative (FIR), both of whom are local fishermen in New Jersey. An FLO and FIR with similar experience and relationships in New York will be hired as the Project progresses. To better understand recreational fishing in the area and to inform this assessment of recreational fishing, Atlantic Shores has compiled information from industry conversations, direct data gathering exercises with fishermen, consultations with government agency representatives, and analysis of public data (see Section 1.4.2 of Volume I). This information also guides the siting, design, O&M, and decommissioning of the Project. In addition to promoting communication with recreational fishermen, Atlantic Shores is dedicated to improving and understanding New Jersey's and New York's marine resources and is a founding member of the Responsible Offshore Science Alliance (ROSA), which shares Atlantic Shores' commitment to advance regional research and monitoring of fishery and offshore wind interactions.

Atlantic Shores has hired Community Liaison Officers (CLOs) to help inform the public of Project activities and to support productive and effective dialogue with stakeholders. The CLOs are New Jersey residents and have existing relationships and prior experience within New Jersey coastal communities, allowing Atlantic Shores to better understand the stakeholder groups and their concerns. CLOs with similar experience and relationships in New York will be hired as the Project progresses.

Atlantic Shores has also conducted a thorough review of potential visual effects of the Project to recreational beaches and other locations (see Section 5.0 Visual Resources) and a detailed assessment of the finfish species that are considered commercially and recreationally important (see Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat).

### 7.3.1 Affected Environment

The description of the affected environment related to recreation and tourism encompasses a variety of activities that are known or expected to take place in the Onshore and Offshore Project Areas. For recreational and tourism activities, the majority of the affected environment will occur in or offshore of New Jersey given the location of the Lease Area. In New York, the affected environment is limited to the areas surrounding the Northern ECC corridor and associated potential landfall(s), and onshore interconnection cable route options. Consistent with previously published studies on offshore wind energy projects and effects on recreation and tourism, several types of activities are likely to occur in the vicinity of project activities during construction, O&M, and decommissioning (ICF 2012) including the following:

- nature-based (e.g., birdwatching, kayaking, hiking);
- beach (e.g., shell collecting, sunbathing, swimming);
- sporting (e.g., surfing, hunting, fishing);
- history-based (e.g., tours, museums);
- cultural (e.g., festivals, dining, community immersion, wine-tasting); and
- boardwalk (e.g., arcades, shopping, amusements).

Given the regional importance and unique attributes of recreational fishing compared to the other types of recreation and tourism, the following discussion is separated into two categories: recreation and tourism and recreational fishing.

#### 7.3.1.1 Recreation and Tourism

The description of recreation and tourism within the affected environment is based on available scientific literature, online data portals, and relevant information from Federal and State agencies (ICF 2012; Parsons and Firestone 2018; Tourism Economics 2020). Within the Offshore and Onshore Project Areas, recreation and tourism opportunities are abundant and may experience some limited interruption by Project activities, mainly during construction. Offshore recreation and tourism activities include boating, sightseeing, and other water sports (e.g., kayaking, diving, stand-up paddle boarding). Onshore recreation and tourism include activities associated with visits to beaches, parks, conservation areas, boardwalks, and tourist destinations which offer shopping, sightseeing, and entertainment near the shoreline.

The affected environment for recreation and tourism includes the New Jersey Offshore and Onshore Project Areas but mainly the coastal communities within Monmouth and Ocean Counties.

The New Jersey shoreline is predominantly sandy beach, which is widely accessible to the public from many locations. At least 90 beaches along the New Jersey shoreline, some with associated boardwalks, are listed in public databases. Some of these areas face the Offshore Project Area and may have visibility of the Wind Turbine Generators (WTGs) and Offshore Substations (OSSs) (see Section 5.0 Visual Resources). Currently there are several places in both Monmouth and Ocean Counties where the ECCs could make landfall.

The coast of New Jersey is a popular tourist destination and is famous for its beaches and boardwalks. The recreation and tourism industry which is centered around New Jersey's shore counties (i.e., Monmouth and Ocean) typically lead the State in direct sales from tourism. In the State of New Jersey's annual reporting on the economic impact of tourism on the broader economy, visitor spending in New Jersey fell from $46.4 billion in 2019 to $29.4 billion in 2020; $3.5 billion of that total is attributable to recreational spending. The Coronavirus pandemic largely contributed to the decreased overall spending of visitors in New Jersey, with the spending rate falling to lows previously observed in 2012; however, the proportion of recreational spending (12%) did not change from 2019 to 2020 (Tourism Economics 2021). The visitor economy typically drives economic growth for New Jersey and is responsible for growth in employment and State and local tax revenues. In fact, in 2020, visitors generated $4.0 billion in state and local taxes, which is equivalent to $1,200 in tax savings for every household in New Jersey (Tourism Economics 2021). Despite significant downturns in tourism and related economic activity because of the Coronavirus pandemic,  quick rebounds in activity were realized with visitors spending $45.4 billion in 2022, an increase of 22% over the prior year (Tourism Economics 2023). The direct visitor spending of $45.4 billion generated a total economic impact of $73.5 billion New Jersey in 2022 including indirect and induced impacts (Tourism Economics 2023).

The coastal counties of New Jersey offer a diversity of recreation and tourism opportunities. Beaches, parks, recreational/public access areas, bike paths and wildlife areas constitute the primary onshore recreational outlets in the area. Figure 7.3-1 indicates the locations of mapped recreation and tourism opportunities in the general vicinity of the Onshore Project Area in New Jersey (NJDEP 2020).

Within the Offshore Project Area, inclusive of waters along the ECCs, recreational boating and fishing are known to occur with varying intensity. Historically, the recreational boating industry has been credited for 18,000 jobs and an estimated $2.1 billion dollars in annual spending across New Jersey (MTANJ 2008). In 2018, the recreational boating industry was credited for approximately 29,000 direct and indirect jobs and was estimated to contribute $6.6 billion to the New Jersey economy (NMMA 2018). According to a Marine Trades Association of New Jersey survey, most recreational boating is associated with fishing activity and most recreational boaters target lakes, rivers, and bays, rather than offshore waters, as destinations (MTANJ 2008). There are many marinas along the New Jersey Coast between the proposed landfall sites but there are no marinas directly affected by these landfall locations.

The affected environment for recreation and tourismin New York State includes the Offshore and Onshore Project Areas, but mainly the urban/shore counties of Richmond and Kings Counties.

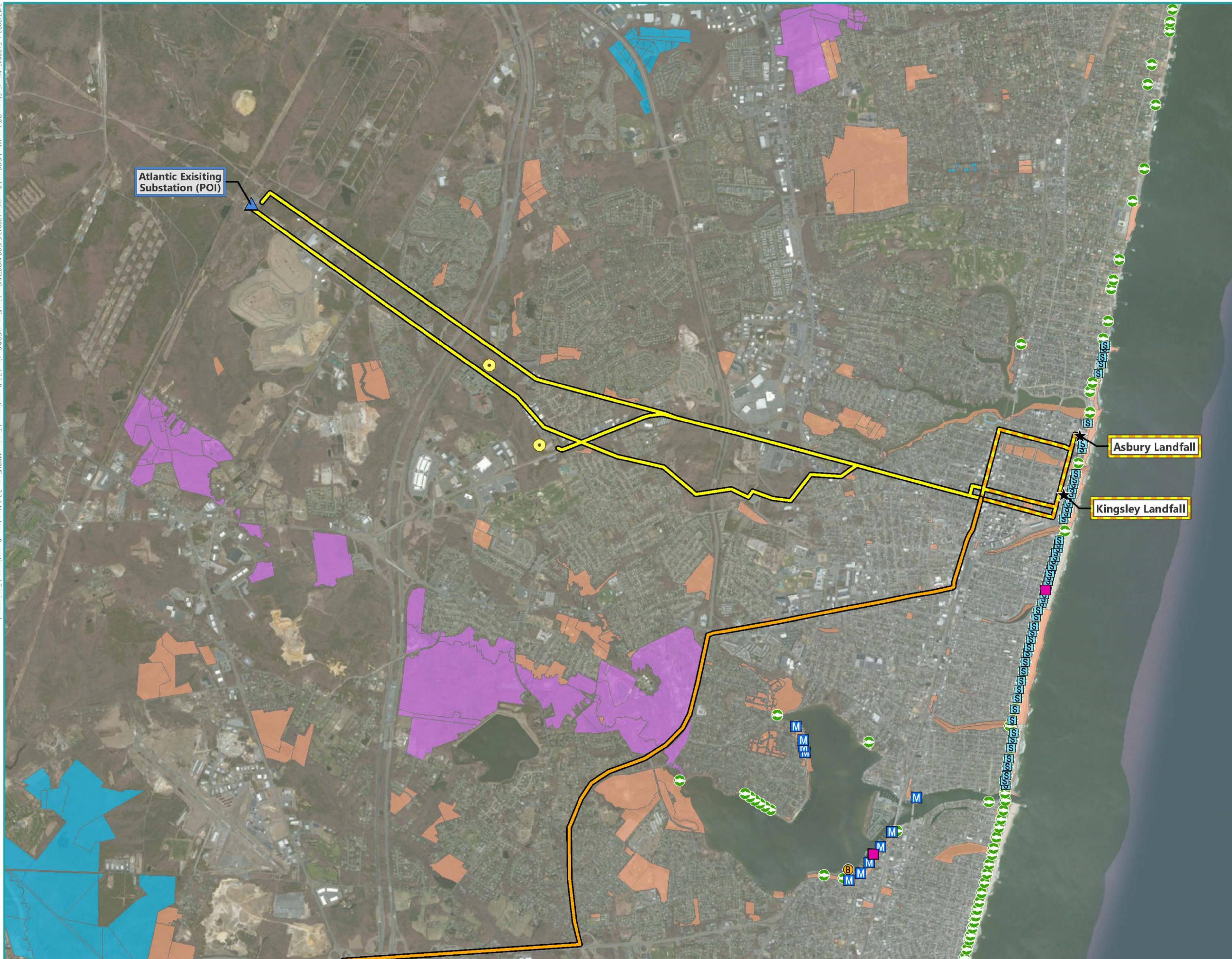
The New York City/western Long Island shoreline is predominantly sandy beach, which is widely accessible to the public from many locations. At least 15 beaches are listed in public databases along the shorelines of Brooklyn and Staten Island. Some of these areas face the Offshore Project Area but would not have visibility of the Wind Turbine Generators (WTGs) and Offshore Substations (OSSs) (see Section 5.0 Visual Resources). Currently there are several places in both Richmond and Kings Counties where the ECCs could make landfall.

The coasts along Staten Island and Brooklyn are a mix of popular tourist destinations and hotspots for local residents to enjoy the natural beach scenery. In addition to typical beach-going activities, this particular area of New York is unique in that it combines the natural beauty of the beach with the densely populated urban areas in New York City. This setting provides additional recreational opportunities onshore. The recreation and tourism industry which is split among New York City and other areas of the State (i.e., Long Island, upstate etc.) typically contribute to the state's direct sales from tourism.

In New York City's annual reporting on the economic impact of tourism on the broader economy, visitor spending in 2020 in New York City fell by 75% from $80.3 billion in 2019 to $20.2 billion (ONYSC 2021). The Coronavirus pandemic largely contributed to the decreased overall spending of visitors in New York City. The visitor economy typically drives economic growth for New York City with the industry supporting a higher share of workers who are self-employed (14.4%). The visitor economy is also responsible for growth in employment and State and local tax revenues. In fact, in 2020, visitors generated $1.2 billion in state and local taxes, despite decreased overall spending (ONYSC 2021).

As in New Jersey, the coastal counties of New York offer a diversity of recreation and tourism opportunities. Figure 7.3-2 indicates the locations of the mapped recreation and tourism opportunities in the general vicinity of the Onshore Project Area in New York.

Within the Offshore Project Area, inclusive of waters along the ECCs, recreational boating and fishing are known to occur with varying intensity. Historically, the recreational boating industry has been credited for 18,700 jobs and an estimated $1.8 billion dollars in annual spending across the state of New York (Sea Grant 2004). In 2009, the recreational boating industry in New York State was an $8 billion industry with a total of 435,213 registered recreational boaters (NYS 2019). More recently, the National Marine Manufacturers Association (NMMA) estimated that the recreational boating industry has a $10 billion annual economic impact in New York State (NMMA 2023). According to a Sea Grant study, most recreational boating is associated with fishing activity and most recreational boaters target lakes, rivers, and bays, particularly the Great Lakes and Finger Lakes (Sea Grant 2004). The largest economic impact of boating by region in the state, however, was the New York City/Long Island Metropolitan area with approximately $843 million in associated recreational spending (Sea Grant 2004). There are many marinas along the New York coastline between the proposed landfall sites but there are no marinas directly affected by these landfall locations.




ATLANTIC SHORES offshore wind


0 1,500 3,000 6,000 Feet
0 500 1,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: NJ Office of Information Technology - 2015 Natural Color Imagery Service

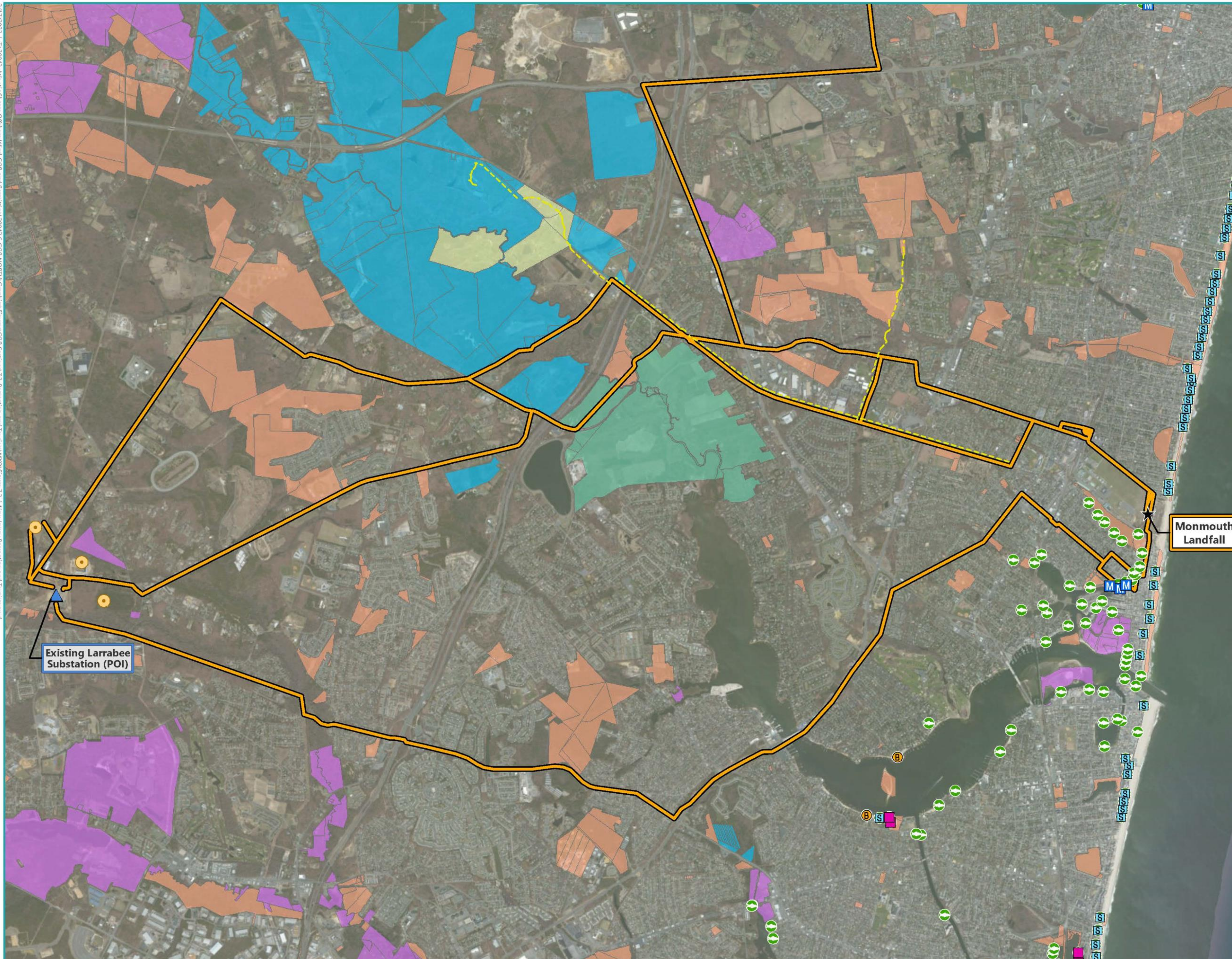
**LEGEND**

- Boat Launch
- Fishing Access
- Marina
- Pier
- Swimming Access
- Local Parks and Recreation Areas
- County Parks and Open Space
- State Parks, Preserves and Open Space
- Potential Landfall
- Potential Atlantic Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Larrabee Onshore Interconnection Cable Route Option
- Atlantic Onshore Interconnection Cable Route Option
- Atlantic or Larrabee Onshore Interconnection Cable Route Option

**Figure 7.3-1**

*Sheet 1 of 2*

*Landfall and Onshore Interconnection Cable Route Options*
*Monmouth and Ocean County, New Jersey*
*Recreation and Tourism Opportunities*





0 1,500 3,000 6,000 Feet

0 500 1,000 Meters

N W E S

*Map Projection: NAD 1983 UTM Zone 18N*
*Basemap: NJ Office of Information Technology - 2015 Natural Color Imagery Service*

**LEGEND**

- Boat Launch
- Fishing Access
- Marina
- Pier
- Swimming Access
- Bike Path/Bikeway
- Local Parks and Recreation Areas
- Golf Course
- County Parks and Open Space
- State Parks, Preserves and Open Space
- National Wildlife Refuge or Wildlife Management Area
- Potential Landfall
- Potential Larrabee Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Larrabee Onshore Interconnection Cable Route Option

**Figure 7.3-1**

*Sheet 2 of 2*

*Landfall and Onshore Interconnection Cable Route Options*
*Monmouth and Ocean County, New Jersey*
*Recreation and Tourism Opportunities*

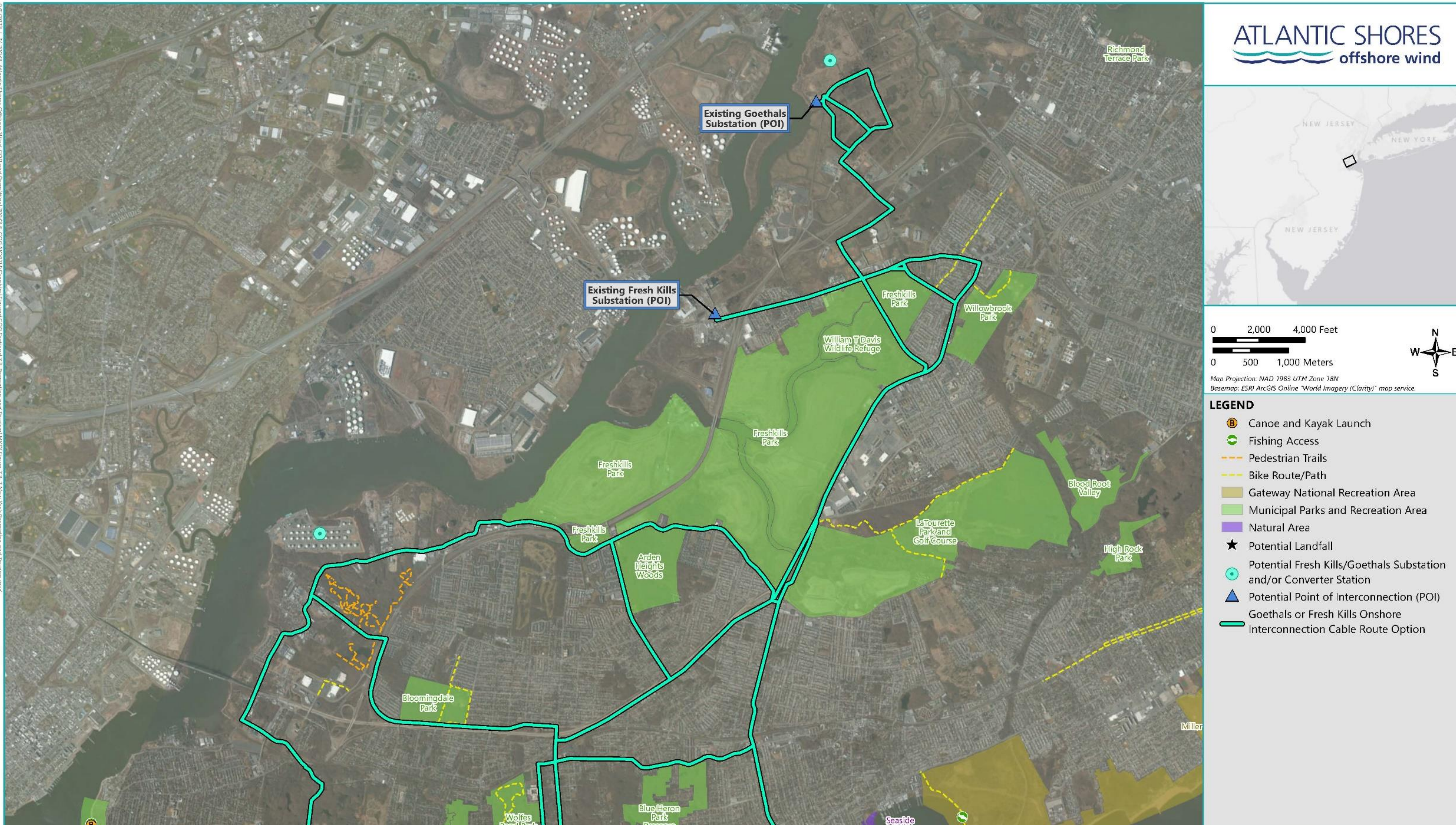



**Figure 7.3-2**

*Sheet 1 of 2*

*Landfall and Onshore Interconnection Cable Route Options Richmond and Kings County, New York Recreation and Tourism Opportunities*


ATLANTIC SHORES offshore wind


0 2,000 4,000 Feet
0 500 1,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: ESRI ArcGIS Online "World Imagery (Clarity)" map service.

**LEGEND**
- Canoe and Kayak Launch
- Fishing Access
- Bike Route/Path
- Gateway National Recreation Area
- Municipal Parks and Recreation Area
- Potential Landfall
- Potential Gowanus Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Gowanus Onshore Interconnection Cable Route Option

**Figure 7.3-2**

*Sheet 2 of 2*

*Landfall and Onshore Interconnection Cable Route Options*
*Richmond and Kings County, New York*
*Recreation and Tourism Opportunities*

### 7.3.1.2 Recreational Fishing

Recreational fishing is a popular activity in the waters offshore of New Jersey and New York. In 2020, Atlantic Shores became the first developer to include a Recreational FIR as part of their Fisheries Engagement Team when Captain Adam Nowalsky, the New Jersey State Chapter Lead for the Recreational Fishing Alliance, was hired. The purpose of a Recreational FIR is to represent the collective voice of the recreational fishing industry and share their views to advise Atlantic Shores. An additional role is to bring recreational expertise to help inform Atlantic Shores' Project planning and to disseminate project information to the recreational community. The Recreational FIR is working with local recreational fishermen to help Atlantic Shores fill data gaps and gather local knowledge of recreational fishing activity within the Lease Area and along the ECCs. Atlantic Shores' ongoing outreach efforts include one-on-one meetings with stakeholders to better understand fishermen's concerns and to familiarize New Jersey and New York fishermen with the Project.

Most statistics on recreational fishing efforts are reported on a statewide basis, such that data specific to recreational fishing activity in the Lease Area and along the ECCs is more limited. Statewide data regarding recreational offshore fishing in New Jersey and New York are presented below.

**New Jersey and New York Recreational Fishing Data**

According to statewide data, just over 2.0 million angler trips per year were conducted in the coastal and offshore waters in New Jersey from 2015 to 2020. More than 530,000 New Jersey residents participated in statewide, marine recreational fishing in 2016. In addition to local fishermen, about 380,000 out-of-state recreational anglers fished New Jersey waters in 2016 (NOAA MRIP 2020). The New Jersey Offshore Wind Strategic Plan highlights the economic contributions of the millions of recreational anglers and angler trips each year in New Jersey: Statewide recreational fishing provides at least 15,000 jobs and adds $1.7 billion in sales, $0.7 billion in income, and $1.1 billion in value added to the State's economy (NJBPU 2020; NOAA Fisheries 2019). Privately owned vessels make up a significant portion of the overall recreational fishing effort.

According to statewide data, just over 3.0 million angler trips per year were conducted in the coastal and offshore waters in all of New York from 2015 to 2020. More than 78,030 New York residents participated in statewide, marine recreational fishing in 2016 (NOAA 2018). In addition to local fishermen, about 112,957 out-of-state recreational anglers fished New York waters in 2016 (NOAA 2020). Statewide recreational fishing provides at least 10,000 jobs and adds $1.1 billion in sales, $47 million in income, and $8 billion in value added to the State's economy (NOAA 2018). Privately owned vessels make up a significant portion of the overall recreational fishing effort.

Although recreational fishing occurs on a year-round basis throughout the offshore waters of New Jersey and New York, most recreational fishing takes place during the warmer weather months. Based on Marine Recreational Information Program (MRIP) data, the number of angler trips in New Jersey and New York are typically greatest during the months of July and August. For example, from 2015 to 2019, an average of approximately 720,000 New Jersey angler trips occurred during July and August combined, which is approximately 35% of all annual angler trips. During the same time period in New York, an average of 1,000,000 angler trips occurred during July and August, representing approximately

33% of all annual angler trips. The timing of migratory species' "runs" through the offshore waters of New Jersey and New York, as well as open seasons, catch limits, and size limits, may also dictate the timing and intensity of recreational fishing effort for specific species. Although there are a diverse range of species in the offshore waters of New Jersey and New York, from 2015 to 2019, the non-bait species most frequently caught in New Jersey by landed weight were striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix*), and black sea bass (*Centropristis striata*) (NOAA 2020). Other common and important demersal species include scup (*Stenotomus chrysops*), tautog (*Tautoga onitis*), clearnose skate (*Raja eglanteria*), little skate (*Leucoraja erinacea*), and monkfish (*Lophius americanus*).

Much of the New Jersey's recreational fishing effort is concentrated within 3 miles (mi) (4.8 kilometers [km]) of shore, far inshore from the Lease Area which is located a minimum of 8.7 mi (14 km) from the New Jersey coast. However, fishing for Federally regulated Atlantic Highly Migratory Species (HMS), such as Federally regulated sharks, blue and white marlin (*Makaira nigricans* and *Tetrapterus albidus*), sailfish (*Istiophorus albicans*), roundscale spearfish (*Tetrapturus georgii*), and swordfish (*Xiphias gladius*), occurs farther offshore than most other recreational fishing and may occur within the Lease Area and portions of the ECCs farther offshore. As a result of their distance offshore, comparatively fewer anglers participate in these fisheries. To fish for Federally regulated HMS in the Atlantic Ocean, an Atlantic HMS Angling category permit is required. In 2016, there were 20,020 angling permit holders for Atlantic HMS (this number includes for-hire recreational fishermen) and that same year 13.3% of HMS angling trips originated in New Jersey (NMFS 2019).

There are artificial reef sites adjacent to the Lease Area and ECC that are managed by the New Jersey Artificial Reef Program and are considered prime recreational fishing grounds. The New Jersey Artificial Reef Program is one of the largest on the east coast of the U.S. consisting of 15 ocean sites containing over 1,000 reefs and 100 sunken vessels.

Recreational anglers often take advantage of artificial reefs, which provide refuge for recreational species and their prey. Therefore, these artificial sites have been excluded from the Lease Area and ECCs, although some sites are present near or at the borders of the Lease Area and the ECCs. Other fishing hotspots in proximity to the Lease Area and ECCs are Axel Carlson, Manasquan Inlet, Sea Girt, Shark River, and Sandy Hook in New Jersey (NJDFW 2019). Fishing hot spots in New York in proximity to the ECCs include Rockaway and Atlantic Beach (NYSDEC 2022). Artificial reefs and areas identified as recreational fisheries hotspots are shown in Figure 7.3-2.

New Jersey and New York also host several offshore fishing tournaments each year and participating anglers may transit or fish within the Lease Area and ECCs, though fishing effort in any particular geographic area is highly dependent on the productivity of that area. Fishing tournaments are economically important to local cities or towns where shoreside amenities and services (e.g., dockage, fuel, supplies, and lodging) support tournament participants. In 2021, for example, 12 such tournaments were held in New Jersey (Table 7.3-1). These events primarily occur in the summer months and are geared toward anglers targeting HMS. Similar tournaments hosted in New York occur in eastern Long Island or Long Island Sound, well removed from the Lease Area and ECCs.

## Table 7.3-1. New Jersey Recreational Fishing Tournaments, 2021

| Tournament | Location | Start Date | End Date |
|---|---|---|---|
| Jersey Coast Shark Anglers Mako "Catch It" Fever | Brielle, New Jersey | 6/19/2021 | 6/27/2021 |
| Jersey Coast Anglers Fluke Tournament | Brick, New Jersey | 7/21/2021 | 7/31/2021 |
| Beach Haven White Marlin Invitational | Beach Haven, New Jersey | 8/11/2021 | 8/14/2021 |
| Berkeley Striper Club Spring Striped Bass C&R Tournament | Seaside Park, New Jersey | 5/28/2021 | 6/5/2021 |
| Governor's Surf Fishing Tournament | Island Beach State Park, New Jersey | 5/23/2021 | 5/23/2021 |
| Spring Striper Marathon | Brick, New Jersey | 5/22/2021 | 5/22/2021 |
| Tuna Mania | Shark River – Manasquan – Barnegat, New Jersey | 6/10/2021 | 6/13/2021 |
| South Jersey Mid-Atlantic Tuna Tournament | Cape May, New Jersey | 6/9/2021 | 6/13/2021 |
| Jimmy Johnson's Atlantic City "Quest for the Ring" Championship Fishing Week | Atlantic City, New Jersey | 7/12/2021 | 7/19/2021 |
| The Hatch Club of Stone Harbor Invitational Marlin Tournament | Cape May, New Jersey | 7/22/2021 | 7/24/2021 |
| The Mid-Atlantic Cup | Cape May, New Jersey | 8/15/2021 | 8/20/2021 |
| Jersey Coast Anglers Blackfish Tournament | Brick, New Jersey | 11/26/2021 | 11/26/2021 |

### 7.3.2 Potential Impacts and Proposed Environmental Protection Measures

Data from economic impact studies in Europe and the U.S. indicate the potential for net positive gains to recreation and tourism activities due to the attractive quality of offshore wind projects (ICF 2012). Proposed Project activities are not expected to have long-term negative effects on recreation and tourism. Only localized, short-term adverse effects could be experienced in certain onshore and offshore areas primarily near and during active construction activities. To further lower the potential for adverse effects to people engaging in recreational and tourism activities near Project activities, Atlantic Shores, its CLOs, FLO, and its Recreational FIR will engage with the public throughout all phases of the Project, the public to raise awareness of Project activities, reconcile issues, and facilitate the exchange of information.

Atlantic Shores is committed to scheduling construction activities that could disturb shoreline recreation areas and tourist destinations to occur outside of the peak tourism season (Memorial Day to Labor Day) to the extent practicable. However, for public health and safety reasons, planned construction activities, onshore and offshore, may temporarily disrupt or limit public access to Project work areas where heavy equipment or vessels are maneuvering. For marine construction, most of these work areas will be 8 mi (12.9 km) or more offshore and localized to specific locations within the Offshore Project Area (i.e., foundation installation and WTG locations). Onshore, the presence and movement of Project personnel, equipment, and vehicles during construction could generate short periods of activity that could increase traffic, noise, and light in discrete locations adjacent to the work activity. Similar effects may be expected during decommissioning if onshore and offshore Project components are removed or significantly altered.

During O&M, the primary concern related to recreation and tourism is the presence of the WTGs and OSSs and the effects their presence may have on tourism (i.e., attracting or deterring visitors) and recreation (i.e., attracting or deterring recreational users, including boaters and fishermen). Any potential visual effects these structures may have on the area have been addressed in Section 5.0 Visual Resources. Otherwise, Project activities during O&M involve routine movements of Project vessels, vehicles, and personnel, which would not lead to any measurable effect. Only in limited, non-routine situations where a Project component requires substantial repairs or replacement, would disturbances, albeit very localized and short-term, occur.

The specific potential IPFs that may affect recreation and tourism during Project construction, O&M, or decommissioning are presented in Table 7.3-2 and detailed further in the following subsections. Potential effects on public health are discussed in Section 9.0 Public Health and Safety.

### Table 7.3-2. Impact Producing Factors for Recreation and Tourism

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Installation and Maintenance of New Structures and Cables | • | • | • |
| Presence of Structures | • | • | • |
| Traffic (Vessel and Vehicle) | • | • | • |
| Noise | • | | • |
| Light | • | | • |

The maximum Project Design Envelope (PDE) analyzed for potential effects to recreation and tourism is the maximum onshore and offshore build-out of the Project (see Section 4.11 of Volume I), assuming the use of all piled foundations for the assessment of pile driving noise.

Given the unique characteristics of recreational fishing compared to other types of recreation and tourism, the description of potential impacts is separated into two categories: recreation and tourism, and recreational fishing.

#### 7.3.2.1 Installation and Maintenance of New Structures and Cables

**Recreation and Tourism**

The installation and maintenance of new foundation structures, WTGs, OSSs, offshore cables, onshore cables, and onshore substations may affect recreation and tourism through direct temporary access restrictions and disruptions in distinct onshore and offshore areas when these Project activities take place. Indirect or secondary, temporary effects may be experienced for the duration of Project activities by recreation and tourism businesses that operate in or be within or around view of construction areas. In any phase when there are installation, maintenance, or removal (decommissioning) activities, there will be established work areas and specific periods of time when work takes place. During these periods of onshore and offshore work activities, recreational and tourism activities will be temporarily interrupted at discrete locations to allow Project activities to be conducted safely.

During all Project phases, Atlantic Shores will post notices on their website and will work with local officials to inform the public of Project activities. The Project will have a designated Marine Coordinator that will communicate Project schedule information to user groups that may be impacted by certain onshore and offshore activities. The Marine Coordinator, like the Atlantic Shores CLOs, FLO, and Recreational FIR, will serve as another point of contact for Project stakeholders to facilitate the exchange of information, answer questions, and address any Project-related concerns. These actions have been established to minimize impacts to recreation and tourism to the maximum extent practicable

The Presence of Structures section addresses the change in viewshed and user experience resulting from the WTGs and OSSs, although this topic is more thoroughly analyzed in Section 5.0 Visual Resources.

**Recreational Fishing**

Construction and support vessels will be present within the Lease Area and ECCs during pre-installation and installation activities for WTGs, OSSs, offshore cables (export, inter-array, and inter-link), and other Project components. It is anticipated that temporary safety zones will be established around Project construction vessels and installation activities, which may cause short-term disruption or relocation of recreational fishing activities in proximity to the temporary safety zones in the Lease Area and/or ECCs. The duration of effects depends, in part, on the installation method selected. Regardless of installation method, only a limited area surrounding the installation activity will be affected at any given time, leaving surrounding areas available for recreational fishing activities. Installation methods and timeframes are described in Section 4.0 of Volume I. For the ECCs and WTGs, it is anticipated that the duration of construction will be on the order of several months. Additionally, during Project installation, noise from activities such as pile-driving or vessel engines may cause the temporary, short-term displacement of some target species (see Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat).

During all Project phases, Atlantic Shores will adhere to its Fisheries Communication Plan (see Appendix II-S) to avoid and minimize interactions with fishing vessels and fishing gear.

Atlantic Shores, its FLO, and its Recreational FIR will continue to liaise with the fishing community to reconcile issues and facilitate the exchange of information. Atlantic Shores will also employ a Marine Coordinator to monitor daily vessel movements, enforce temporary safety zones, and to be the primary point of contact with regulators, authorities, and stakeholders. Additionally, Atlantic Shores will coordinate with the U.S. Coast Guard (USCG) to distribute a local Notice to Mariners at each phase of Project development when vessels and/or equipment are deployed offshore. This notice will show the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, any safety parameters, and timelines of the operation/deployment. The Project's website will also include a "For Mariners" page containing Project information specifically for commercial and recreational fishermen. These activities and actions have been established to minimize impacts to recreational fishing to the maximum extent practicable.

#### 7.3.2.2 Presence of Structures

**Recreation and Tourism**

The Offshore Project Area does not have any permanent, visible structures currently located within it. Once installed, the Project will result in a change in the visual and physical character of the ocean environment. People engaged in offshore recreation or tourism activities (e.g., boating, sailing, other watercraft, etc.) may choose to explore the waters in and around the WTGs to experience the structures or to fish near the structure foundations. Some visitors may choose to recreate outside of the Lease Area. Data from European and U.S. studies of coastal area visitation and the presence of offshore wind farms, suggest that recreational or visitation choices made by individuals vary greatly and are strongly influenced by factors both dependent and independent of the presence of wind turbines (ICF 2012; Parsons and Firestone 2018). For example, changes in people's access to natural resources (e.g., fishing, boating) or their general perception about offshore wind, seem to influence their opinion regarding perceived versus actual effects. European studies also suggest that certain factors, such as age, income, types of tourism/recreation choices, and location, influence the magnitude of perceived effects (ICF 2012).

Decisions by both beachgoers and non-beachgoers to visit shoreline areas with views of an offshore wind farm are influenced by more than just the offshore structures (Parsons and Firestone 2018). How developed a shoreline is greatly influences how its visitors will react to the presence of the offshore WTGs and was the single most important beach characteristic in a survey conducted for a BOEM 2018 Study. Parsons and Firestone (2018) estimated trip loss for beaches with boardwalks was 6.5% lower than for beaches without boardwalks. Beachgoers at beaches with boardwalks or engaged in more non-beach related activities may experience fewer negative effects because these visitors are generally more concerned with non-beach related activities than the presence of an offshore wind facility (Parsons and Firestone 2018).

Recreation and tourism may benefit from the presence of operational WTGs. Parsons et al. (2020) have documented large increases in the number of trips to the shoreline to view offshore wind projects in parts of Europe. New studies of the Block Island Wind Farm corroborate positive effects on tourism. In a study relying on trends in summer vacation property rentals, researchers at the University of Rhode Island observed a 19% increase in summer monthly revenue for Block Island vacation property landlords compared to other regional summer vacation rental hotspots like Narragansett and Westerly, Rhode Island and Nantucket, Massachusetts (Carr-Harris and Lang 2019). The factors that may be driving the increase in rental volume are not defined in the study, but the researchers hypothesized that tourists may be curious to see the wind farm or that the recreational fishing near the wind farm has improved significantly, thereby increasing interest to visit the wind farm itself (Carr-Harris and Lang 2019).

**Recreational Fishing**

Introduction of new offshore foundations (for WTGs, OSSs, and the meteorological [met] tower), scour protection, offshore cables, and offshore cable protection will introduce habitat complexity and diversity in a largely homogenous, sandy environment, which may result in habitat conversion/creation and species attraction. The presence of structures may also affect navigation by recreational fishermen within the Lease Area; however, the layout has been developed to accommodate vessel transit to local fishing ports and offshore fishing grounds.

As described more fully in Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat, the presence of structures and cable protection can create a “reef effect,” providing ecological benefits and habitat diversity in the Mid-Atlantic Bight. The offshore foundations, scour protection, and cable protection provide habitat for developing new ecosystems and attract species seeking prey or refuge from predators. For example, the creation of structured habitat is expected to benefit species such as striped bass, black sea bass, and Atlantic cod by potentially increasing their habitat. Similarly, the presence of foundations may increase habitat and provide forage and refuge for some migratory finfish targeted by recreational fishermen. Increasing potential habitat for fish and their prey may positively affect recreational fishing within the Lease Area. Additionally, interest in visiting the Lease Area may result in an increased number of fishing trips originating from New Jersey ports. These additional vessel trips could support an increase in angler expenditures at shoreside facilities servicing for-hire recreational fishermen (Kirkpatrick et al. 2017).

In September 2019, Atlantic Shores signed a MOU with Stockton University to sponsor research, support faculty and students, and investigate technology innovation related to the development of offshore wind energy. One of the projects identified under this MOU is to investigate potential fisheries benefits resulting from offshore wind structures. One such effect is the “reef effect,” or the aggregation or generation of fish biomass, biodiversity, or movement in and around artificial structures. Findings from this research will be used to support the design and implementation of pre-, during, and post-construction fisheries monitoring in and around the Lease Area and ECCs.

Atlantic Shores has sited Project infrastructure to avoid areas of concentrated fishing activity to the maximum extent practicable. The Lease Area and ECCs will be open to marine traffic and no permanent restrictions to recreational fishing are proposed during the O&M phase of the Project. Limited restrictions may occur during some maintenance activities, where temporary safety zones may need to be established around maintenance vessels and activities.

Atlantic Shores is also working to minimize effects to recreational fishing from the presence of the offshore cables. All offshore cables will have a target minimum burial depth of 5 to 6.6 feet (ft) (1.5 to

2 meters [m]). The cable burial depth is based upon a cable burial risk assessment that considers activities such as fishing practices and anchor use to develop a safe target burial depth for the cables (see Appendix II-A5). Atlantic Shores has determined that the target burial depth is sufficient to protect the cables from expected fishing practices, so the presence of these cables is not anticipated to interfere with any typical recreational fishing activities.

Atlantic Shores will conduct a detailed Navigation Safety Risk Assessment (NSRA), in support of the Project that will be submitted as part of a future Construction and Operations Plan (COP) Supplement (See Section 7.6). The NSRA indicates that the proposed WTG and OSS layout will safely accommodate the transit of recreational fishing vessels through the Lease Area. The 1.0 nautical miles (nm) (1.85 km) east-northeast corridors will accommodate all the existing AIS-equipped fishing fleet and 99.6% of the Automatic Identification System (AIS)-equipped recreational vessels. A 0.60 nm (1.1 km) corridor will accommodate 99.9% of the fishing fleet and 92.4% of the recreational vessels. A 0.54 nm (1.0 km) diagonal corridor will accommodate 99% and 89% of the fishing and recreational vessels, respectively. Navigational impacts are not anticipated along the ECCs.

To facilitate safe navigation, all foundations will contain marine navigation lighting and marking in accordance with the USCG and BOEM guidance. To aid mariners navigating within and near the Lease Area, each WTG position will be maintained as a Private Aid to Navigation (PATON). Atlantic Shores will work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities. Based on USCG District 5 Local Notice to Mariner (LNM) 45/20, Atlantic Shores expects to include unique alphanumeric identification on each foundation, lights on each foundation that are visible in all directions, and sound signals on select foundations. AIS will be used to mark each WTG, OSS, and meteorological position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG. Additional information on marine navigation lighting and marking on the foundations can be found in the NSRA (see Appendix II-T). Additionally, WTG and OSS foundations will be equipped with access ladders to allow distressed mariners access to an open refuge area above the splash zone. The presence of a person on the offshore structure will be detected by cameras or intrusion detectors.

As explained in Section 8.2 of the NSRA (see Appendix II-T), the presence of structures in the Lease Area is anticipated to have only a minor impact on recreational fishing vessels transit routes. With input from the FIR, the potential rerouting of recreational fishing vessels through and around the WTA was analyzed. Based on this analysis, there would be very little change in overall distance traveled if vessels elected to navigate through the Lease Area, routing around turbines where and if necessary, though it is assumed vessels may operate at slower speeds when traveling within the Lease Area. If vessels elect to transit around the Lease Area, it is anticipated that rerouting will have a small effect on travel distance and time, at most, increasing travel distance by up to 1.6 nm (3.0 km) and increasing travel time by up to approximately 3.8 minutes. Several routes would not be impacted by the Lease Area and for most routes, transiting around the Lease Area would result in less than 0.7 nm (1.3 km) of additional distance traveled.

#### 7.3.2.3 Noise and Vibration

In-air sounds and vibrations generated during Project-related activities, primarily the movement of heavy equipment and engine sounds from vessel and vehicle traffic, have the potential to affect recreation and tourism. It is important to note that to the maximum extent practicable, onshore equipment that produce noise will be located to avoid areas where recreational and tourism activities take place, so adverse effects of Project-related noise and vibration are greatly minimized. Except for the ECC landfall points at the shoreline (where the export cables will be installed via horizontal directional drilling [HDD] under the beach), the Project areas do not encompass identified sensitive recreation and tourism areas. Most Project-related noise and vibration would be short-term and localized to the immediate work areas.

Sounds from the operation of Project vessels, vehicles, equipment, and facilities can occur at levels that are considered noisy. Project-related noise will be controlled and abated in accordance with State (i.e., stationary commercial and industrial noise sources) and local (i.e., construction noises) regulations to safeguard public health and safety. Noise and vibration generated during Project construction, O&M, and decommissioning have the potential to result in temporary disruption or disturbance of a relatively small number of individuals who may be participating in recreational and tourist activities within range of noise and vibration-producing Project activities.

Noise and vibration will be most prevalent during periods of construction (and possibly decommissioning). Very limited direct effects on recreation and tourism activities are expected offshore during construction because temporary safety zones will be established around work areas and boaters will be notified when construction activities are ongoing. The Onshore Project Area is characterized by existing development, vehicle traffic and commercial activity. Noise and vibration from the Project is expected to be limited in the context of the surrounding land uses, localized and short-term. In addition, onshore construction in the vicinity of recreational areas and tourist destinations will be scheduled outside of peak tourist season (Memorial Day through Labor Day) as necessary to minimize construction-related impacts. Additional detail regarding onshore noise is provided in Appendix II-V Onshore Noise Report.

#### 7.3.2.4 Vessel and Vehicle Traffic

**Recreation and Tourism**

Only localized, short-term effects on recreation and tourism from Project-related vehicle and vessel traffic could be expected during construction (and possibly decommissioning).

Incremental increases in traffic volume associated with the construction and operation of onshore facilities will be concentrated along the cable routes and at the substations (see Section 7.9 Onshore Transportation and Traffic). Onshore vehicle traffic could result in detours to certain routes or restricted parking, especially near the cable landings. As mentioned above, onshore construction will be scheduled outside of peak tourism periods (Memorial Day through Labor Day) to the extent practicable.

Increased vessel traffic will occur during construction, O&M, and decommissioning, as described in detail in Section 7.6 Navigation and Vessel Traffic. On average, approximately two to six vessel round trips per day between shore and the Offshore Project Area are expected during construction and O&M. Atlantic Shores will manage vessel activities to minimize disruptions to mariners (including recreational fishermen) to the maximum extent practicable. Recreational boaters may experience a few isolated situations when they might need to modify their activity specifically because of Project vessel traffic. These situations would mostly be concentrated in the Lease Area or along the ECCs where most of the Project vessels will remain for days or weeks at a time, during construction, and will not be transiting to port facilities on a frequent basis.

**Recreational Fishing**

As discussed in the previous section, Project vessel traffic is not expected to result in impacts other than limited and isolated instances during construction when vessels are temporarily occupying a work area in the Lease Area or ECCs. Otherwise, Project vessels used for construction and O&M will operate primarily from ports with little commercial fishing activity. Consequently, competition for dock- and shore-side services within these ports is not expected to affect recreational fishing activities.

Atlantic Shores will utilize a Marine Coordinator to manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be charged with monitoring daily vessel movements, implementing communication protocols with external vessels both in port and offshore to avoid conflicts, and monitoring safety zones. Communications will begin prior to construction and will continue throughout the construction process. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. To provide construction zone control, the Marine Coordinator will employ radio communications and safety vessels to address any vessels entering the construction zone.

The Marine Coordinator will be responsible for coordinating with the USCG for any required Notices to Mariners, and during construction will be the primary point of contact with the USCG, port authorities, State and local law enforcement, marine patrols, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).

Communication with the recreational fishing community will take place throughout all Project phases. As described in the Fisheries Communication Plan (see Appendix II-S), Atlantic Shores will regularly distribute updated asset and operational awareness bulletins showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines, and relevant contact information. Finally, Atlantic Shores also expects to establish specific methods for communicating with fishermen while they are at sea including establishing a 24-hour phone line to address any real-time operational conflicts and/or safety issues.

Further, all construction vessels and equipment will display the required navigation lighting and day shapes and make use of AIS as required by the USCG.

#### 7.3.2.5 Light

Project-generated light from equipment, vehicles, and vessels during construction, and offshore Project components during O&M, may be visible to people participating in recreational or tourism activities. Visual impacts from the Project are discussed in Section 7.3.2.2 and in Section 5.0 Visual Resources.

Within the Onshore Project Area, construction lighting may be necessary to illuminate portions of the Project work areas in order to maintain safety standards for workers and the surrounding communities. It is likely, however, that onshore nighttime work will be limited for a variety of reasons, including adherence to local zoning ordinances, building permit conditions, and community agreements. Many of the areas within the Onshore Project Area are already illuminated by artificial light because they are associated with the existing substations, commercial areas, or roadways. The specific Project-related information regarding Project light sources and anticipated effects are also discussed in Section 5.0 Visual Resources.

During O&M, the onshore substations will require security lighting on buildings. The lighting will be the minimum necessary to comply with security and safety guidelines and will not illuminate adjacent areas. No other portions of the Onshore Project Area will have permanent lighting. Within the Offshore Project Area, the WTGs, OSSs, meteorological (met) tower, and their associated foundations will be equipped with navigation warning lights in accordance with Federal Aviation Administration (FAA), USCG, and BOEM requirements. As discussed in Section 5.0 Visual Resources, Atlantic Shores is considering use of an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval, which could substantially reduce the amount of time that the aviation obstruction warning lights are illuminated, minimizing visual impacts on recreation and tourism activities.

#### 7.3.2.6 Summary of Proposed Environmental Protection Measures

Atlantic Shores understands the importance of recreation and tourism within New Jersey's and New York's coastal communities and has developed the following proposed environmental protection measures:

**Recreation and Tourism**

Atlantic Shores is working to maximize the positive economic and environmental benefits of the Project. As discussed in Section 7.3.2.2, the operating Project will likely result in beneficial effects, including increased visitation to the New Jersey and New York shorelines to view the Project or to fish around the new structures, which are anticipated to enhance recreational fisheries over time. Atlantic Shores is also committed to the following proposed environmental protection measures:

- Atlantic Shores has worked, and will continue to work, in collaboration with local communities to site Project facilities and develop Project construction techniques and schedules that will avoid disruption to the maximum extent possible.

- In consultation with municipalities and state agencies, Atlantic Shores will schedule onshore construction activities that occur near recreational resources or tourist destinations outside of the tourist season (Memorial Day to Labor Day) to the extent practicable.
- Construction activities and schedule will be conducted in accordance with municipal noise ordinances.
- Additional mitigation measures including those designed to mitigate potential visual effects, ensure navigational safety, and reduce community disruptions from facility noise and vibration are discussed in Sections 5.0 Visual Resources, 7.6 Navigation and Vessel Traffic, and 8.0 In-Air Noise and Hydroacoustics, respectively.

**Recreational Fishing**

Atlantic Shores is committed to ensuring harmonious coexistence with recreational fishermen. Information from industry conversations, direct data gathering exercises with fishermen, consultations with government agency representatives, and analysis of public data have been compiled and used to guide the siting, design, O&M, and decommissioning of the Project. As a result, Project infrastructure has been sited to avoid concentrated areas of fishing effort to the maximum extent practicable and to accommodate vessel transit to local fishing ports and offshore fishing grounds. Atlantic Shores is also committed to the following proposed environmental protection measures:

- Atlantic Shores is a founding member of the ROSA, which advances regional research and monitoring of fishery and offshore wind interactions.
- Atlantic Shores signed a MOU with Stockton University to sponsor research to investigate technology development related to the development of offshore wind energy and to investigate potential fisheries benefits resulting from offshore wind structures. Findings from this research will be used to support the design and implementation of pre-, during, and post-construction fisheries monitoring.
- AIS will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG.
- Project infrastructure is being sited and oriented to avoid concentrated areas of recreational fishing activity (e.g., artificial reefs) to the maximum extent practicable.
- Offshore cables will be buried at a sufficient depth of 5 to 6.6 ft (1.5 to 2 m) to avoid interaction with fishing gear.
- To facilitate safe navigation, all offshore structures will include marine navigation lighting and marking in accordance with USCG and BOEM guidance. It is anticipated that each foundation will include unique alphanumeric identification and lights that are visible in all directions, and sound signals on select foundations. Atlantic Shores will continue to work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities.
- WTG, OSS, met tower and met buoy positions will be maintained as PATONs.

- WTG and OSS foundations will be equipped with access ladders to allow distressed mariners access to an open refuge area above the splash zone. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors.
- A Fisheries Communication Plan has been developed that defines outreach and engagement with fishing interests during all phases of the Project, from development through decommissioning.
- Atlantic Shores has hired CLOs to help inform the public of Project activities and to support productive and effective dialogue with stakeholders.
- Atlantic Shores employs an active commercial fisherman, Captain Kevin Wark, as the FLO and an active recreational fisherman, Captain Adam Nowalski, as the Recreational FIR to support communication and feedback with the fishing community. Atlantic Shores was the first developer to hire a Recreational FIR.
- A “For Mariners” Project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and FLO and Recreational FIR contact information.
- Updated asset and operational awareness bulletins will be regularly distributed showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines, and relevant contact information. Atlantic Shores will also publish announcements and share updates with print and online industry publications and local news outlets.
- Specific methods for communicating with offshore fishermen while they are at sea are being established, including a 24-hour phone line to address any real-time operational conflicts and/or safety issues.
- A Marine Coordinator will be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. The Marine Coordinator will be responsible for coordinating with the USCG for any required NTMs.

## 7.4 Commercial Fisheries and For-Hire Recreational Fishing

This section describes commercial fisheries and for hire recreational fishing in the Atlantic Shores Offshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning. The waters offshore New Jersey and New York are used by a variety of commercial and for-hire recreational fishermen. Atlantic Shores recognizes the importance of fisheries and marine resources and is committed to ensuring coexistence with commercial and for-hire recreational fishermen operating within Lease Area OCS-A 0599 (Lease Area).

Atlantic Shores has dedicated considerable resources to solicit input from commercial and for-hire recreational fishermen and boaters regarding potential Project-related effects. Atlantic Shores has developed a detailed Fisheries Communication Plan (see Appendix II-R) and will be hiring one or more Fisheries Liaison Officers (FLO) and Recreational Fishing Industry Representatives (FIR); who will be local, New Jersey and/or New York fishermen. Atlantic Shores has engaged with the industry to collect data directly from the fishing community; consulted with government agency representatives; and analyzed publicly available data to inform this assessment of commercial and for-hire recreational fisheries. This information also guides the siting, design, O&M, and decommissioning of the Project.

In addition to promoting communication, Atlantic Shores is dedicated to understanding and helping to preserve New Jersey and New York's marine resources both through interpreting existing data and by conducting new collaborative research where data gaps exist. Atlantic Shores is a founding member of, and contributor to, the Responsible Offshore Science Alliance (ROSA), which shares Atlantic Shores' commitment to improve understanding of ocean and coastal ecosystems by advancing regional research and monitoring of fishery and offshore wind interactions. Atlantic Shores is coordinating with educational and technical institutions to support cooperative science, engineering, research, and next generation workforce training that may benefit the Project's development, construction, and operations (see Appendix I-B). These activities also contribute to broader regional research efforts (see Volume I, Section 2.2). Atlantic Shores has asked more than 52 different institutions to declare their interest in collaboration on academic and educational work in relation to the Project, of which approximately eight have expressed an interest in doing so to date. Atlantic Shores engages with commercial and recreational boaters and fishermen that are active in and around the Atlantic Shores' Offshore Project Area. To date, Atlantic Shores has held meetings with commercial and recreational fishermen from Belford, Point Pleasant, Barnegat Light, Atlantic City, Cape May, and other ports like Ocean City and Sea Isle City. Atlantic Shores' engagement with fishermen is described further in Section 1.4.2.1 of Volume I). Additionally, Atlantic Shores is working closely with the surf clam industry to better understand how the effects of climate change are influencing the distribution and abundance of surf clams within the Lease Area and the greater Mid-Atlantic Bight. In partnership with Rutgers University, Atlantic Shores is funding a multi-phase modeling study that will evaluate the economics of the Atlantic surf clam fishery in response to current and future wind farm activity over the Project's approximate 30-year life span.

In addition to this section on commercial fisheries and for-hire recreational fishing, Atlantic Shores has prepared a detailed assessment of Finfish, Invertebrates, and Essential Fish Habitat in Section 4.6. Recreation and Tourism (including not-for-hire recreational fishing) are discussed in Section 7.3.

Atlantic Shores is currently in the process of conducting a detailed Navigation Safety Risk Assessment (NSRA) which will be provided in a future COP supplement.

## 7.4.1 Affected Environment

This section describes the fishing fleets, fishing ports, fishing activity, and the value of fish harvested in the Offshore Project Area, which includes the Lease Area and Export Cable Corridors (see Figure 1.0-1). The affected environment evaluated in this section includes waters that are fished or transited by fishermen operating primarily from ports in New Jersey and New York, though fishermen operating vessels from North Carolina to New Hampshire may fish in the continental shelf waters off the coasts of New Jersey and New York and utilize port facilities within the two States. This section focuses particularly on fishing activities that occur within the Lease Area and ECCs.

This section uses multiple sources of information and data to assess and characterize commercial and for-hire recreational fishing activity. Primary sources used to evaluate commercial and for-hire recreational fishing activity include, but are not limited to:

- mapping of Vessel Trip Report (VTR) and Vessel Monitoring System (VMS) data by the Northeast Regional Ocean Council (NROC) and the Mid-Atlantic Regional Council on the Ocean (MARCO);
- mapping and analysis of Automatic Identification System (AIS) data for commercial fishing data (see also Volume II, Section 7.6);
- analysis of a National Marine Fisheries Service (NMFS) dataset that includes modeled results of VTRs and clam logbook data linked to dealer data for value and landings information that were then queried for spatial overlap with the Lease Area and ECCs;
- technical reports funded by the Bureau of Ocean Energy Management (BOEM) and prepared by NMFS, as well as other academic and government-funded studies and reports; and
- outreach and engagement to commercial fisheries stakeholders.

Additional information about these sources is provided in Section 7.4.2.1.

Section 7.4.2 describes commercial fisheries, which are regional in nature, such that species of interest often span across large areas in the ocean and fishermen catching those species may port along the Atlantic coastline. Based on currently available data, vessels operating from New Jersey commercial fishing ports are the primary commercial fishing vessels operating in the Offshore Project Area. Vessels operating from New York, and from North Carolina to New Hampshire may have some presence within the Lease Area and ECCs; however, available data indicates that ports and fishing fleets outside of New Jersey are not expected to have meaningful economic exposure within the Offshore Project Area and are, therefore, described briefly in this section.

### 7.4.1.1 Commercial Fishing Ports

According to NMFS (2021) data, up to 97 different ports in 11 different states reported landings from the Offshore Project Area. As described in Section 7.4.2.3, approximately 87% of landings from the

Offshore Project Area are landed at ports in New Jersey, therefore these ports are the focus of this section. Ports in other states have a modest presence in the Offshore Project Area. Landings from the Offshore Project Area in New Bedford, Massachusetts, for example, represent approximately 7.7% of the average annual landings from the Offshore Project Area. Based on non-confidential landings data for Hampton, Hampton Bay, and Montauk, New York, combined, these ports represent approximately 0.6% of average annual landings from the Offshore Project Area. Though, all landings from the Offshore Project Area in New York represent approximately 1.2% of annual average landings.

Statewide between 2016 and 2020 New Jersey commercial fisheries landed an annual average of 173.8 million pounds of catch, worth approximately $200.5 million. At New Jersey ports the primary landings by volume and value are typically Atlantic sea scallops (*Placopecten magellanicus)*, menhadens (*Brevoortia spp.*), Blue Crab (*Callinectes sapidus*), Shortfin Squid (*Illex illecebrosus)*, and Atlantic surf clam (*Spisula solidissima)*. Like many coastal states, however, New Jersey hosts a diverse commercial fishery with many species that are important to its fishing fleets and ports. Table 7.4-1 shows those species of regional significance landed in New Jersey with an average annual value of more than $1.0 million for the period 2016 to 2020. The primary gear utilized in these fisheries are dredges, trawls, gillnets, pots/traps, purse seines and hook/line.

### Table 7.4-1. Primary New Jersey Commercial Species, 2016-2020

| Species | Average Annual Landings (Pounds) | Average Annual Value (U.S. Dollars [USD], Deflated) |
|---|---|---|
| Sea Scallop (*Placopecten magellanicus*) | 10,158,339 | $109,621,675 |
| Menhadens (*Brevoortia spp*.) | 80,967,480 | $17,591,800 |
| Blue Crab (*Callinectes sapidus*) | 19,623,769 | $7,659,771 |
| Atlantic Surf Clam (*Spisula solidissima*) | 10,225,435 | $7,325,083 |
| Longfin Squid (*Doryteuthis [Amerigo]* pealeii) | 3,701,593 | $5,455,375 |
| Summer Flounder (*Paralichthys dentatus*) | 1,362,090 | $45,394,324 |
| Black Sea Bass (*Centropristis striata*) | 784,116 | $2,843,442 |
| American Lobster (*Homarus americanus*) | 340,752 | $2,079,075 |
| Monkfish (*Lophius americanus*) | 1,614,000 | $1,676,257 |
| Scup (*Stenotomus chrysops*) | 2,174,257 | $1,572,437 |
| Bigeye Tuna (*Thunnus obesus*) | 258,828 | $1,358,871 |
| Golden Tilefish (*Lopholatilus chamaeleonticeps*) | 390,247 | $1,339,727 |
| **Total** | **131,600,906** | **$203,917,837** |

Source: National Oceanic and Atmospheric Administration (NOAA), 2022.

There are four primary commercial fishing ports in New Jersey: Atlantic City, Cape May/Wildwood, Long Beach/Barnegat, and Point Pleasant. Commercial fishing vessels active in the Offshore Project Area are understood to be operating predominantly from the New Jersey ports listed on Table 7.4-2.

## Table 7.4-2. Commercial Landings at New Jersey Ports[1]

| Port | 2016 | | 2017 | | 2018 | | 2019 | | 2020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lbs[2] | USD[2] | Lbs[2] | USD[2] | Lbs[2] | USD[2] | Lbs[2] | USD[2] | Lbs[2] | USD[2] |
| Atlantic City | 24.3 | $19.7 | 24.7 | $18.6 | 24.8 | $18.2 | 23.5 | $17.2 | 17.5 | $12.4 |
| Cape May-Wildwood | 46.6 | $84.7 | 101.6 | $81.0 | 101.2 | $66.3 | 94.5 | $90.0 | 103.7 | $92.8 |
| Long Beach-Barnegat | 7.2 | $26.9 | 7.6 | $24.7 | 6.3 | $24.3 | 7 | $24.9 | 5.6 | $21.7 |
| Point Pleasant | 26.3 | $32.1 | 37.5 | $35.3 | 43.3 | $32.4 | 37.3 | $35.4 | 35.3 | $35.7 |
| **Total** | **104.4** | **$163.4** | **171.4** | **$159.6** | **175.6** | **$141.2** | **162.3** | **$167.5** | **162.1** | **$162.6** |

[1]Source: NOAA, 2021 [2]Values are shown in millions (pounds of fish and US dollars [nominal])

### Atlantic City

The Atlantic City commercial fishery consists of a sizable fleet of vessels harvesting surf clams and ocean quahogs alongside a smaller number of inshore crab, hard clam, net, and pot vessels. The clam fleet has reportedly declined in recent years due to changes in Federal law allowing the consolidation, lease, and transfer of individual quotas (New Jersey Department of Agriculture 2020). Nonetheless, in 2020, 30 federally permitted vessels listed Atlantic City as their principal port, 27 of which hold permits for ocean quahogs and surf clam.

In 2020 commercial fishing vessels landed 17.5 million pounds of catch worth an estimated $12.42 million in Atlantic City, making it the 66th most valuable port in the U.S. Most of Atlantic City's commercial fishing revenue comes from surf clam, ocean quahog, and scallops (NEFSC 2014). Over the 5-year period of 2014 to 2018, an annual average of approximately $570,000 of all species harvested from the Lease Area were landed in Atlantic City (NMFS 2020). Atlantic City's annual average landings from the Lease Area during this 5-year period accounted for approximately 2.3% of the port's total average annual landings. The five most recent years of all commercial landings in Atlantic City are summarized in Table 7.4-2 and are discussed relative to the Offshore Project Area in Section 7.4.2.4.

### Cape May/Wildwood

The Port of Cape May/Wildwood is the largest commercial fishing port in New Jersey. The port serves as the center of fish processing and freezing in New Jersey and has numerous shore side support and supply services. Cape May is home to Garden State Seafood Association (GSSA) whose membership includes 92 commercial fishing vessels.

Cape May has an active trawler fleet in addition to scallop and surf clam dredge vessels, pot boats, hand gear, and purse seiners (New Jersey Department of Agriculture 2020).

The Cape May/Wildwood commercial fishing industry landed 103.7 million pounds of catch in 2020 worth an estimated $92.8 million, making it the sixth-most valuable port in the U.S. Over the 5-year period of 2014 to 2018, an annual average of approximately $45,000 of all species harvested from the Lease Area were landed in Cape May (NMFS 2020). Cape May/Wildwood's average annual landings from the Lease Area during this 5-year period accounted for <0.1% of the port's total annual average landings. The five most recent years of all commercial landings in Cape May/Wildwood are summarized in Table 7.4-2 and are discussed relative to the Offshore Project Area in Section 7.4.2.4.

### Long Beach/Barnegat

Barnegat Light is the primary commercial seaport on Long Beach Island and is the homeport to approximately 36 commercial vessels. Barnegat Light's two commercial docks are home to several scallop vessels, longliners, and a fleet of smaller inshore gillnetters (New Jersey Department of Agriculture 2020).

In 2020 the Barnegat/Long Beach commercial fishing industry landed 5.6 million pounds of catch worth an estimated $21.7 million, making it the 35th most valuable port in the U.S. Over the 5-year period of 2014 to 2018, an annual average of approximately $65,000 of all species harvested from the Lease Area were landed in Barnegat (NMFS 2020). Long Beach/Barnegat's average annual landings from the Lease Area during this 5-year period accounted for <0.1% of the port's total annual average landings. The five most recent years of all commercial landings in Long Beach/Barnegat are summarized in Table 7.4-2 and are discussed relative to the Offshore Project Area in Section 7.4.2.4.

### Point Pleasant

The Point Pleasant commercial fishing fleet includes dredge and gillnet vessels as well as day boat trawlers. The Fishermen's Dock Cooperative located in Point Pleasant operates two docks, an ice-making machine, cold storage facility, retail store, and a truck-loading station. It is one of two active fishing cooperatives in New Jersey.

In 2020 the Point Pleasant commercial fishing industry landed 35.3 million pounds of catch worth an estimated $35.7 million, making it the 25th most valuable port in the U.S. Over the 5-year period of 2014 to 2018, an annual average of approximately $4,900 of all species harvested from the Lease Area were landed in Point Pleasant (NMFS 2020). Point Pleasant's average annual landings from the Lease Area during this 5-year period accounted for <0.1% of the port's total annual average landings. The five most recent years of all commercial landings in Point Pleasant are summarized in Table 7.4-2 and are discussed relative to the Offshore Project Area in Section 7.4.2.4.

### New Bedford, Massachusetts

New Bedford is home to a large commercial fishing fleet with access to the port's well-established shoreside infrastructure that includes seafood wholesale and processing companies and other related shoreside industries that serve several active fisheries. Much of New Bedford's commercial fishing revenue comes from the sea scallop fishery, which landed 41.9 million pounds of sea scallops in Massachusetts worth over $397 million in 2019. In total, New Bedford commercial fishing vessels landed 115.4 million pounds of fish in 2020, worth an estimated $376.6 million, making it the most valuable port in the U.S.

Over the 5-year period of 2016 to 2020, an annual average of approximately $66,223 of all species harvested from the Lease Area were landed in New Bedford (NMFS 2022). New Bedford's average annual landings from the Lease Area during this 5-year period accounted for <0.1% of the port's total annual average landings.

#### 7.4.1.2 Fisheries Management

Fisheries in waters 0 to 3 nautical miles (nm) (0 to 5.6 kilometers [km]) from shore are under State authority while waters 3 to 200 nm (4.8 to 370 km) from shore encompass the Exclusive Economic Zone (EEZ) of the U.S., which is managed under the Federal authority of NOAA Fisheries also known as the NMFS. Federal management of fisheries under the Magnuson-Stevens Fishery Conservation and Management Act, the primary mechanism governing fishing in the EEZ along the Atlantic coast, is split among three regional fishery management councils: The New England, Mid-Atlantic, and South Atlantic Fishery Management Councils. Each council develops fisheries policy for its region. The NOAA Fisheries Greater Atlantic Region Fisheries Office (GARFO) has authority for final approval of all recommended management actions by the New England and Mid-Atlantic Councils. In addition, the Atlantic States Marine Fisheries Commission (ASMFC) manages 27 shellfish, diadromous, and marine species, some of which are managed solely by the Commission and the Atlantic States (e.g., menhaden and American lobster) while other species (e.g., Atlantic herring [Clupea harengus] and summer flounder [Paralichthys dentatus]) are cooperatively managed by the GARFO and the ASMFC, and the regional commissions.

Certain commercially harvested fish species are managed through species-specific Fisheries Management Plans (FMPs) developed by the regional councils and some FMPs include multiple species because they share habitat and are often fished using the same gear type. In the Offshore Project Area, species are managed through FMPs by the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), the ASMFC, or some combination of these. In addition to cooperative management of certain species with the ASMFC, the State waters of New Jersey within the Offshore Project Area are managed by the New Jersey Department of Environmental Protection (NJDEP) Division of Fish & Wildlife.

As noted above, the ASMFC coordinates interstate management of the American lobster fishery from 0 to 3 nm (0 to 5.6 km) offshore while management authority in the EEZ from shore lies with the GARFO. Three separate stocks of lobsters are managed: The Gulf of Maine, Georges Bank, and Southern New England, with each stock further divided into seven management areas. The Offshore Project Area is within Lobster Management Area 5.

## 7.4.2 Assessment of Commercial Fishing Activity in the Offshore Project Area

This section describes sources of data that provide information on commercial fishing activities within the Offshore Project Area. This section further describes baseline estimates of the economic value of those commercial fishing activities. The data sources used to quantify relative commercial fishing effort include mapping of those activities based on VTRs, VMS data, AIS data, and commercial fishing data visualization products maintained by NROC and MARCO. This summary of commercial fisheries exposure is based on data from Federal VTRs made available by NMFS (2020).

Estimates of the economic value of commercial fishing activity in the Offshore Project Area presented in the following subsections represent the potential economic exposure, or maximum potential economic value, of commercial fisheries. These estimates of economic exposure do not represent actual or expected economic impacts. Most, if not all, existing fishing effort in the Offshore Project Area would be expected to continue throughout the construction, O&M, and decommissioning of the Project.

### 7.4.2.1 Description of Commercial Fishing Data Sources

This section describes the sources, uses, limitations, and geographic extent of commercial fishing data that were used to support the assessment of commercial fishing in the Offshore Project Area.

#### Vessel Trip Report Data

Except for vessels holding only a lobster permit(s), NMFS requires every federally permitted fishing vessel to submit a VTR for every fishing trip. Among other data, VTRs provide information on the time and location of most of the reported fishing. Each VTR also provides the trip date, number of crew on board the vessel, species and quantities caught, and the trip location. Each vessel’s permit data additionally include a "principal port" and other data related to the vessel (e.g., length and horsepower). The NMFS VTR dataset provides a comprehensive overview of fishing activity for many of the commercial fisheries active in the Offshore Project Area.

NOAA’s Fisheries Statistics Division and the Atlantic Coastal Cooperative Statistics Program each maintain a publicly accessible automated data summary program of U.S. commercial fisheries landings in Federal waters based on VTRs. These data summary programs can be queried for commercial landings in several formats including pounds and dollar value of commercial landings by year, State, and species from 1990 onwards.

NROC and MARCO have developed commercial fishing data visualization products using VTRs. The VTR-based maps characterize both fixed and mobile gear fisheries within the Offshore Project Area by using trip location point data as inputs to create density polygons representing vessel visitation frequency. Over different multi-year periods, the VTR-based maps depict total labor including crew time and time spent transiting to and from fishing locations. According to MARCO, VTR data were aggregated to the "community" level and none of the resultant maps represent a fishing area of any individual fishing vessel. Similarly, these data are aggregated across years (i.e., 2011-2015) which masks interannual trends in fishing activity.

The NROC or MARCO data portals allow users to query the VTR maps to display additional information about specific geographic locations (for example, the various port communities that have recorded a significant level of fishing activity at that location). The NROC and MARCO datasets can also be queried by port, which will then identify the geographic area in which 90% of that port's fishing effort is located. According to MARCO, drafts of the maps were reviewed with a diverse range of fishermen and fishing industry managers throughout the Mid-Atlantic and New England States including at MAFMC and NEFMC meetings. MARCO (2020) also notes that overlay comparison of their VTR-based maps with VMS-based maps (see following subsection) reveals substantial agreement between the two, with the VMS maps providing additional useful precision for fisheries where both VTR and VMS data are available.

### Vessel Monitoring System Data

VMS data are collected through a satellite monitoring system that is primarily used for monitoring the location of certain commercial fishing vessels active in U.S. Federal waters. According to NOAA, the monitoring system uses satellite-based communications from onboard transceiver units that certain vessels are required to carry, including certain vessels harvesting scallop, squid, and mackerel. The transceiver units typically send position reports once per hour including vessel identification, time, date, and location.  As noted by ROSA (2022), not all FMPs require the use of VMS (e.g., summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish). When vessels with permits for VMS fisheries participate in one of the fisheries where VMS is not required, they broadcast a "Declared out of Fishery" VMS trip code. Vessel activity that cannot be assigned to a specific fishery may represented by the Declared out of Fishery VMS code. Although the Declared of Fishing VMS code cannot necessarily inform what the target species, it does indicate where vessel activity has occurred.

Landings data are not associated with the VMS point locations. Rather, the VMS maps provide a qualitative assessment of the intensity of fishing vessel activity in the Offshore Project Area and should be evaluated alongside other data sources. Characterizing fishing effort with VMS data is also complicated by the fact that VMS is used differently in separate fisheries. For example, the monkfish (*Lophius americanus)* fishery only requires VMS for vessels reporting days-at-sea under limited access permits for the offshore monkfish fishery but, otherwise, vessels may elect to report days-at-sea under different monkfish permit categories. There is also limited historical coverage for most fisheries as VMS was required for fisheries at different times.  For example, the groundfish and scallop fisheries required VMS starting 2006, but VMS was only required for Shortfin Squid beginning in 2017.

Nonetheless, VMS is a good data source for understanding the spatial distribution of fishing vessels in the Offshore Project Area. In 2018, 912 VMS equipped vessels operating across all fisheries in the Northeast U.S. represented 71% to 87% of summer flounder, scup (Stenotomus chrysops), black sea bass (Centropristis striata), and skate landings and greater than 90% of landings for scallops, squids, monkfish, herring, mackerel, large mesh multispecies, whiting, surf clam, and ocean quahogs (BOEM 2020).

NROC and MARCO have developed updated commercial fishing data visualization products that make use of VMS data provided by NMFS. The VMS datasets and associated mapping made available by

NROC and MARCO qualitatively characterize the density of commercial fishing vessel activity for fisheries in the northeast and mid-Atlantic regions of the U.S. based on VMS for the years 2015 to 2019. The fisheries include Multispecies, Monkfish, Herring, Scallop, Surfclam, Ocean Quahog, and Squid/Mackerel/Butterfish. The NROC and MARCO data products depict the standardized density of locations for vessels that use VMS for each of these fisheries as well as those declared out of any fishery, and for all activity regardless of declaration for different aggregated time periods. The time periods assessed were either from January 2015 to December 2019 or for monkfish, multispecies and scallop, by their fishing season (Fontenault 2022). After processing the raw VMS data, the resulting density grids represent a "heat map" of the vessel activity, which indicate a relative level of vessel presence and spatially represent specific fisheries over clear timespans. VMS data are subject to strict confidentiality restrictions. The process of removing confidential vessel locations follows the "rule of three"[58] by using a screening grid to identify which grid cells contained three or more VMS records. Per the NMFS "rule of three," any record within a cell that contains fewer than three VMS records was eliminated from the analysis.

Unlike NROC and MARCO's previous processing of VMS data, the updated mapping of VMS data does not filter vessels operating at or below a vessel speed consistent with gear deployment for that fishery. Consequently, because of the large number of signals sent from VMS transmitters in port areas, ports show up as areas of high vessel density. However, these ports should not necessarily be understood as important fishing locations.

### Automatic Identification System Data

AIS is, in part, a shipborne mobile equipment system that typically consists of integrated very high frequency (VHF) radio and Global Positioning Systems (GPS) which broadcast a vessel's name, dimensions, course, speed, and position as well as destination and estimated time of arrival, amongst other vessel characteristics. The primary use of AIS is to allow vessels to monitor marine traffic in their area and to broadcast their location to other vessels with AIS equipment onboard. Broad categories of vessel type, including fishing vessels, can also be identified using the information contained in a vessel's AIS transmissions. As of 2016, Federal regulations require self-propelled commercial fishing vessels greater than 65 feet (ft) (20 meters [m]) in length to operate an AIS Class B device to broadcast vessel information (33 CFR §164.46; USCG NAVCEN 2017). Because of the autonomous and continuous nature of AIS data, it can also be compiled to establish a record of vessel operating history.

### Summary of Commercial Fishing Data Sources Used in Assessment

Table 7.4-3 summarizes the primary data sources used in the assessment, which include AIS, VMS, and VTR data, as well as information from fishing industry representatives.

[58] The process of removing sensitive vessel locations followed the "rule of three" mandated by NMFS Office of Law Enforcement by using a screening grid to identify which grid cells contained three or more VMS records. VMS records within cells that contain fewer than three VMS records were not included in the analysis.

**Table 7.4-3. Primary Data Sources for Assessment of Commercial Fishing Activity in the Offshore Project Area**

| Source | Date | Title/Description |
|---|---|---|
| MARCO | 2016 | VTR Commercial Fishing – Communities at Sea<br>• Original Data Provided by NOAA NMFS Northeast Fisheries Science Center (NEFSC)<br>• Data Processed by the Grant F. Walton Center for Remote Sensing and Spatial Analysis, Rutgers University |
| NROC | 2022 | VMS Commercial Fishing Density Northeast and Mid-Atlantic Regions<br>• Original Data Provided by NOAA NMFS Office of Law Enforcement<br>• Data Processed by RPS Group |
| NMFS | 2023 | Landings and Value for Vessel Trips that Occurred within Lease Area and Monmouth ECC, Modeled Results of Federal VTR, Clam Logbook Data, Dealer Data |
| Azavea/Last Tow, LLC | 2020 | Fishing Route Analytics Report, VMS Point Data |

#### 7.4.2.2 Commercial Fishing Vessel Activity in the Offshore Project Area

This section provides an overview of commercial fishing vessel activity in the Offshore Project Area using AIS, VTR, and VMS data. AIS data provide a quantitative assessment of vessel activity in the Lease Area, while VTR and VMS data provide qualitative representations of commercial fishing vessel activity within the Lease Area and along the ECCs.

##### AIS Data

A 3-year (2017-2019) AIS-based analysis of commercial fishing vessel traffic within the Lease Area separated commercial fishing vessel traffic into two categories based on vessel speed: (1) vessels operating at speeds greater than 4 knots (2.1 meters per second [m/s]) and assumed to be engaged in non-fishing activities such as transiting; and (2) vessels operating at speeds less than 4 knots (2.1 m/s) and assumed to be engaged in fishing or towing (i.e., fishing gear deployed) (see Figure 7.4-1). The full AIS analysis is provided within Appendix II-T – Navigation Safety Risk Analysis.

The VTR datasets produced qualitative representations of vessel activity within the bottom trawl, dredge, gillnet, longline, and pots and traps fisheries (excluding American lobster and Jonah crab [Cancer borealis]). Figures 7.4-2 through 7.4-7 are VTR-based maps depicting those fisheries. The VTR-based mapping of the bottom trawl fishery is further divided into two categories: vessels less than 65 ft (20 m) in length (Figure 7.4-3) and vessels greater than 65 ft (20 m) in length (Figure 7.4-4). The VTR datasets indicate the following regarding levels of fishing effort within the Offshore Project Area:

- During the years analyzed, areas of low fishing effort by vessels deploying dredge gear occur within the Lease Area and portions of the ECCs, as compared to the waters east of the Offshore Project Area (see Figure 7.4-2).[59] Section 7.4.2.4 provides additional detail on the surf clam/ocean quahog fishery is active in the Offshore Project Area. In general, and as noted in Section 7.4.2.4, during the years analyzed, the areas of higher fishing effort within the dredge fisheries appear to be moving further offshore and northeastward of the Lease Area and ECCs.
- During the years analyzed, only limited areas of low fishing effort by bottom trawl vessels are reflected in the Lease Area, though northerly portions of Northern ECC indicates low to moderate presence of bottom trawl vessels (see Figures 7.4-3 and 7.4-4).[60] VTR bottom trawl data for vessels less than 65 ft (20 m) suggest little to no fishing occurs in the Lease Area, though areas of elevated density occur in the nearshore waters to the west of the Monmouth ECC, offshore of Point Pleasant, and along the northernly sections of the Northern ECC. VTR bottom trawl data for vessels greater than 65 ft (20 m) in length suggest that the areas of highest activity are east of the Offshore Project Area along the edge of the continental shelf break and the waters between Mannasquan and Shark River.
- During the years analyzed, moderate to high fishing effort by gillnet vessels is reflected in the nearshore waters in proximity to and along the ECCs (see Figure 7.4-5).[61] Species sought by gillnetters in New Jersey include bluefish, monkfish, weakfish (*Cynoscion regalis*), and dogfish (GSSA 2020).
- During the years analyzed, no fishing effort by longline vessels, typically targeting pelagic species, occur within the Lease Area. Near the Monmouth ECC, areas of low to moderate longline vessel activity occur in proximity to the Axle Carlson artificial reef, offshore of Tom's River, and in proximity to the Barnegat Light artificial reef (see Figure 7.4-6). Artificial reefs are shown on Figure 7.4-1.
- During the years analyzed, little to no pots and traps effort occurred within the Lease Area. Except for a small area southeast of the Axle Carlson artificial reef and geographically limited areas of high effort south of Rockaway Inlet and west of Sandy Hook, little to no pots and traps effort is reflected along the Northern ECC (see Figure 7.4-7).

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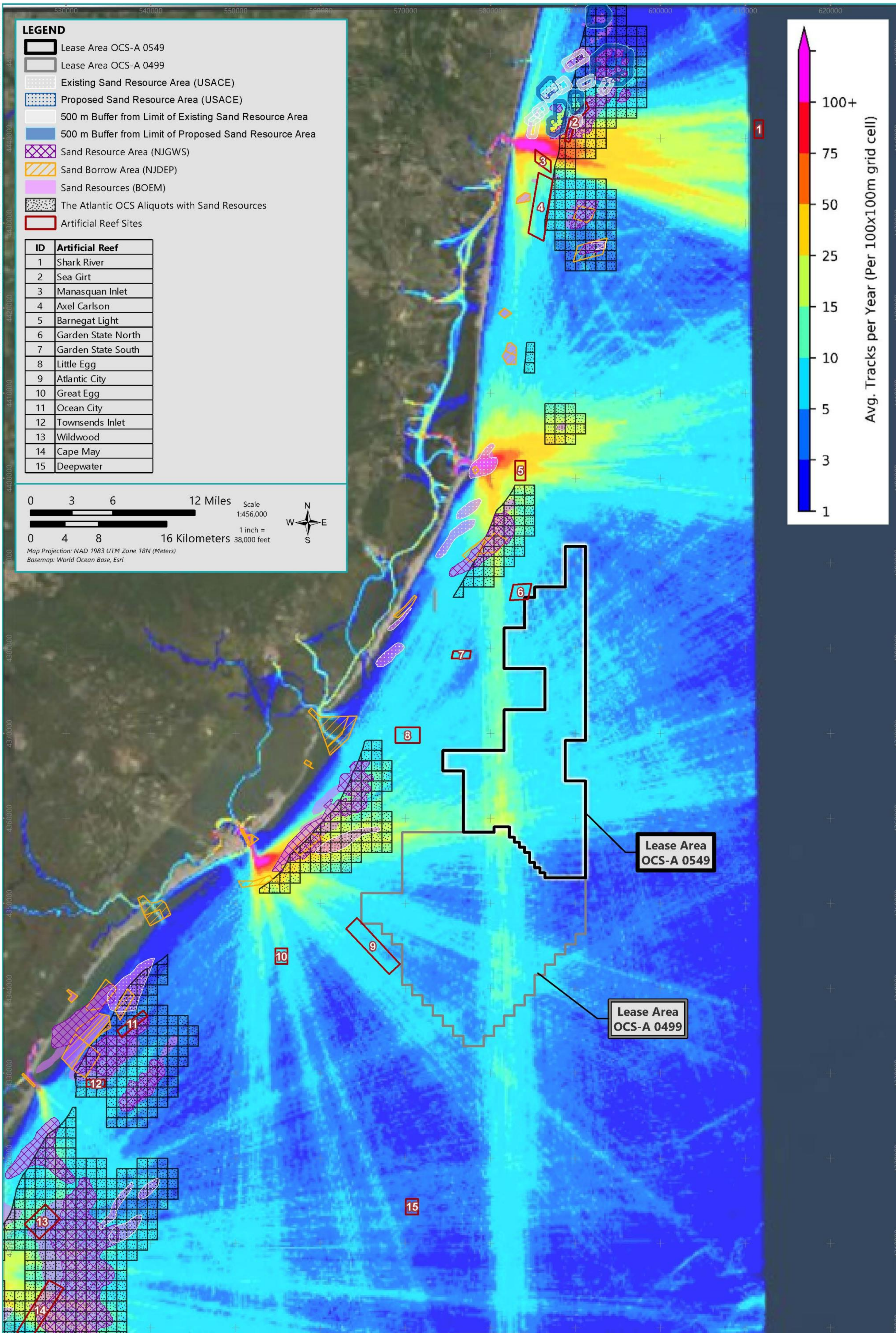
59 Dredge gear types include: ocean quahog/Atlantic surf clam dredge, mussel dredge, Atlantic sea scallop dredge, and urchin dredge.

60 Bottom trawl gear includes: haddock separator otter trawl, beam otter trawl, bottom otter trawl, Atlantic sea scallop trawl, Ruhle otter trawl, bottom pair trawl, and Scottish seine.

61 Gill net gear includes: drift gill net, large and small mesh, runaround gill net, sink gill net, drift gill net.




ATLANTIC SHORES offshore wind

**Figure 7.4-1**

*Track Density of Transiting (>4 knots; left)*

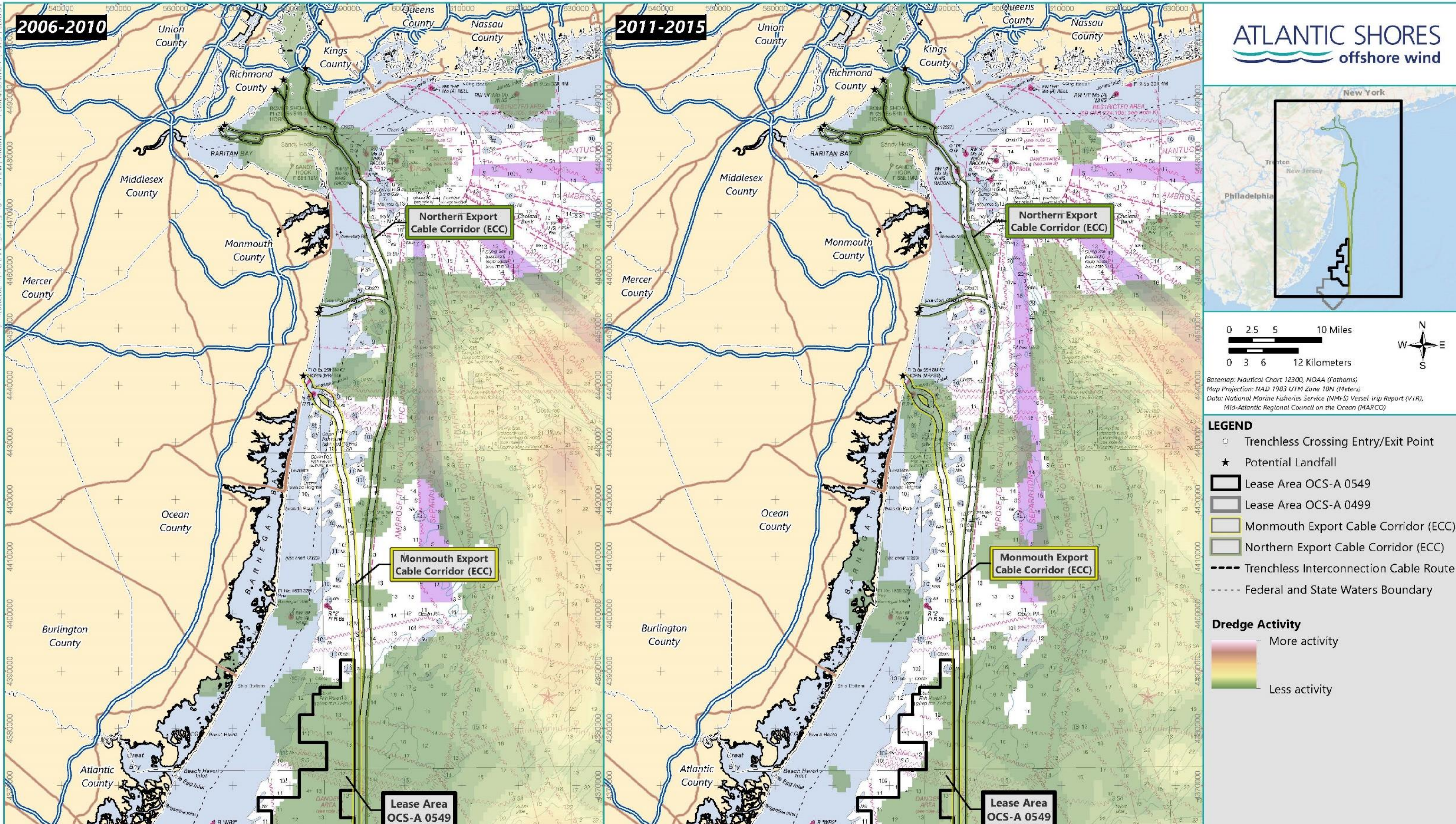
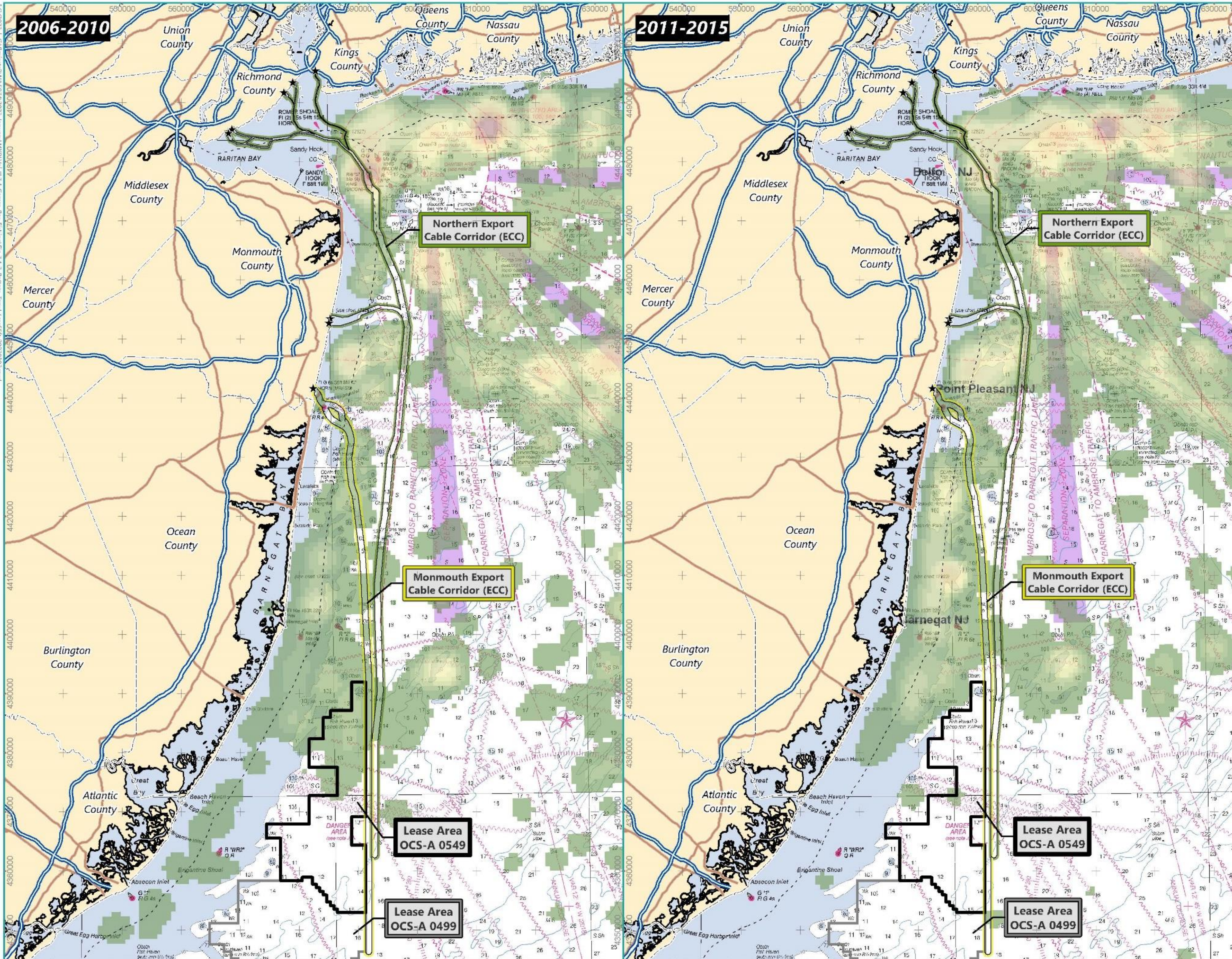



**Figure 7.4-2**

*Dredge Activity*
*Vessel Trip Report Data*
*2006–2010 and 2011-2015*




ATLANTIC SHORES offshore wind


0 2.5 5 10 Miles
0 3 6 12 Kilometers

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Bottom Trawl Activity (Vessels <65 ft.)**

More activity

Less activity

**Figure 7.4-3**

*Bottom Trawl Activity (Vessels <65 ft.) Vessel Trip Report Data 2006–2010 and 2011-2015*

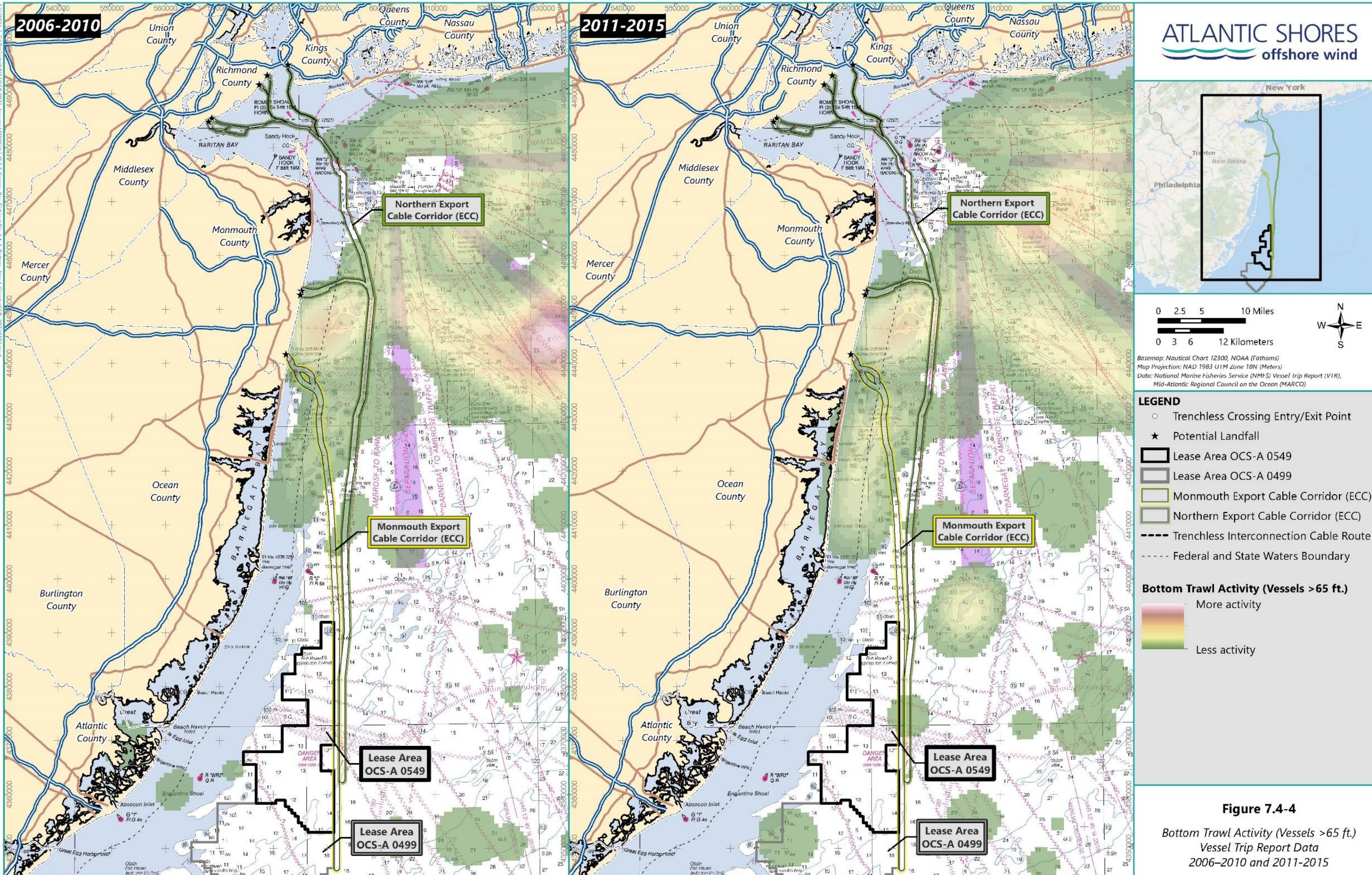
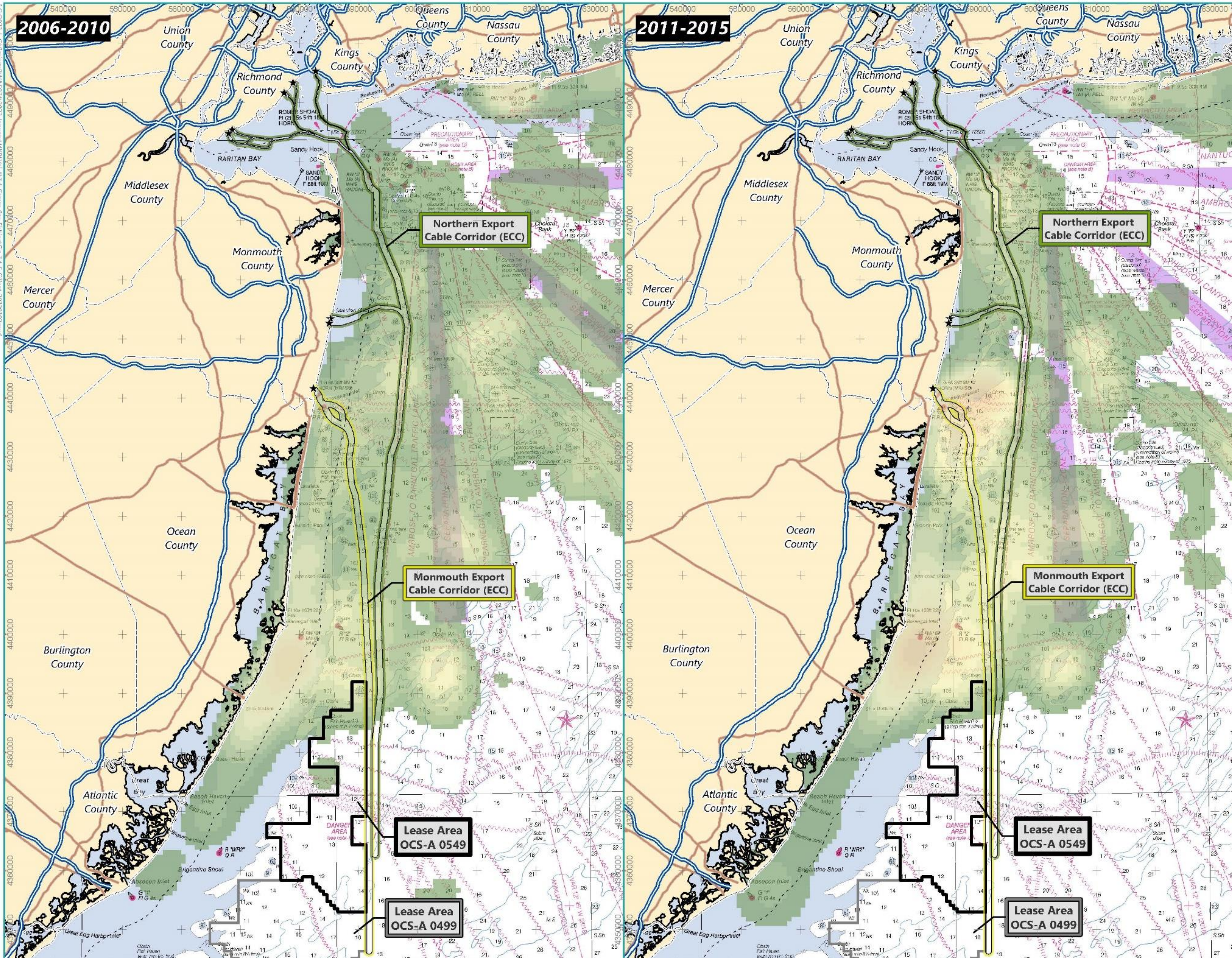



**Figure 7.4-4**

*Bottom Trawl Activity (Vessels >65 ft.) Vessel Trip Report Data 2006–2010 and 2011-2015*




ATLANTIC SHORES offshore wind

0 2.5 5 10 Miles
0 3 6 12 Kilometers

Basemap: Nautical Chart 12300, NOAA (Fathoms)
Map Projection: NAD 1983 UTM Zone 18N (Meters)
Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

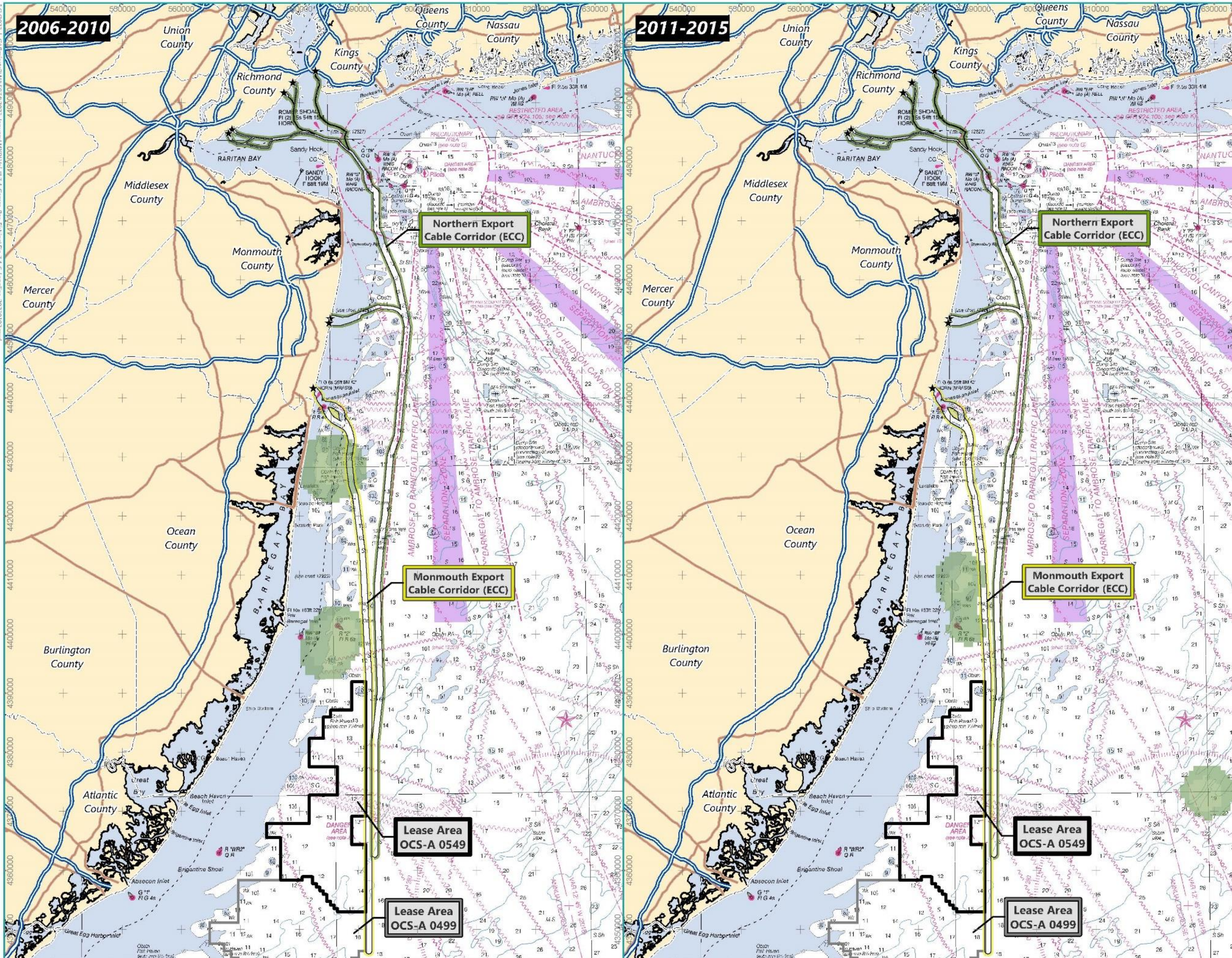
**Gillnet Activity**

More activity

Less activity

**Figure 7.4-5**

*Gillnet Activity Vessel Trip Report Data 2006–2010 and 2011-2015*







0 2.5 5 10 Miles

0 3 6 12 Kilometers

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Longline Activity**

More activity

Less activity

**Figure 7.4-6**

*Longline Activity*
*Vessel Trip Report Data*
*2006–2010 and 2011-2015*

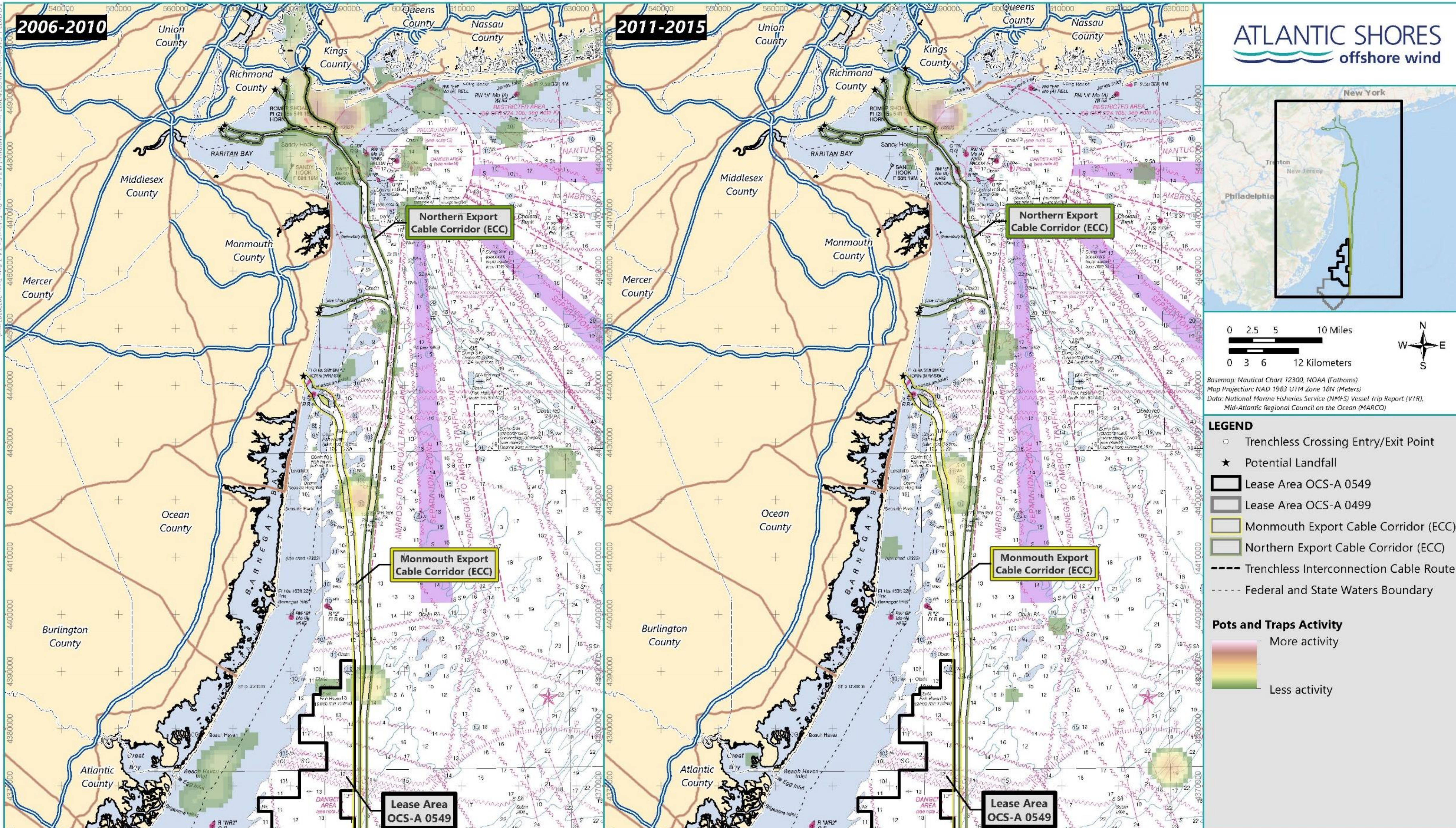



**Figure 7.4-7**

*Pots and Traps Activity Vessel Trip Report Data 2006–2010 and 2011-2015*

## VMS Data

As noted in Section 7.4.2.1, NROC and MARCO have developed commercial fishing data visualization products that use VMS data to qualitatively characterize the density of commercial fishing vessel activity of seven fisheries and vessels Declared out of Fishery in the Northeast and Mid-Atlantic regions for the years 2015 to 2019. Figures 7.4-8 through 7.4-5 depict a standardized density of commercial fishing vessel activity within the surf clam, ocean quahog, Northeast Multispecies[62], monkfish, scallop, and squid, mackerel, and butter fish fisheries, and vessels Declared out of Fishery in the northeast and Mid-Atlantic regions of the U.S. based on VMS data for the years 2015 to 2019.

The VMS figures depict relative vessel density between 2015 and 2019, as distinct from the VTR figures (Figures 7.4-2 through 7.4-7) which have been aggregated, separately, for 2006 to 2010 and 2011 to 2015.

The VMS-based analysis of the Offshore Project Area (i.e., the Lease Area and ECCs) shows the following results for the years analyzed:

- Vessels targeting surf clam appear to be active throughout the Lease Area and southern sections of the ECCs during the years analyzed (see Figure 7.4-8). These represent all VMS data between 2015 and 2019 reported by vessels with a Federal surf clam/ocean quahog permit. As described in additional detail in Section 7.4.2.3, this is the predominant fishery in the Offshore Project Area and the high density of vessels targeting this species is consistent with other data sources. The terms "Medium-High" or "High" are not specifically defined, rather they indicate the relative density of vessel traffic as classified by the underlying model (Fontenault 2022).
- Vessels targeting ocean quahog appear to be active throughout the Lease Area and sections of the ECCs during the years analyzed (see Figure 7.4-9). These represent all VMS data between 2015 and 2019 reported by vessels with a Federal ocean quahog permit. As described in additional detail in Section 7.4.2.3, the fishery's limited value of landings withinin the Offshore Project Area suggest that the vessels activity depicted on Figure 7.4-9 are vessels transiting the Offshore Project Area rather than vessels actively engaged in fishing.
- Very limited Northeast Multispecies vessel activity occurs within the Offshore Project Area (see Figure 7.4-10). The two areas of low vessel activity in the ECCs are likely vessels transiting from Manasquan and Belford.These represent VMS data between 2015 and 2019 reported under the multispecies fisheries. Multispecies VMS data include fisheries with a limited access multispecies permit fishing under a Category A or B days-at-sea, catch-regulated species, ocean pout (Zoarces americanus) while on a sector trip, or those with a

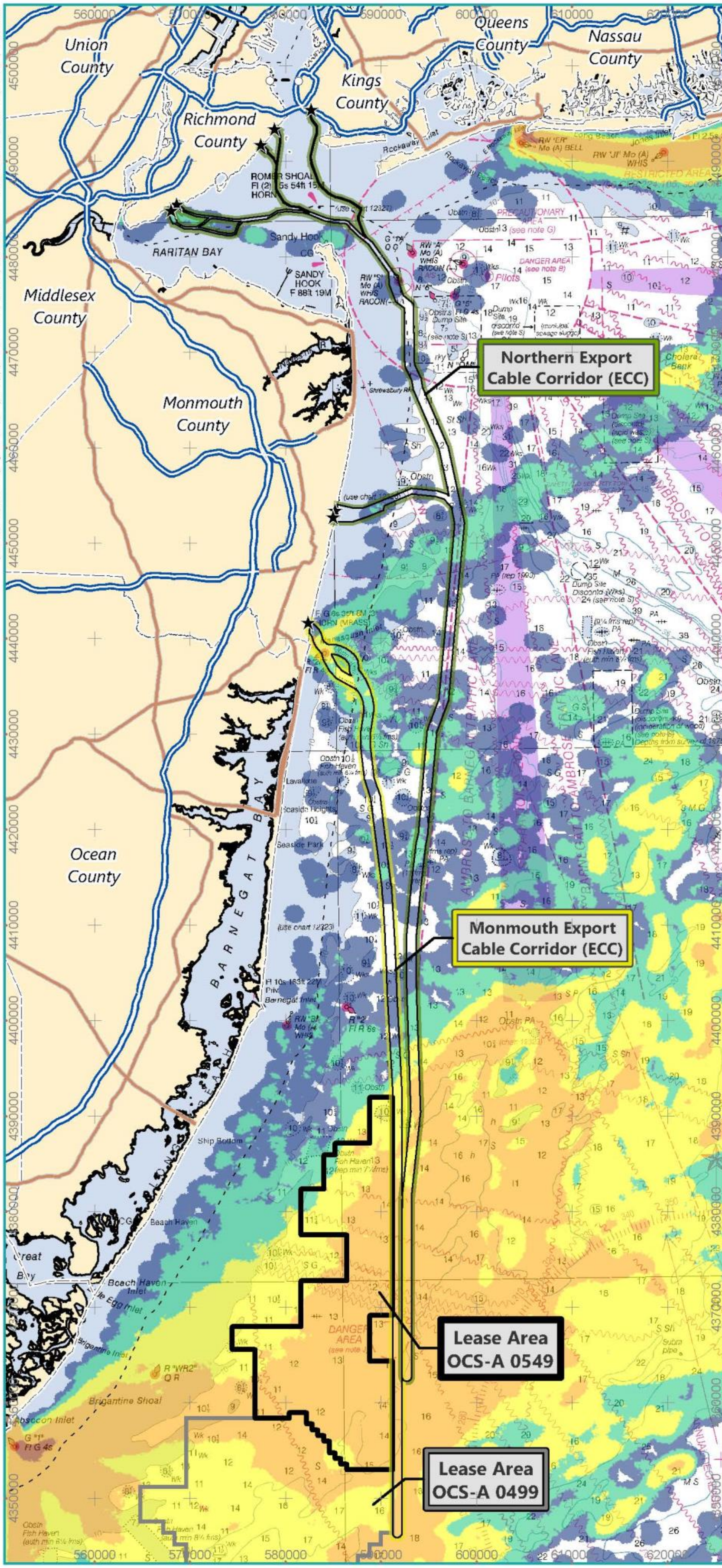
[62] American plaice (*Hippoglossoides platessoides*), Atlantic cod (*Gadus morhua*), Atlantic halibut *(Hippoglossus hippoglossus*), haddock (*Melanogrammus aeglefinus*), ocean pout, Pollock (*Pollachius virens*), redfish *(Sebastes fasciatus*), white hake (*Urophycis tenuis*), windowpane flounder (*Scophthalmus aquosus*), winter flounder (*Pseudopleuronectes americanus*), witch flounder (*Glyptocephalus cynoglossus*), and yellowtail flounder *(Limanda ferruginea*).

limited access northeast multispecies small vessel category or Handgear A permit that fish in multiple northeast multispecies broad stock areas.[63]

- Vessels targeting monkfish (see Figure 7.4-11) appear to be active in limited areas of the ECCs during the years analyzed. This activity, characterized as Medium-High to High, predominantly occurs within proximity to the Axle Carlson and Manasquan Inlet artificial reefs. The distribution of monkfish vessel activity depicted on the NROC and MARCO maps extends into the nearby Manasquan Inlet and Barnegat Inlet, suggesting that some, if not all, of this vessel activity may reflect vessels departing or arriving at nearby ports.
- Scallop vessel density during the years analyzed is generally Medium-High within the Offshore Project Area (see Figure 7.4-12).[64] High and Very High levels of scallop vessel density occur further offshore, to the east of the Offshore Project Area, which also suggests scallop fishing did not regularly occur in the Offshore Project Area during the years analyzed. Scallop vessel density represents all VMS data between 2015 and 2019 reported by vessels with a Federal Atlantic sea scallop permit, which includes limited 7-112cess vessels and general access category vessels in the Atlantic sea scallop fishery.
- Very little squid, mackerel, and butterfish vessel activity occurs in the Offshore Project Area, though there are areas of High vessel density to the west of the ECCs offshore of Barnegat Bay and offshore of the Manasquan Inlet and in proximity to Sandy Hook (see Figure 7.4-13). Some, if not all, of the vessel activity within the ECCs in proximity to Manasquan Inlet and Sandy Hook may reflect vessels departing or arriving at nearby ports.
- (Limited areas of Low vessel density in the herring fishery are indicated in descrete areas of the ECCs and within the Lease Area (see Figure 7.4-14).As noted in Section 7.4.2.1, when vessels with permits for VMS fisheries participate in one of the fisheries where VMS is not required, they broadcast a "Declared out of Fishery" VMS trip code. Vessel activity that cannot be assigned to a specific fishery may represented by the Declared out of Fishery VMS code. Although the Declared of Fishing VMS code cannot necessarily inform what the target species, it does indicate where vessel activity has occurred. As shown in Figure 7.4-15, Declared out of Fishery vessels are active throughout the Offshore Project Area.

63 50 CFR §648.10

64 VMS activity in Mid-Atlantic areas that are identified during periods when the fishery is closed likely reflects scallop permit holders actually targeting summer flounder, scup, and black seabass.




ATLANTIC SHORES offshore wind


0 2.5 5 10 Miles

0 3 6 12 Kilometers

N W E S

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- ○ Trenchless Crossing Entry/Exit Point
- ★ Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

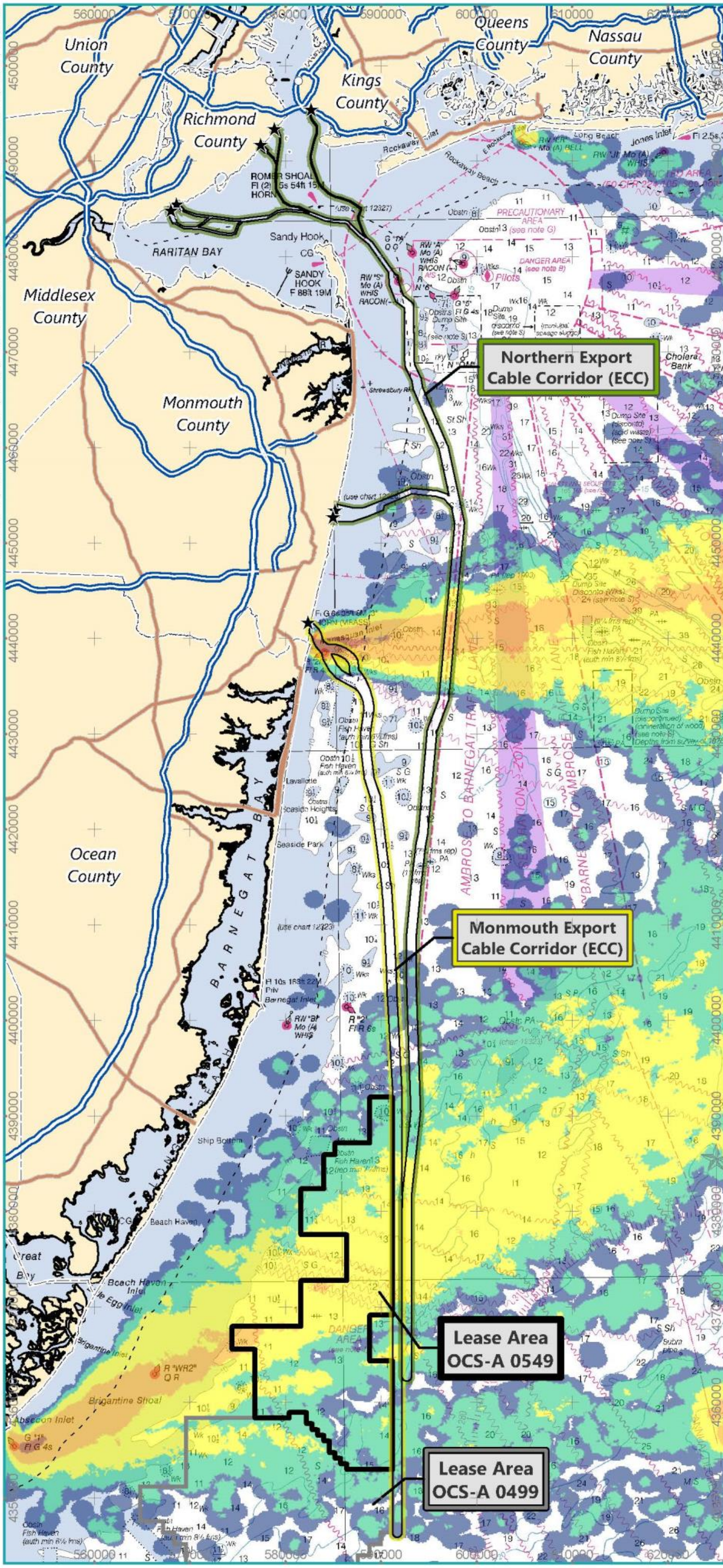
**Commercial Fishing Density**

- Very High
- High
- Medium-High
- Medium-Low
- Low

**Figure 7.4-8**

*Surf Clam*
*Commercial Fishing Density*
*Vessel Monitoring System Data*
*2015-2019*

1/3/2023 | G:\Projects2\NJ\5974\2023_January\MXD\Vol_III\7.4_Comm_Rec_Fishing\Fig 7.4-8_Surf_Clam_20230103.mxd




ATLANTIC SHORES offshore wind


0 2.5 5 10 Miles

0 3 6 12 Kilometers

N E S W

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Commercial Fishing Density**

- Very High
- High
- Medium-High
- Medium-Low
- Low

**Figure 7.4-9**

*Ocean Quahog Commercial Fishing Density Vessel Monitoring System Data 2015-2019*

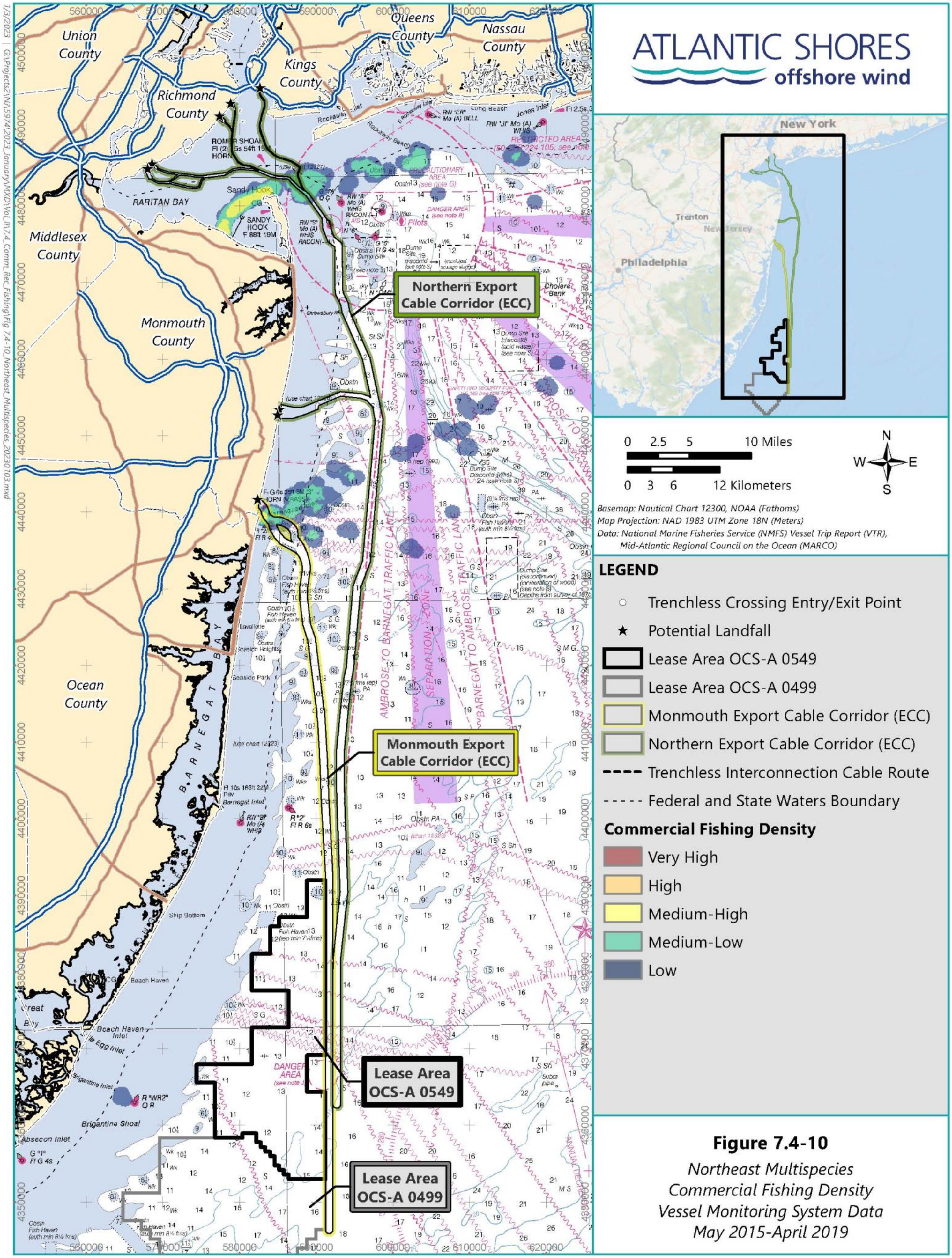
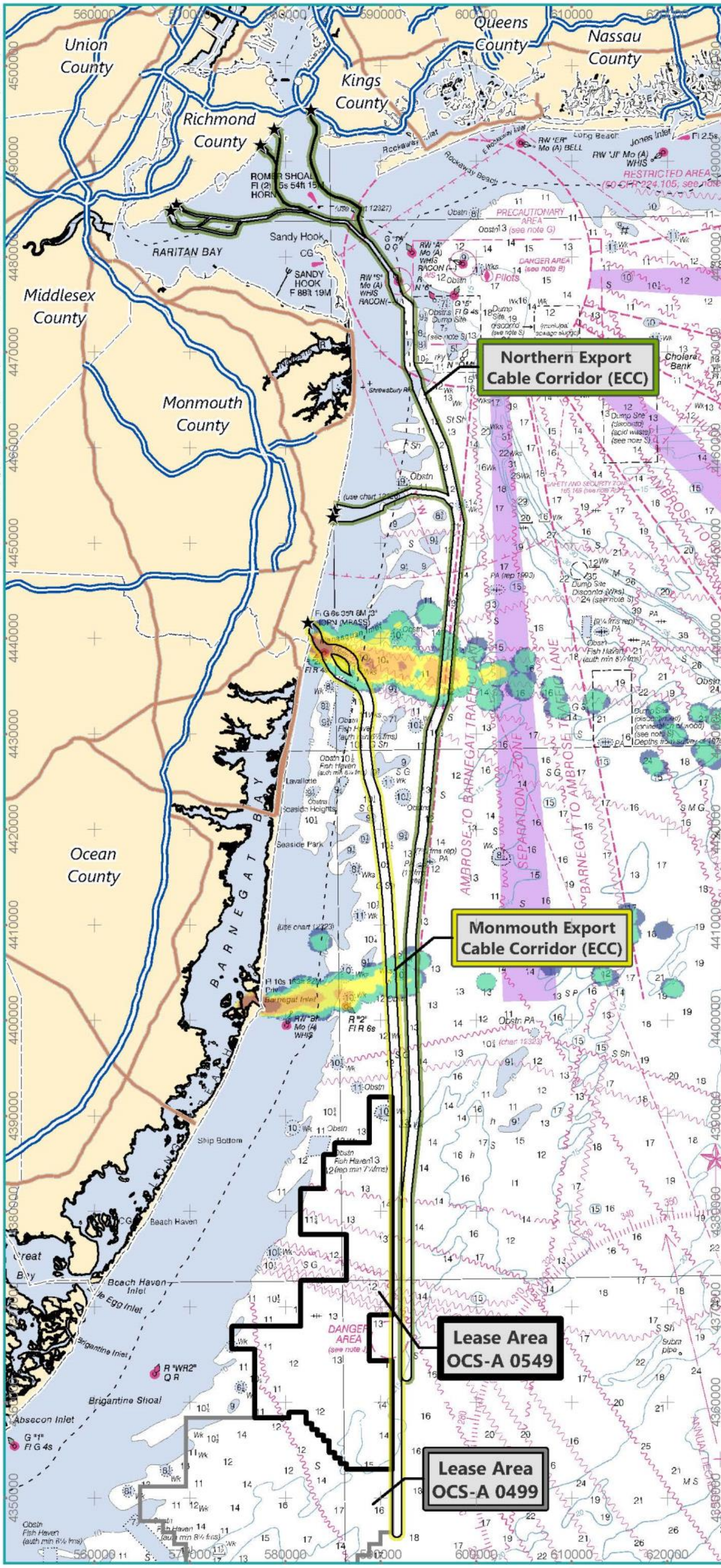



**Figure 7.4-10**

*Northeast Multispecies Commercial Fishing Density Vessel Monitoring System Data May 2015-April 2019*




ATLANTIC SHORES
offshore wind


0 2.5 5 10 Miles

0 3 6 12 Kilometers

N W E S

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Commercial Fishing Density**

- Very High
- High
- Medium-High
- Medium-Low
- Low

**Figure 7.4-11**

*Monkfish*
*Commercial Fishing Density*
*Vessel Monitoring System Data*
*May 2015-April 2019*

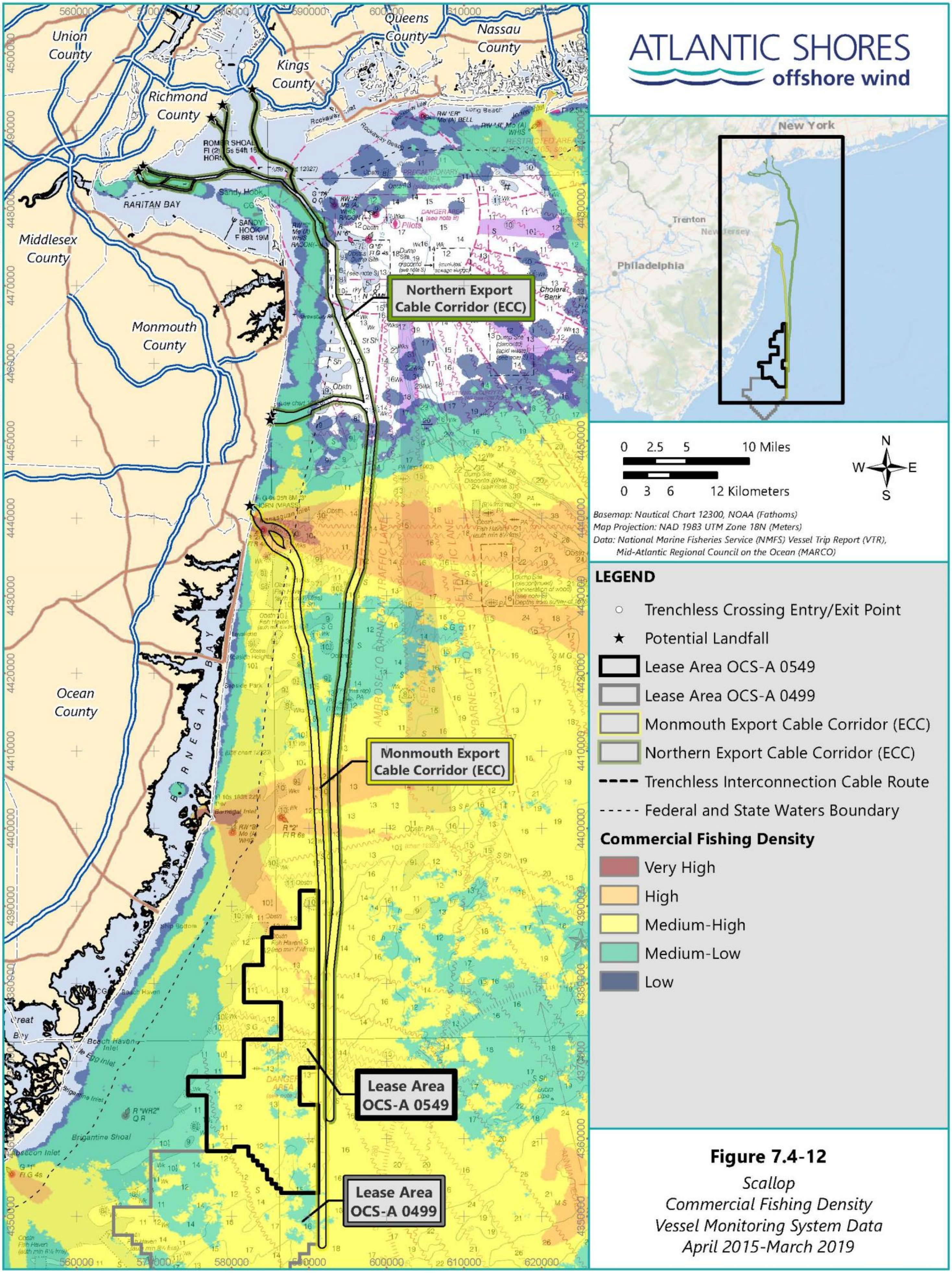



**Figure 7.4-12**

*Scallop*
*Commercial Fishing Density*
*Vessel Monitoring System Data*
*April 2015-March 2019*

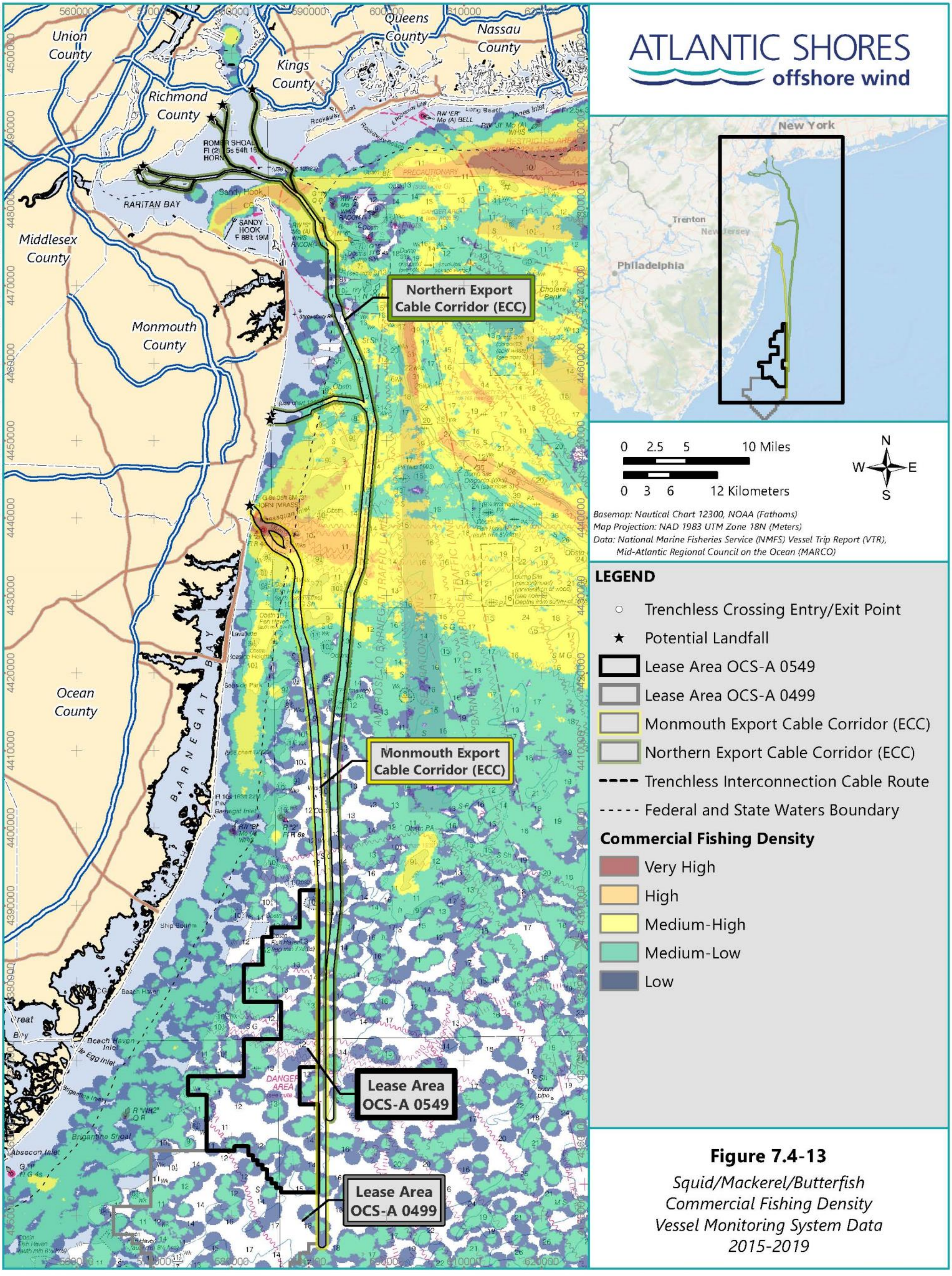
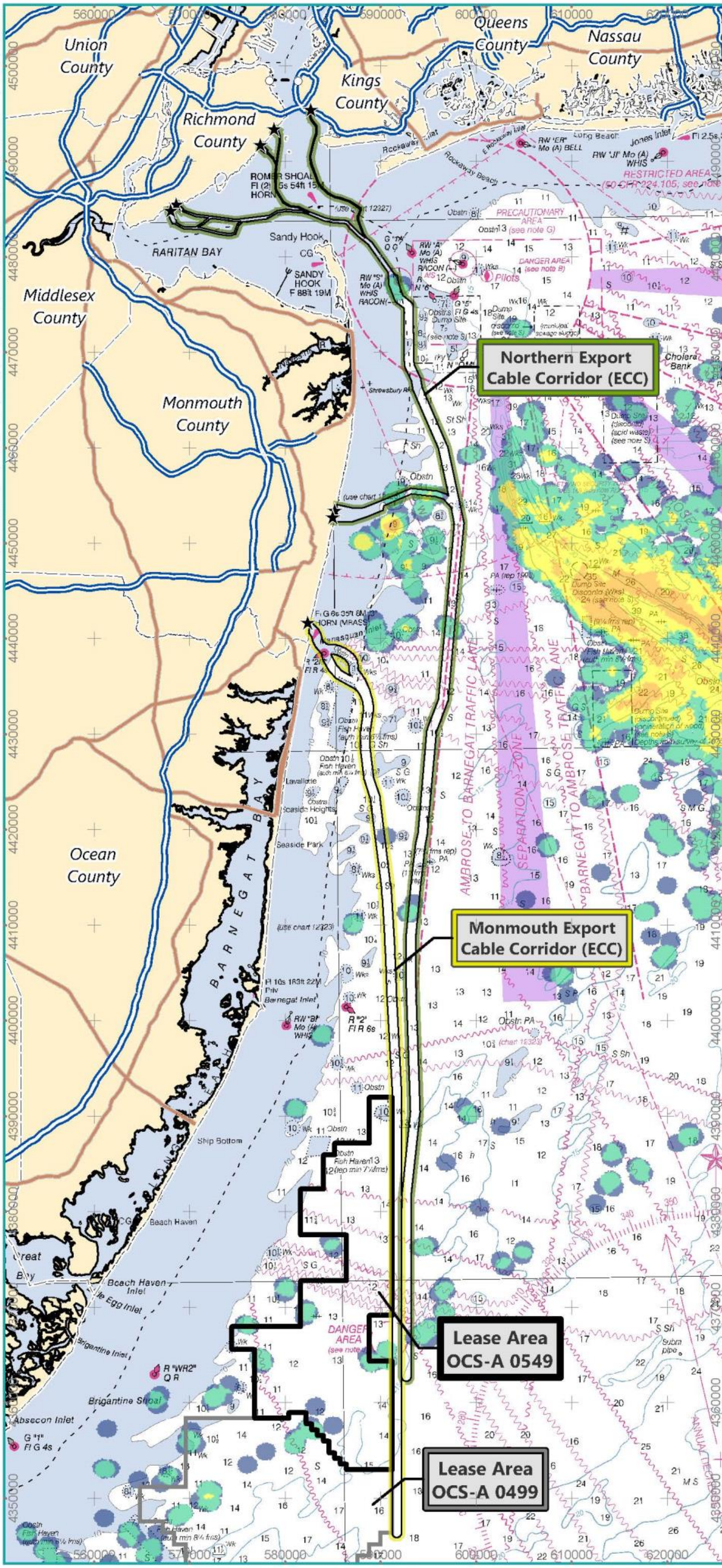



**Figure 7.4-13**

*Squid/Mackerel/Butterfish Commercial Fishing Density Vessel Monitoring System Data 2015-2019*




ATLANTIC SHORES
offshore wind


0 2.5 5 10 Miles

0 3 6 12 Kilometers

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

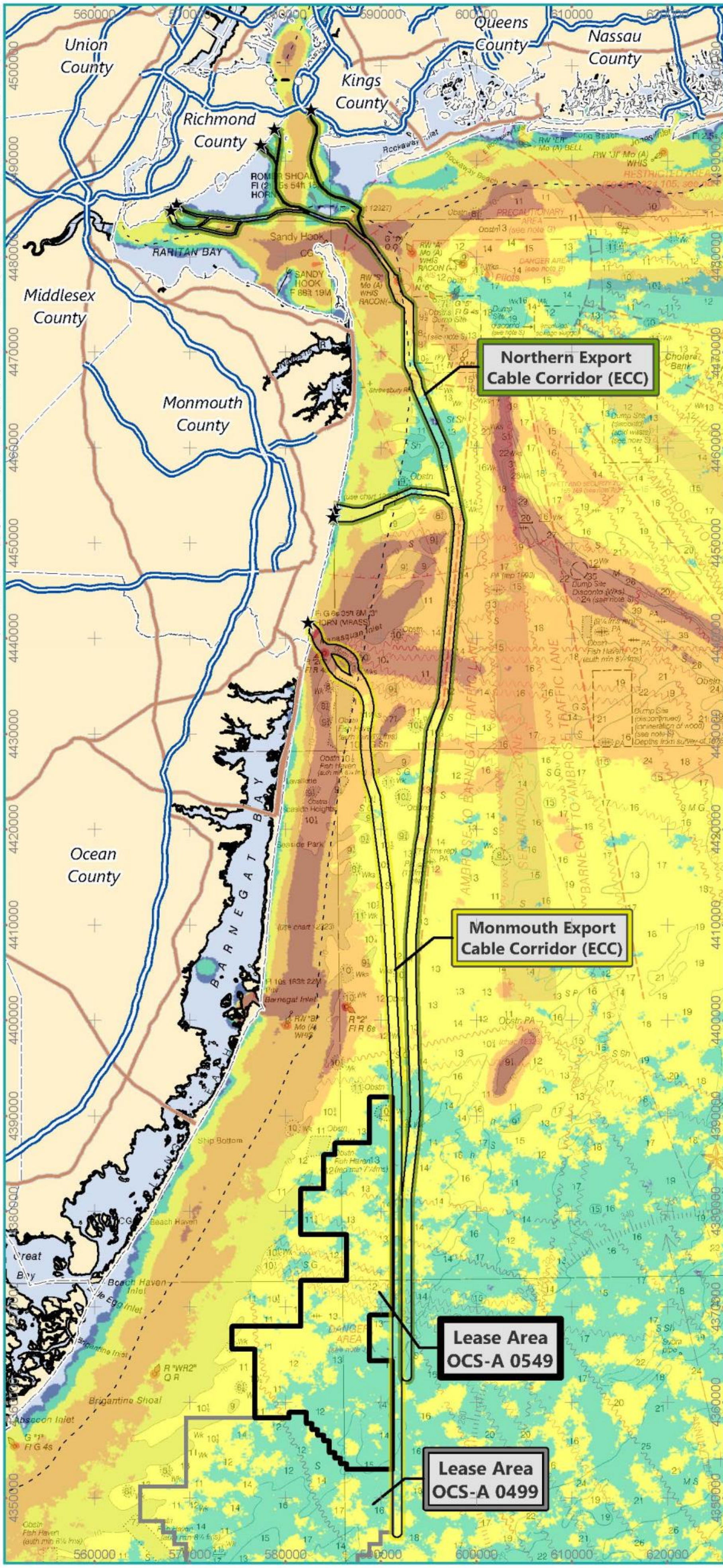
- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Commercial Fishing Density**

- Very High
- High
- Medium-High
- Medium-Low
- Low

**Figure 7.4-14**

*Herring*
*Commercial Fishing Density*
*Vessel Monitoring System Data*
*2015-2019*




ATLANTIC SHORES offshore wind


0 2.5 5 10 Miles

0 3 6 12 Kilometers

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary

**Commercial Fishing Density**

- Very High
- High
- Medium-High
- Medium-Low
- Low

**Figure 7.4-15**

*Declared Out of Fishery*
*Commercial Fishing Density*
*Vessel Monitoring System Data*
*2015-2019*

1/16/2023 | G:\Projects2\NJ\15974\2023_January\MXD\Vol_II\7.4_Comm_Rec_Fishing\Fig 7.4-15_Declared_Out_of_Fishery_20230116.mxd

#### 7.4.2.3 Economic Exposure of Commercial Fisheries in the Lease Area and Export Cable Corridors

In April 2022, NMFS provided Atlantic Shores with a report summarizing fisheries landings by weight and dollar values for vessel trips that occurred within the ECCs from 2016 to 2020. Atlantic Shores is also using NMFS data that summarizes fisheries landings by weight and dollar value for vessel trips that occurred within the Lease Area from 2017 to 2021.

The NMFS datasets include modeled results of VTRs and clam logbook data linked to dealer data for value and landings information that were then queried for spatial overlap with the Lease Area and ECCs. In brief, the modeled results of VTRs create a spatial scale of each fishing trip that is more representative of actual fishing effort, in part, by reducing the effect of location inaccuracy of VTRs. Additionally, rather than placing the entire value reported for each VTR at the reported point location, the model allocates a percentage of a trip’s reported landings to a specific geographic area, such as within the Lease Area and ECCs. Additional details on the VTR modeling are described in DePiper (2014) and Benjamin, Lee, DePiper (2018).

The modeling efforts are useful to address some of the limitations associated with VTR data. VTR reporting only requires that a single geographic position (point location) be reported for each fishing trip. Vessels are required to record the position where most of the fishing occurred, but because a new VTR is necessary only when gear type changes or fishing occurs in a new statistical area, multiple tows within the same statistical area using the same gear will likely be assigned only a single point location. Consequently, point locations reported for fixed gear (e.g., gillnet, pots) may be more representative of the actual fishing location than point locations reported for mobile fishing gear (e.g., trawl, dredge). Similarly, VTRs from day trips may be more representative of fishing location than VTRs from multi-day trips. Absent efforts to improve the spatial representation of self-reported VTR point locations, as described in DePiper (2014) and Benjamin, Lee, DePiper (2018), the VTR point location may not be representative of where the fishing occurred. However, all summaries of VTR data provided by NMFS and used in this section incorporate the modeled results from VTR data and, therefore, are more representative of actual fishing effort. The VTR data used are built from percentages of a trip that overlapped spatially with the Lease Area and ECCs. These percentages were applied to landings and values for that trip and summed.

The summaries presented in the following subsections identify the probable portion of a vessel trip that overlapped spatially with the Offshore Project Area and, as a result, provide a measure of the economic exposure of commercial fisheries to the Project. Tables 7.4-4 through 7.4-19 summarize landed weight and value by species, gear type, port, and state of landing. To meet data confidentiality requirements, records that did not meet the NMFS “rule of three” (i.e., greater than or equal to three unique dealers reports and greater than or equal to three unique vessel permits) were anonymized, which may result in modest discrepancies when comparing summarized data across certain groupings. Also, as previously noted, federally permitted lobster vessels possessing only lobster permits do not have a VTR requirement and are not reflected in this summary. There are also fisheries in New Jersey State waters that may not be reflected in data from Federal VTRs (e.g., whelk, bluefish). To aid in the comparison of the value of landings over time, the nominal values of landings were updated by NMFS to 2019 values. The annual value in the following tables is in 2019 U.S. dollars, unless otherwise noted.

Tables 7.4-4 through 7.4-7 identify the states with landings from the Lease Area, the Monmouth ECC, the Northern ECC and the Asbury Branch of the Northern ECC. In accordance with confidentiality requirements, landings from the Offshore Project Area in certain states were combined by NMFS and identified as “All Other States.” As part of this analysis, any state with annual average landings from the Offshore Project Area of less than $1,000 were added to the combined confidential state landings.

### Table 7.4-4. Landed Value and Weight from the Lease Area, by State (2017–2021)[1]

| State | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value[2] |
| New Jersey | 2,866,513 | $1,972,830 | 573,303 | $394,566 |
| Massachusetts | 32,006 | $310,028 | 6,401 | $62,006 |
| Virginia | 6,916 | $36,814 | 1,383 | $7,363 |
| Rhode Island | 58,346 | $36,395 | 11,669 | $7,279 |
| North Carolina | 2,168 | $9,373 | 434 | $1,875 |
| All Other States[3] | 14,265 | $7,844 | 2,853 | $1,569 |
| **Total** | **2,980,214** | **$2,373,284** | **596,043** | **$474,657** |

[1]Source: NMFS, 2023.

[2]Nominal values of landings were updated to 2020 values by NMFS.

[3] As part of this analysis, Maryland, New York, and North Carolina each have annual average landings of less than $1,000 from the Lease Area and are included in “All Other States.” According to NMFS (2023) data, “All Other States” may include up to six different states with landings from the Lease Area.

### Table 7.4-5. Landed Value and Weight from the Monmouth ECC, by State (2016–2020)[1]

| State | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| New Jersey | 1,270,551 | $791,721 | 254,110 | $158,344 |
| Massachusetts | 18,454 | $40,662 | 3,691 | $8,132 |
| Virginia | 3,294 | $18,527 | 659 | $3,705 |
| Rhode Island | 21,901 | $11,366 | 4,380 | $2,273 |
| All Other States[3] | 7,745 | $6,005 | 1,614 | $1,295 |
| **Total** | **1,321,945** | **$868,281** | **264,454** | **$173,751** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] As part of this analysis, Connecticut, Maryland, New York, and North Carolina each had annual average landings from the Monmouth ECC of less than $1,000 and are included in "All Other States." According to NMFS (2021) data, "All Other States" may include up to seven different states with landings from the Monmouth ECC.

## Table 7.4-6. Landed Value and Weight from the Asbury Branch of the Northern ECC, by State (2016–2020)[1]

| State | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Weight (lbs) |
| New Jersey | 1,094,958 | $715,444 | 218,992 | $143,089 |
| Massachusetts | 45,337 | $40,767 | 9,067 | $8,153 |
| New York | 8,876 | $28,368 | 1,775 | $5,674 |
| Virginia | 3,295 | $14,677 | 659 | $2,935 |
| Rhode Island | 27,147 | $14,552 | 5,429 | $2,910 |
| All Other States[3] | 24,030 | $11,119 | 4,910 | $2,402 |
| **Total** | **1,203,643** | **$824,927** | **240,832** | **$165,163** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] [3] As part of this analysis, Connecticut, Maryland, and North Carolina each had annual average landings from the Asbury Branch of the Northern ECC of less than $1,000 and are included in "All Other States." According to NMFS (2021) data, "All Other States" may include up to seven different states with landings from the Asbury Brach of the Northern ECC.

## Table 7.4-7. Landed Value and Weight from the Northern ECC, by State (2016–2020)[1]

| State | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Weight (lbs) |
| New Jersey | 1,409,921 | $915,487 | 281,984 | $183,097 |
| Massachusetts | 51,141 | $48,940 | 10,328 | $9,837 |
| New York | 11,278 | $35,941 | 2,256 | $7,188 |
| Virginia | 3,964 | $18,115 | 793 | $3,623 |
| Rhode Island | 32,966 | $17,621 | 6,593 | $3,524 |
| All Other States[3] | 26,934 | $12,399 | 5,519 | $2,703 |
| **Total** | **1,536,204** | **$1,048,503** | **307,473** | **$209,973** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] [3] As part of this analysis, Connecticut, Maryland, and North Carolina each had annual average landings from the Northern ECC of less than $1,000 and are included in "All Other States." According to NMFS (2021) data, "All Other States" may include up to seven different states with landings from the Northern ECC.

Tables 7.4-8 through 7.4-11 identify the commercial ports with landings from the Lease Area, the Monmouth ECC, the Northern ECC and the Asbury Branch of the Northern ECC. In accordance with confidentiality requirements, landings at certain ports were combined by NMFS and identified as "All Other Ports." As part of this analysis, any port with annual average landings from the Offshore Project Area of less than $2,500 were added to the combined confidential port landings.

### Table 7.4-8. Landed Value and Weight from the Lease Area, by Port (2017–2021)[1]

| Port | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Atlantic City, NJ | 2,269,401 | $1,533,775 | 453,880 | $306,755 |
| New Bedford, MA | 29,910 | $308,294 | 5,982 | $61,659 |
| Barnegat, NJ | 312,154 | $195,974 | 62,431 | $39,195 |
| Cape May, NJ | 235,029 | $168,830 | 47,006 | $33,766 |
| Point Pleasant, NJ | 9,805 | $31,213 | 1,961 | $6,243 |
| Barnegat Light, NJ | 31,621 | $14,967 | 6,324 | $2,993 |
| All Others Ports[3] | 92,298 | $120,229 | 18,460 | $24,046 |
| **Total** | **2,980,218** | **$2,373,282** | **596,044** | **$474,656** |

[1]Source: NMFS, 2023.

[2]Nominal values of landings were updated to 2020 values by NMFS.

[3] According to NMFS (2023) data, "All Other Ports" may include up to 91 different ports with landings from the Lease Area.

### Table 7.4-9. Landed Value and Weight from the Monmouth ECC, by Port (2016–2020)[1]

| Port | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Atlantic City, NJ | 440,052 | $294,301 | 88,477 | $59,259 |
| Barnegat, NJ | 377,045 | $192,261 | 75,409 | $38,452 |
| Point Pleasant, NJ | 339,164 | $234,808 | 67,833 | $46,962 |
| Cape May, NJ | 187,798 | $59,917 | 40,026 | $12,335 |
| New Bedford, MA | 14,140 | $34,305 | 2,828 | $6,861 |
| All Other Ports[3] | 55,568 | $62,340 | 11,446 | $13,314 |
| **Total** | **1,413,767** | **$877,932** | **286,019** | **$177,183** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, "All Other Ports" may include up to 92 different ports with landings from the Lease Area.

### Table 7.4-10. Landed Value and Weight from the Asbury Branch of the Northern ECC, by Port (2016–2020)[1]

| Port | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Point Pleasant, NJ | 212,943 | $196,891 | 42,589 | $39,378 |
| Barnegat, NJ | 281,276 | $173,336 | 56,255 | $34,667 |
| Atlantic City, NJ | 242,248 | $162,582 | 48,549 | $32,592 |
| Belford, NJ | 136,024 | $60,654 | 49,485 | $21,201 |
| Cape May, NJ | 109,552 | $43,650 | 22,394 | $8,888 |
| New Bedford, MA | 32,629 | $37,532 | 6,526 | $7,506 |
| Shark River, NJ | 2,065 | $6,386 | 1,033 | $3,193 |
| All Other Ports[3] | 186,711 | $143,384 | 38,108 | $30,550 |
| **Total** | **1,203,448** | **$824,415** | **264,939** | **$177,975** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, "All Other Ports" may include up to 89 different ports with landings from the Lease Area.

### Table 7.4-11. Landed Value and Weight from the Northern ECC, by Port (2016–2020)[1]

| Port | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Barnegat, NJ | 358,369 | $220,201 | 71,685 | $44,058 |
| Point Pleasant, NJ | 236,911 | $217,563 | 47,382 | $43,513 |
| Atlantic City, NJ | 308,802 | $207,213 | 61,760 | $41,443 |
| Belford, NJ | 175,914 | $100,457 | 64,308 | $38,580 |
| Cape May, NJ | 135,285 | $54,230 | 27,078 | $10,853 |
| New Bedford, MA | 37,027 | $45,235 | 7,482 | $9,091 |
| Shark River, NJ | 2,427 | $7,496 | 1,214 | $3,748 |
| All Other Ports[3] | 282,194 | $196,919 | 57,282 | $41,384 |
| **Total** | **1,536,929** | **$1,049,313** | **338,191** | **$232,669** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, "All Other Ports" may include up to 90 different ports with landings from the Lease Area.

Tables 7.4-12 through 7.4-15 identify species with landings from the Lease Area, the Monmouth ECC, the Northern ECC and the Asbury Branch of the Northern ECC. In accordance with confidentiality requirements, certain species were combined by NMFS and are identified as "All Other Species." As part of this analysis, any species with annual average landings from the Offshore Project Area of less than $1,000 were added to the combined confidential species landings.

The following tables also provide a comparison of landings from the Offshore Project Area to statewide landings of the same species in New Jersey because approximately 86.9% of the average annual value of all species harvested from the Offshore Project Area are landed at New Jersey ports. According to NMFS (2022) data, Massachusetts and New York accounted for approximately 8.2% and 1.2% of landings from the Offshore Project Area, with all other states accounting for approximately 3.7% of landings. Although vessels operating from other states are clearly active in the Offshore Project Area, the comparison to state-wide landings in New Jersey alone provides a more conservative estimate of each species' exposure to the Offshore Project Area because the combined average annual value of these landings in Mid-Atlantic states is much greater than New Jersey alone.

Table 7.4-12 identifies species with landings from the Lease Area. As shown in Table 7.4-12, this comparison indicates that the exposed annual average value of species harvested from the Lease Area is quite small. The average annual value of the most exposed species in the Lease Area, surf clam and smooth dogfish, represent approximately 2.8% and 1.6%, respectively, of those species' total average annual landings in New Jersey. The annual average value of most species harvested from the Lease Area is typically less than 0.4% of their annual average value in New Jersey.

### Table 7.4-12. Landed Value and Weight from the Lease Area, by Species (2017–2021)[1]

| Species | Lease Area Total All Years | | Lease Area Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value[2] | Weight (lbs) | Value[3] |
| Surf Clam (*Spisula solidissima*) | 2,246,936 | $1,509,932 | 449,387 | $301,986 | 10,053,361 | $10,967,503 |
| Sea Scallop (*Placopecten magellanicus*) | 46,348 | $531,605 | 9,270 | $106,321 | 8,956,015 | $89,865,116 |
| Summer Flounder (*Paralichthys dentatus*) | 19,783 | $82,157 | 3,957 | $16,431 | 1,484,302 | $4,843,407 |
| Menhaden (*Brevoortia* spp.) | 326,262 | $34,866 | 65,252 | $6,973 | 86,485,816 | $33,412,247 |
| Spiny Dogfish (*Squalus acanthias*) | 160,884 | $28,488 | 32,177 | $5,698 | 1,876,258 | $349,993 |
| Channeled Whelk (*Busycotypus canaliculatus*) | 2,873 | $26,218 | 575 | $5,244 | 19,189 | 1,320,488 |
| Smooth Dogfish (*Mustelus canis*) | 28,772 | $23,888 | 5,754 | $4,778 | 617,206 | $316,834 |
| Shortfin Squid (*Illex illecebrosus*) | 29,224 | $19,073 | 5,845 | $3,815 | 18,850,667 | $6,728,719 |
| Black Sea Bass (*Centropristis striata*) | 7,404 | $17,998 | 1,481 | $3,600 | 901,476 | $2,748,560 |
| Longfin Squid (*Doryteuthis* [Amerigo] *pealeii*) | 14,535 | $17,209 | 2,907 | $3,442 | 3,056,773 | $4,138,393 |
| Monkfish (*Lophius americanus*) | 7,566 | $10,676 | 1,513 | $2,135 | 1,422,953 | $1,196,940 |
| Skates | 20,813 | $10,008 | 4,163 | $2,002 | 2,488,682 | $463,462 |

| Species | Lease Area Total All Years | | Lease Area Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value[2] | Weight (lbs) | Value[3] |
| American Lobster (*Homerus americanus*) | 1,018 | $5,835 | 204 | $1,167 | 328,972 | $1,935,733 |
| Atlantic Mackerel (*Scomber scombrus*) | 14,999 | $5,650 | 3,000 | $1,130 | 4,374,320 | $866,547 |
| All Other Species[4] | 52,464 | $49,551 | 10,493 | $9,910 | - | - |
| **Total** | **2,979,881** | **$2,373,154** | **595,976** | **$474,631** | **-** | **-** |

[1]Source: NMFS, 2023.
[2]Nominal values of landings were updated to 2020 values by NMFS.
[3]Nominal values of landings provided by NOAA were updated to 2019 values using the Bureau of Labor Statistics, Producer Price Index for Commodity Code # 0223, Unprocessed, and Prepared seafood.
[4] According to NMFS (2023) data, "All Other Species" may include up to 135 different species with landings from the Lease Area.

Table 7.4-13 identifies species with landings from the Monmouth ECC. As shown in Table 7.4-13, the comparison of landings from the Monmouth ECC to total landings of the same species in New Jersey indicates that the exposed annual average value of species harvested from the Monmouth ECC is small. The average annual value of the most exposed species in the Monmouth ECC, spiny dogfish and smooth dogfish, represent approximately 3.3% and 3.1%, respectively, of those species' total annual average landings in New Jersey. The annual average value of most species harvested from the Monmouth ECC is less than 1.0% of their annual average value in New Jersey.

### Table 7.4-13. Landed Value and Weight from the Monmouth ECC, by Species (2016–2020)[1]

| Species | Monmouth ECC Total, All Years | | Monmouth ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Surf Clam (*Spisula solidissima*) | 440,388 | $293,476 | 88,527 | $59,074 | 17,042,392 | $6,851,634 |
| Sea Scallop (*Placopecten magellanicus*) | 10,229 | $108,018 | 2,046 | $21,604 | 10,158,339 | $102,507,798 |
| Summer Flounder (*Paralichthys dentatus*) | 22,449 | $95,933 | 4,490 | $19,187 | 1,362,090 | $5,021,409 |

| Species | Monmouth ECC Total, All Years | | Monmouth ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Monkfish (*Lophius americanus*) | 53,259 | $72,886 | 10,652 | $14,577 | 1,614,000 | $1,585,141 |
| Spiny Dogfish (*Squalus acanthias*) | 394,232 | $69,803 | 78,846 | $13,961 | 2,261,289 | $421,552 |
| Skates | 109,181 | $53,024 | 21,836 | $10,605 | 2,528,688 | $478,114 |
| Smooth Dogfish (*Mustelus canis*) | 64,687 | $48,767 | 12,937 | $9,753 | 601,855 | $310,246 |
| American Lobster (*Homerus americanus*) | 5,740 | $31,920 | 1,148 | $6,384 | 340,752 | $1,941,915 |
| Menhaden (*Brevoortia* spp.) | 205,016 | $23,818 | 41,003 | $4,764 | 80,967,480 | $16,139,757 |
| Black Sea Bass (*Centropristis striata*) | 5,973 | $17,269 | 1,195 | $3,454 | 784,116 | $2,634,831 |
| Bluefish (*Pomatomus saltatrix*) | 22,983 | $15,655 | 4,597 | $3,131 | 277,405 | $216,608 |
| Channeled Whelk (*Busycotypus canaliculatus*) | 935 | $7,665 | 234 | $1,916 | 26,158 | $156,964 |
| Atlantic Herring (*Clupea harengus*) | 30,982 | $6,502 | 8,428 | $1,757 | 3,174,986 | $233,821 |
| Longfin Squid (*Doryteuthis* [Amerigo] *pealeii*) | 4,560 | $6,345 | 912 | $1,269 | 3,701,593 | $5,056,500 |
| Atlantic Mackerel (*Scomber scombrus*) | 23,151 | $6,029 | 4,630 | $1,206 | 4,200,214 | $833,023 |
| All Other Species[4] | 20,986 | $21,138 | 4,550 | $4,736 | - | - |
| **Total** | **1,414,751** | **$878,248** | **286,031** | **$177,377** | **-** | **-** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3]Nominal values of landings provided by NOAA were updated to 2019 values using the Bureau of Labor Statistics, Producer Price Index for Commodity Code # 0223, Unprocessed, and Prepared seafood.

[4] According to NMFS (2021) data, "All Other Species" may include up to 133 different species with landings from the Monmouth ECC.

Table 7.4-14 identifies species with landings from the Asbury Branch of the Northern ECC. As shown in Table 7.4-14 the comparison of landings from the Asbury Branch of the Northern ECC to total landings of the same species in New Jersey indicates that the exposed annual average value of species harvested from the Asbury Branch of the Northern ECC is small. The average annual value of the most exposed species in the Asbury Branch of the Northern ECC, tautog and smooth dogfish, represent approximately 6.9% and 2.8%, respectively, of those species' total annual average landings in New Jersey. The annual average value of most species harvested from the Asbury Branch of the Northern ECC is less than 0.8% of their annual average value in New Jersey.

### Table 7.4-14. Landed Value and Weight from the Asbury Branch of the Northern ECC, by Species (2016–2020)[1]

| Species | Asbury ECC Total All Years | | Asbury ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Surf Clam (*Spisula solidissima*) | 241,541 | $161,130 | 48,374 | $32,270 | $59,074 | 17,042,392 |
| Summer Flounder (*Paralichthys dentatus*) | 29,985 | $128,726 | 5,997 | $25,745 | 1,362,090 | $5,021,409 |
| Monkfish (*Lophius americanus*) | 74,153 | $100,810 | 14,831 | $20,162 | 1,614,000 | $1,585,141 |
| Sea Scallop (*Placopecten magellanicus*) | 9,393 | $96,015 | 1,879 | $19,203 | 10,158,339 | $102,507,798 |
| American Lobster (*Homerus americanus*) | 11,735 | $62,955 | 2,347 | $12,591 | 340,752 | $1,941,915 |
| Spiny Dogfish (*Squalus acanthias*) | 243,187 | $46,081 | 48,637 | $9,216 | 2,261,289 | $421,552 |
| Smooth Dogfish (*Mustelus canis*) | 53,582 | $43,166 | 10,716 | $8,633 | 601,855 | $310,246 |
| Skates | 115,682 | $42,550 | 23,136 | $8,510 | 2,528,688 | $478,114 |
| Menhaden (*Brevoortia* spp.) | 246,481 | $30,779 | 49,296 | $6,156 | 80,967,480 | $16,139,757 |

| Species | Asbury ECC Total All Years | | Asbury ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Scup (*Stenotomus chrysops*) | 16,734 | $15,545 | 3,347 | $3,109 | 2,147,257 | $1,465,916 |
| Atlantic Herring (*Clupea harengus*) | 70,748 | $14,289 | 14,547 | $2,934 | 3,174,986 | $233,821 |
| Longfin Squid (*Doryteuthis* [Amerigo] *pealeii*) | 9,375 | $13,802 | 1,875 | $2,760 | 3,701,593 | $5,056,500 |
| Black Sea Bass (*Centropristis striata*) | 4,464 | $13,615 | 893 | $2,723 | 784,116 | $2,634,831 |
| Atlantic Mackerel (*Scomber scombrus*) | 40,993 | $10,071 | 8,199 | $2,014 | 4,200,214 | $833,023 |
| Bluefish (*Pomatomus saltatrix*) | 9,495 | $7,182 | 1,899 | $1,436 | 277,405 | $216,608 |
| Channeled Whelk (*Busycotypus canaliculatus*) | 577 | $4,712 | 144 | $1,178 | 26,158 | $156,964 |
| Tautog (*Tautoga onitis*) | 1,356 | $5,733 | 271 | $1,147 | 4,677 | $16,611 |
| All Other Species[4] | 23,722 | $27,146 | 5,053 | $5,872 | - | - |
| **Total** | **1,203,203** | **$824,307** | **241,441** | **$165,661** | **-** | **-** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3]Nominal values of landings provided by NOAA were updated to 2019 values using the Bureau of Labor Statistics, Producer Price Index for Commodity Code # 0223, Unprocessed, and Prepared seafood.

[4] According to NMFS (2021) data, "All Other Species" may include up to 131 different species with landings from the Asbury Branch of the Northern ECC.

Table 7.4-15 identifies species with landings from the Northern ECC. As shown in Table 7.4-15, the comparison of landings from the Northern ECC to total landings of the same species in New Jersey indicates that the exposed annual average value of species harvested from the Northern ECC is small. The average annual value of the most exposed species in the Northern ECC, tautog and smooth dogfish, represent approximately 9.4% and 3.1%, respectively, of those species' total annual average landings in New Jersey. The annual average value of most species harvested from the Northern ECC is less than 0.8% of their annual average value in New Jersey.

## Table 7.4-15. Landed Value and Weight from the Northern ECC, by Species (2016–2020)[1]

| Species | Northern ECC Total, All Years | | Northern ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Surf Clam (*Spisula solidissima*) | 307,692 | $205,259 | 61,538 | $41,052 | $59,074 | 17,042,392 |
| Summer Flounder (*Paralichthys dentatus*) | 34,301 | $147,536 | 6,860 | $29,507 | 1,362,090 | $5,021,409 |
| Monkfish (*Lophius americanus*) | 92,559 | $125,928 | 18,512 | $25,186 | 1,614,000 | $1,585,141 |
| Sea Scallop (*Placopecten magellanicus*) | 11,636 | $119,045 | 2,330 | $23,839 | 10,158,339 | $102,507,798 |
| American Lobster (*Homerus americanus*) | 13,476 | $72,275 | 2,695 | $14,455 | 340,752 | $1,941,915 |
| Spiny Dogfish (*Squalus acanthias*) | 295,502 | $56,076 | 59,107 | $11,217 | 2,261,289 | $421,552 |
| Skates | 139,849 | $51,241 | 27,970 | $10,248 | 2,528,688 | $478,114 |
| Smooth Dogfish (*Mustelus canis*) | 59,838 | $48,846 | 11,968 | $9,769 | 601,855 | $310,246 |
| Menhaden (*Brevoortia* spp.) | 333,326 | $41,703 | 73,704 | $9,236 | 80,967,480 | $16,139,757 |
| Longfin Squid (*Doryteuthis* [Amerigo] *pealeii*) | 11,335 | $44,630 | 5,955 | $8,926 | 3,701,593 | $5,056,500 |
| Scup (*Stenotomus chrysops*) | 21,078 | $19,901 | 4,216 | $3,980 | 2,147,257 | $1,465,916 |
| Black Sea Bass (*Centropristis striata*) | 5,460 | $16,614 | 1,092 | $3,323 | 784,116 | $2,634,831 |

| Species | Northern ECC Total, All Years | | Northern ECC Annual Average | | New Jersey Annual Average | |
|---|---|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value | Weight (lbs) | Value[3] |
| Atlantic Herring (*Clupea harengus*) | 80,530 | $16,368 | 16,213 | $3,298 | 3,174,986 | $233,821 |
| Atlantic Mackerel (*Scomber scombrus*) | 47,096 | $11,679 | 9,430 | $2,339 | 4,200,214 | $833,023 |
| Bluefish (*Pomatomus saltatrix*) | 10,758 | $8,256 | 2,152 | $1,651 | 277,405 | $216,608 |
| Tautog (*Tautoga onitis*) | 1,829 | $7,813 | 366 | $1,563 | 4,677 | $16,611 |
| Channeled Whelk (*Busycotypus canaliculatus*) | 736 | $6,015 | 184 | $1,504 | 26,158 | $156,964 |
| All Other Species[4] | 68,899 | $78,376 | 14,424 | $16,160 | - | - |
| **Total** | **1,535,900** | **$1,077,561** | **318,716** | **$217,254** | **-** | **-** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3]Nominal values of landings provided by NOAA were updated to 2019 values using the Bureau of Labor Statistics, Producer Price Index for Commodity Code # 0223, Unprocessed, and Prepared seafood.

[4] According to NMFS (2021) data, "All Other Species" may include up to 131 different species with landings from the Northern ECC.

Tables 7.4-16 through 7.4-19 identify landings by gear type from the Lease Area, the Monmouth ECC, the Northern ECC and the Asbury Branch of the Northern ECC. In accordance with confidentiality requirements, certain species were combined by NMFS and are identified as "All Other Gear." As part of this analysis, any species with annual average landings from the Offshore Project Area of less than $1,000 were added to the combined confidential landings.

### Table 7.4-16. Landed Value and Weight from the Lease Area, by Gear Type (2017–2021)[1]

| GEAR TYPE | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Clam Dredge | 2,271,857 | $1,533,004 | 454,371 | $306,601 |
| Scallop Dredge | 46,273 | $529,207 | 9,255 | $105,841 |
| Bottom Trawl | 101,415 | $136,268 | 20,283 | $27,254 |
| Sink Gillnet | 301,937 | $71,065 | 60,387 | $14,213 |
| Pot, Other | 5,796 | $22,139 | 1,159 | $4,428 |
| Gillnet, Other | 7,604 | $5,409 | 1,521 | $1,082 |
| All Others Gear[3] | 245,178 | $76,174 | 49,036 | $15,235 |
| **TOTAL** | **2,980,060** | **$2,373,266** | **596,012** | **$474,653** |

[1]Source: NMFS, 2023.

[2]Nominal values of landings were updated to 2020 values by NMFS.

[3] According to NMFS (20231) data, "All Other Gear" may include up to 10 different gear types with landings from the Lease Area.

### Table 7.4-17. Landed Value and Weight from the Monmouth ECC, by Gear Type (2016–2020)[1]

| GEAR TYPE | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Clam Dredge | 445,668 | $298,590 | 89,967 | $60,445 |
| Sink Gillnet | 587,952 | $238,140 | 117,590 | $47,628 |
| Bottom Trawl | 62,547 | $118,562 | 12,509 | $23,712 |
| Scallop Dredge | 10,008 | $104,553 | 2,033 | $21,273 |
| Lobster Pot | 6,943 | $30,709 | 1,389 | $6,142 |
| Midwater Trawl | 38,763 | $7,026 | 19,382 | $3,513 |
| Other Pot | 4,507 | $14,455 | 946 | $3,028 |
| Other Gillnet | 6,091 | $7,348 | 8,718 | $2,511 |
| All Other Gear[3] | 232,567 | $59,084 | 46,591 | $12,029 |
| **Total** | **1,395,046** | **$878,467** | **299,125** | **$180,281** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, "All Other Gear" may include up to eight different gear types with landings from the Monmouth ECC.

## Table 7.4-18. Landed Value and Weight from the Asbury Branch of the Northern ECC, by Gear Type (2016–2020)[1]

| GEAR TYPE | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Sink Gillnet | 373,315 | $201,825 | 74,663 | $40,365 |
| Bottom Trawl | 157,267 | $194,514 | 31,453 | $38,903 |
| Clam Dredge | 243,897 | $163,874 | 48,856 | $32,834 |
| Scallop Dredge | 9,267 | $93,822 | 1,866 | $18,885 |
| Lobster Pot | 18,287 | $68,315 | 3,657 | $13,663 |
| Midwater Trawl | 89,112 | $16,509 | 31,523 | $5,845 |
| Other Pot | 2,267 | $7,542 | 568 | $1,888 |
| Other Gillnet | 13,554 | $5,554 | 4,518 | $1,851 |
| Handline | 1,535 | $5,107 | 307 | $1,021 |
| All Other Gear[3] | 294,945 | $67,363 | 58,989 | $13,473 |
| **Total** | **1,203,446** | **$824,425** | **256,400** | **$168,729** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, “All Other Gear” may include up to seven different gear types.

## Table 7.4-19. Landed Value and Weight from the Northern ECC, by Gear Type (2016–2020)[1]

| GEAR TYPE | Total, All Years | | Annual Average | |
|---|---|---|---|---|
| | Weight (lbs) | Value[2] | Weight (lbs) | Value |
| Sink Gillnet | 449,510 | $244,105 | 89,962 | $48,880 |
| Bottom Trawl | 86,773 | $226,918 | 37,355 | $45,384 |
| Clam Dredge | 310,598 | $208,615 | 62,120 | $41,723 |
| Scallop Dredge | 1,515 | $116,681 | 2,303 | $23,336 |
| Lobster Pot | 1,141 | $78,517 | 4,228 | $15,703 |
| Midwater Trawl | 100,050 | $18,502 | 33,506 | $6,199 |
| Other Pot | 2,878 | $9,579 | 720 | $2,395 |
| Other Gillnet | 17,301 | $7,090 | 5,767 | $2,363 |
| Handline | 1,993 | $6,651 | 399 | $1,330 |
| All Other Gear[3] | 434,444 | $131,852 | 86,889 | $26,370 |
| **Total** | **1,406,203** | **$1,048,510** | **323,249** | **$213,683** |

[1]Source: VTR data provided by NMFS, 2022.

[2]Nominal values of landings were updated to 2019 values by NMFS.

[3] According to NMFS (2021) data, "All Other Gear" may include up to seven different gear types.

## Summary

The quantitative assessment of commercial fishing activity and value within the Lease Area described in Section 7.4.2.4 was conducted using VTR data provided by NMFS; this quantitative assessment was also informed by assessments of fishing activity using VMS and AIS data. As described in Section 7.4.2.1, while VTR data used in this quantitative assessment represent the best available data, it is recognized that there are some limitations associated with VTR data and that they do not provide a complete picture of the value or intensity of any one fishery, particularly for lobster and Jonah crab because vessels that fish exclusively for these two species are not required to file VTRs. Available VTR and VMS data indicate that relatively little commercial fishing effort for lobster and Jonah crab occur in the Lease Area. This suggests that the VTR data provide a reasonable estimate of economic exposure within the Lease Area.

As noted in Section 7.4.2, estimates of the economic value of commercial fishing activity in the Lease Area represents the potential economic exposure, or maximum potential economic value, of commercial fisheries and do not represent actual or expected economic impacts. It is anticipated that most, if not all, historical fishing effort in the Lease Area can be maintained throughout the construction, O&M, and decommissioning of the Project.

Based on the preceding assessment of VTR data, approximately $5.0 million of total landings (approximately $1.0 million per year) were harvested from the Offshore Project Area from 2016 to 2021. This analysis indicates that:

- Approximately $475,000 of total landings per year were harvested from the Lease Area;
- Approximately $180,000 of total landings per year were harvested from the Monmouth ECC.
- Approximately $170,000 of total landings per year were harvested from the Asbury Branch of the Northern ECC.
- Approximately $220,000 of total landings per year were harvested from the Northern ECC.

Surf clams are the highest revenue producing and most exposed species in the Lease Area, and account for approximately 63.6% of average annual revenue from the Lease Area. Landings along the ECCs are also predominately surf clams.

The sea scallop fishery, although not highly exposed within the Lease Area due, in part, to the high value of this fishery, is the second highest revenue species and accounts for 22.4% of average annual revenue in the Lease Area. Based on ongoing communication between commercial scallop fishermen and the Atlantic Shores FLO, little scallop fishing activity is understood to occur within the Lease Area.

The ports most affected as measured by total revenue are likely those that process surf clams in the region—Atlantic City, NJ, New Bedford, MA, and Cape May, NJ. In general, and over a two-decade period, surf clam landings have been declining in the Mid-Atlantic region, although this fishery is still active in the Offshore Project Area. Trends in the surf clam fishery show that warming waters of the Mid-Atlantic Bight have resulted in the commercial fishing effort for this fishery shifting northward and farther offshore into deeper waters (Hofmann et al. 2018). The fishery's response to this trend, primarily the relocation of fishing effort and processing capacity to the species more northerly range, has concentrated fishing pressure in the area immediately south of the Hudson Canyon resulting in decreased stock in the nearshore areas surrounding the Lease Area (Hofmann et al. 2018). A decline in landings per unit effort has resulted, meaning additional cost to the vessel operator and more fishing effort expended to land the same volume of surf clam. However, over the past decade, the total number of vessels participating in this fishery has remained relatively stable, as there has been very little change in the volume and value of landings and the numbers of vessels and dealers participating in this fishery. The shift of surf clams into deeper water has also contributed to mixing of surf clam within shellfish beds where the predominant species was ocean quahog, increasing the likelihood of co-occurrence during harvesting (Hofmann et al. 2018).

Landings, VTR, and VMS data do not fully explain the dynamic factors that influence landings and revenue. Although the effects of these factors may be reflected in the resulting reported revenue and landing, these data do not explain why catch may be high or low at any point in time, nor do they necessarily indicate either a high or low abundance of species. In addition, management of fisheries, including annual quotas for target and bycatch species, geographic and/or fisheries closures, and permit restrictions each influence fisheries landings and revenues, as do economic factors of market prices and supply, O&M costs, and quota and permit lease prices. Environmental conditions, such as water temperature, are also significant factors in the productivity of commercial fisheries. As a result, the locations of commercial fishing efforts are variable.

### 7.4.3 Assessment of For-Hire Recreational Fishing Effort

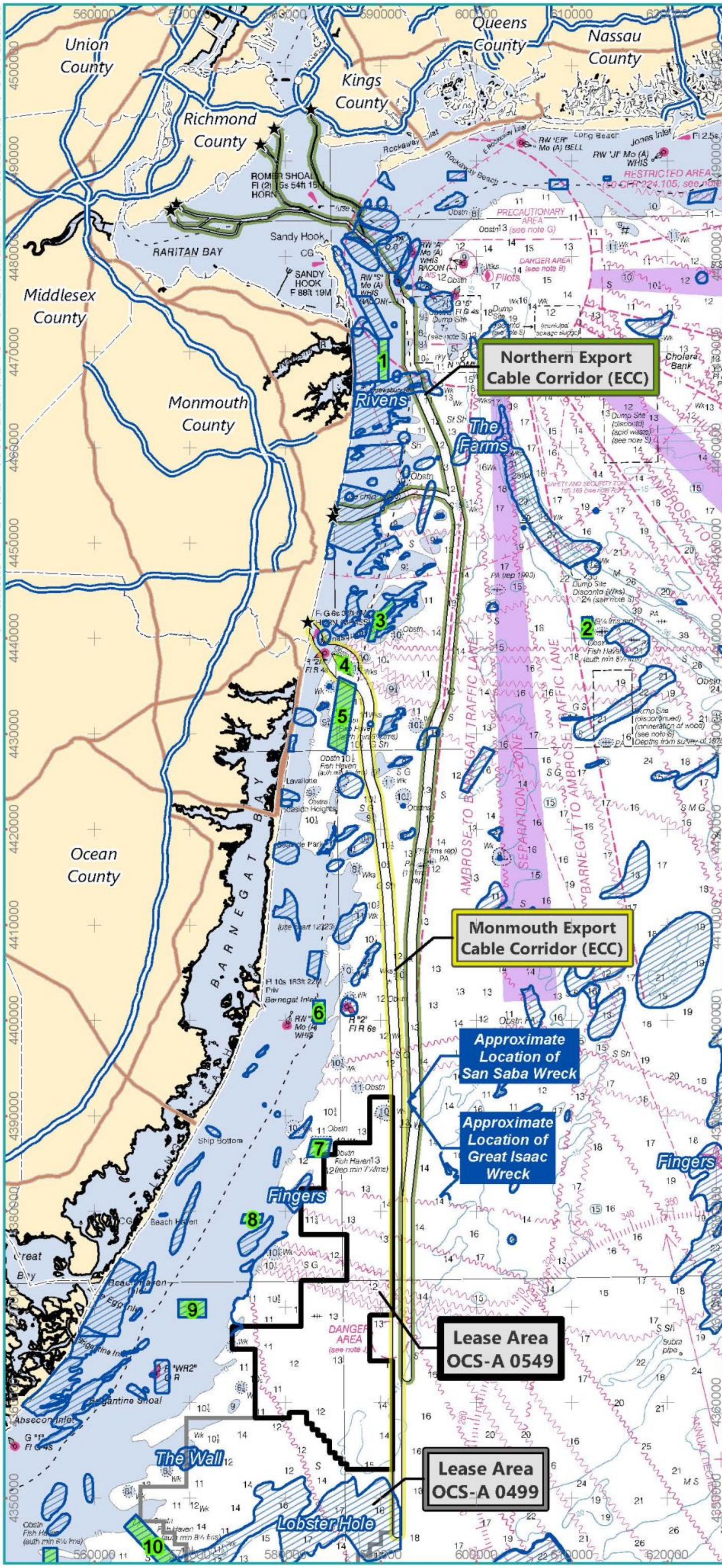
For-hire recreational fishing has important cultural and economic value in the Mid-Atlantic region, including within the Offshore Project Area. The entire near-coastal region and, more specifically, numerous locations off the coast of New Jersey and New York host species targeted by for-hire recreational fishing operations.

Figure 7.4-16 identifies the "prime" fishing grounds within the Offshore Project Area and locations of artificial reefs constructed in proximity to the Lease Area and ECCs. Prime fishing grounds are known fishing target locations and areas frequented by recreational fishermen. Altantic Shores has done preliminary routing of the ECCs to avoid these areas to the extent practicable and continues to evaluate for-hire recreational fishing effort within the Offshore Project Area and anticipates providing additional data on those fisheries in a future COP supplement.

Atlantic Shores has engaged with the recreational fishing industry to collect data directly from the fishing community on important recreational fishing areas. Atlantic Shores has hired a local, New Jersey fishermen to serve as its Recreational FIR. One of the first tasks completed by Atlantic Shores

Recreational FIR during October of 2020 was to speak to a group of experienced recreational fishermen about their key fishing areas in the NJWEA. This initial map formed the basis of Atlantic Shores' understanding of important recreational fishing areas.

To further understand important areas for recreational fishermen, Atlantic Shores has held meetings with recreational fishermen to gather information on important recreational fishing grounds. At these meetings, the maps created in October of 2020 were shared to all the attendees. Representatives of Atlantic Shores walked through each layer of the maps: NOAA base map, detailed bathymetry at 1 fathom increments, and the key fishing areas. No other feedback was given, other than to agree that the highlighted areas were correct. These data gathering efforts broadly corroborate the locations of prime fishing grounds shown on Figure 7.4-16.




ATLANTIC SHORES offshore wind


0 2.5 5 10 Miles
0 3 6 12 Kilometers

*Basemap: Nautical Chart 12300, NOAA (Fathoms)*
*Map Projection: NAD 1983 UTM Zone 18N (Meters)*
*Data: National Marine Fisheries Service (NMFS) Vessel Trip Report (VTR), Mid-Atlantic Regional Council on the Ocean (MARCO)*

**LEGEND**

- Trenchless Crossing Entry/Exit Point
- Potential Landfall
- Lease Area OCS-A 0549
- Lease Area OCS-A 0499
- Monmouth Export Cable Corridor (ECC)
- Northern Export Cable Corridor (ECC)
- Trenchless Interconnection Cable Route
- Federal and State Waters Boundary
- Prime Fishing Grounds
- Artificial Reef Sites

| ID | Artificial Reef |
|---|---|
| 1 | Sandy Hook |
| 2 | Shark River |
| 3 | Sea Girt |
| 4 | Manasquan Inlet |
| 5 | Axel Carlson |
| 6 | Barnegat Light |
| 7 | Garden State North |
| 8 | Garden State South |
| 9 | Little Egg |
| 10 | Atlantic City |

**Figure 7.4-16**

*New Jersey Prime Fishing Grounds and Artificial Reefs (NJ DEP Data)*

Between 2017 and 2021, an annual average of 166,556 angler trips were estimated to occur on for-hire recreational vessels in State and Federal waters off the coast of New Jersey and an annual average of 162,632 occurred in State and Federal waters of the coast of New York (NOAA MRIP 2021). According to MRIP (2021) data, between 2017 and 2021, the primary species landed by for-hire vessels in New Jersey waters were black sea bass, summer flounder, and scup. In New York waters, the primary species landed by for-hire vessels during those same years were scup, black sea bass, and red hake. It is presumed that for-hire vessels from both New Jersey and New York fish within the Offshore Project Area.

A regional assessment of the economic contribution of for-hire charter/headboat operators is available for the Atlantic and Gulf of Mexico coasts from Maine to Texas for the period of July to November 2013 (Hutt and Silva 2015). Along the stretch of Atlantic coast from Maine to Virginia (referred to as the Northeast), an estimated 4,936 charter trips that targeted Atlantic Highly Migratory Species (HMS) occurred from July to November 2013. Hutt and Silva (2015) estimated a total of $12.1 million in gross revenue in the Northeast from July to November 2013, of which $7.3 million was used for trip expenses (fuel, crew, bait, supplies, etc.) and $4.8 million was for owner net return and operation costs. Because these numbers represent the 2013 value of for-hire charter/headboat fishing along the Atlantic coast from Maine to Virginia, only a fraction of this revenue is likely generated in the Offshore Project Area.

The average fee in the Northeast per charter boat trip was $2,450; after accounting for expenditures, the average net return was estimated at $969 per charter boat trip. The average fee in the Northeast per headboat trip was $6,973; after accounting for expenditures, the average net return was estimated at $2,305 per headboat trip (Hutt and Silva 2015).

New Jersey and New York also host several offshore fishing tournaments each year. These events primarily occur in the summer months and are geared toward anglers targeting HMS, which include federally regulated sharks, blue and white marlin, sailfish, roundscale spearfish, swordfish, and federally regulated tunas including bluefin, yellowfin, bigeye, skipjack, and albacore in the Atlantic, Gulf of Mexico, and Caribbean.

### 7.4.4 Potential Impacts and Proposed Environmental Protection Measures

Atlantic Shores recognizes the importance of commercial and for-hire recreational fisheries and is working to ensure co-existence and minimize potential effects. As part of those efforts, Atlantic Shores has developed a Gear Loss Avoidance Program to avoid fishing gear loss at all phases of the Project. This Program includes direct outreach by the FLO and FIR to fishermen and use of scout boats operated by local fishermen to identify fishing gear located within areas of Project activity. Once the gear is identified, Atlantic Shores avoids identified fishing gear or works with fishermen to remove or relocate the gear. This plan also allows for agreements to temporarily delay Project activities until fishing is completed. Lastly, in the unlikely event that gear is lost or damaged, a gear loss form and policy is available on the "For Mariners" portion of the Project's website. During 2 years of survey efforts (in 2019 and 2020), Atlantic Shores has successfully implemented its Gear Loss Avoidance Program to minimize interactions with fishing gear, by adjusting survey plans to avoid areas of active fishing, communicating with fishermen to remove gear prior to temporary survey activities in the area, and mitigating gear loss.

Atlantic Shores is also committed to finding ways to integrate fishermen into the Project by planning and executing economic opportunities. Atlantic Shores is already employing local fishermen and their facilities for gear scouting in advance of survey vessels and for dock-side vessel support. Atlantic Shores is pursuing avenues to help fishermen meet Atlantic Shores' health, safety, security, and environmental protection (HSSE) standards for vessels and workforce, so that they can be eligible to apply as contractors to support environmental surveys as well as Project construction and O&M activities. In September 2020, Atlantic Shores distributed a formal Request for Interest (RFI) to identify fishing businesses that had available docks and port real estate to support the Project; Atlantic Shores received strong responses from four local fishing companies, indicating that the fishing industry does find valuable economic opportunities in the offshore wind industry. Atlantic Shores is continuing to advance opportunities for local fishermen to work on the Project.

Atlantic Shores recognizes that Project activities may have an effect on commercial and for-hire recreational fisheries. The potential IPFs which may affect commercial fisheries and for-hire recreational fishing during Project construction, O&M, or decommissioning are presented in Table 7.4-20. This section focuses on those IPFs that may affect commercial and for-hire recreational fishing activity within the Lease Area and ECCs. Based on its ongoing outreach with commercial and for-hire recreational fishermen, Atlantic Shores also understands that commercial fishermen are concerned about potential biological effects to finfish and invertebrates, including potential effects from electromagnetic fields, noise, suspended sediment, and possible changes in prey abundance. An assessment of potential biological effects is presented in detail in Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat, which concludes that most Project effects are localized, short-term, and unlikely to cause population level effects.

### Table 7.4-20. Impact Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel Traffic | ● | ● | ● |
| Presence of Structures | ● | ● | ● |
| Installation and Maintenance of New Structures and Cables | ● | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for potential effects to commercial fisheries and for hire recreational fishing is the maximum offshore build-out of the Project (as defined in Section 4.11 of Volume I), assuming the use of all piled foundations for the assessment of pile driving noise.

#### 7.4.4.1 Vessel Traffic

Commercial and for-hire fishing vessels active in the Offshore Project Area, either engaged in fishing (i.e., fishing gear deployed) or transiting between ports and fishing grounds, may be affected by the presence of Project vessels. As described in detail in Section 7.6 Navigation and Vessel Traffic, a minor increase in vessel traffic will occur during construction, O&M, and decommissioning. Approximately two to six vessel round trips per day are expected during construction and O&M. As described in Sections 4.10.3 and 5.5 of Volume I, vessels used for construction and O&M will operate primarily from ports with little commercial fishing activity. Consequently, competition for dock- and shore-side services within these ports is not expected to affect commercial fishing activities. Further, the Project's use of vessels may present additional economic opportunities for commercial fishermen. Through an RFI in September 2020, Atlantic Shore identified multiple ports that would like to support O&M with fuel, repairs, storage, and meeting space. Atlantic Shores has already begun using local commercial fishing facilities for docking and shore-side services and will continue to seek further opportunities to do so.

To minimize the Project's potential effects to commercial and for-hire recreational fishing from increased vessel traffic, Atlantic Shores will establish a Marine Coordinator who will be charged with monitoring daily vessel movements, implementing communication protocols with external vessels both in port and offshore to avoid conflicts, and monitoring safety zones. Communications will begin prior to construction and will continue throughout the construction process. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. To provide construction zone control, the Marine Coordinator will employ radio communications and safety vessels to address any vessels entering the construction zone.

The Marine Coordinator will be responsible for coordinating with the U.S. Coast Guard (USCG) for any required Notices to Mariners (NTMs), and during construction will be the primary point of contact with the USCG, port authorities, State and local law enforcement, marine patrol, port operators, and commercial and for-hire fishing vessel operators. Mariners will be informed of construction activities, including the anticipated locations of those activities by the Marine Coordinator, allowing vessels to alter their navigation routes if needed to avoid affected areas.

Atlantic Shores is committed to maintaining communication, coordination, and involvement with commercial and for-hire recreational fishermen to keep them informed of Project activities and associated vessel traffic. Atlantic Shores has developed a Fisheries Communication Plan (see Appendix II-R) that defines outreach and engagement with commercial and for-hire recreational fishermen during all phases of the Project, from development through decommissioning. This plan promotes the safety of those working and fishing in the Offshore Project Area, obtains community input to address existing data gaps on fisheries in the Lease Area, identifies effects to fishermen and ways these can be avoided and mitigated, resolves conflicts, and builds relationships with local fisheries to inform responsible design and operation of the Project.

To support the execution of the Fisheries Communication Plan, Atlantic Shores utilizes its FLO and its Recreational FIR. Captain Kevin Wark, a commercial New Jersey fisherman, has been hired by Atlantic Shores to serve as the FLO. The FLO acts as a representative of Atlantic Shores and a liaison to the fishing community to help reconcile potential issues and facilitate the exchange of information. Captain Adam Nowalski, a licensed fishing captain, has been hired by Atlantic Shores as the Recreational FIR and represents the recreational fishing industry.

Atlantic Shores' FIR is conducting extensive outreach to recreational fishing stakeholders to better understand how recreational fishing is pursued in the Offshore Project Area. During the winter of 2021, Atlantic Shores held two open houses with members of the recreational fishing industry to present details of the Project, gather input on key concerns, and to identify potential collaborative research efforts. Atlantic Shores' outreach efforts continue with one-on-one meetings with stakeholders to better understand fishermen's concerns and to familiarize New Jersey fishermen with the Project.

The FLO also works to implement the Gear Loss Avoidance Program developed by Atlantic Shores. Prior to and throughout any marine operations, Atlantic Shores works with our FLO to canvas the Offshore Project Area for fixed fishing gear that could interact with Project-related activites, including the scouting of survey vessel routes to avoid negative gear interactions with fishermen. All gear is either catalogued for avoidance, or, if the gear owner can be positively identified, the FLO will engage with the fishermen to establish the procedures for avoidance, and if possible, temporary relocation of the gear. The fishermen are also informed of the process for filing claims associated with lost or damaged gear should an interaction inadvertently occur.

In addition to supporting the Gear Loss Avoidance Program, Atlantic Shores, its FLO, and its FIR employ an array of strategies to engage the fishing community including, but not limited to:

- **A "For Mariners" Project Webpage:** Atlantic Shores established a webpage specifically for commercial and recreational fishermen and boaters containing Project information, real-time buoy data (wind, wave, pressure, and temperature), live vessel schedules and tracking charts, and relevant contact information. This website offers opportunities to submit feedback as well (www.atlanticshoreswind.com/mariners/).
- **Communication and Distribution of Project Updates:** Throughout each stage of the Project, a NTM is published on the Project website and distributed to local docks to show the development area on local nautical charts and a description of active activities, timelines, and relevant contact information. Additionally, announcements and updates will be shared with print, online, and local news outlets, as well as through an email distribution list. A 24-hour phone line has been established to address real-time conflicts and safety concerns.
- **USCG Communication:** A Marine Coordinator will be employed as Atlantic Shores' primary point of contact with the USCG, port authorities, State and local law enforcement, marine patrol, port operators, and commercial operators. An emergency response plan will be developed in coordination with the USCG and communication protocols will be established. The Marine Coordinator will monitor daily vessel movements and will enforce temporary safety zones demarcated around working areas.

- **Meetings and Community Involvement:** Atlantic Shores intends to again commence meetings, open houses, and webinars with local fishermen, gear representatives, professional fisheries organizations, and fishing clubs as a means of introducing the Project to a wide audience and soliciting feedback. Atlantic Shores has previously conducted public open houses for the Project and will establish "Port Hours" with an open-door policy in local ports to encourage local engagement starting later in the third or fourth quarter of 2022. Atlantic Shores and its representatives are also actively attending industry-sponsored meetings (e.g., RODA [Responsible Offshore Development Alliance] and ROSA) and meetings with Federal agencies (e.g., BOEM, NMFS), regional fisheries management councils (e.g., MAFMC, NEFMC) and NJDEP to stay well-informed of the industry status, needs, and concerns at the Project and regional levels.
- **Fishing Tournaments:** Atlantic Shores will participate in commercial and recreational fishing conferences and trade shoes and will identify tournaments and dates, engage with organizers, share operational plans, and contact information, and identify and monitor the VHF channel used by the tournament to minimize Project traffic in these locations and raise awareness of project vessel activity.

The methods outlined in the Atlantic Shores Fisheries Communication Plan (See Appendix II-R) have been implemented since early 2019 in support of the Project site assessment and site characterization activities in the Offshore Project Area. Proactive communication, supported by both the FLO and Recreational FIR, has allowed Atlantic Shores to work with the fishing community to temporarily relocate gear to avoid interactions, appropriately site and route Atlantic Shores facilities to avoid areas of concentrated fishing activity to the maximum extent practicable, and schedule Project activities to avoid interactions with local fishing operations.

#### 7.4.4.2 Installation and Maintenance of New Structures and Cables

Installation and maintenance of new structures and cables within the Lease Area and ECCs (the area of seafloor disturbance during construction is described in Section 4.5.10 of Volume I) may cause temporary disruptions to commercial and for-hire recreational fishing activities. During all Project phases, Atlantic Shores will adhere to its Fisheries Communication Plan (see Section 7.4.4.1 and Appendix II-R) and the Gear Loss Avoidance Program and will reach out to its fishing industry contacts to avoid and minimize interactions with fishing vessels and gear via the outreach and coordination mechanisms described in Section 7.4.4.1.

Construction and support vessels will be present within the Lease Area and ECCs during pre-installation and installation activities for WTGs, offshore substation (OSS) positions, offshore cables (export, inter-array, and inter-link), and other Project components. It is anticipated that temporary safety zones will be established around Project construction vessels and installation activities, which may temporarily disrupt transit and access to fishing grounds that are within or in proximity to temporary safety zones. Installation of the offshore cables may temporarily restrict deployment of fishing gear within the Lease Area and along the ECCs. The duration of any such effects depends, in part, on the installation method selected but, regardless of installation method, only a limited area surrounding the immediate installation activity will be affected at any given time, leaving surrounding areas available for commercial and for-hire recreational fishing activities. Installation methods and timeframes are described in Sections 4.1 and 4.5 of Volume I. For the ECCs, it is anticipated that the duration of construction will be on the order of several months. These areas of restricted activity will be clearly communicated to the fishing community via the outreach and coordination methods described in Section 7.4.4.1. During any marine operation, Atlantic Shores will follow its Gear Loss Avoidance Program to identify and minimize interactions with fishing gear.

As a result of pre-installation and installation activities, some fishing vessels may temporarily elect to fish in other locations. Electing to fish in other locations may incur additional operating costs if those locations are more distant and/or some vessels may experience lower revenue if those locations are less productive, though available data suggest productive fishing areas are available in the area immediately surrounding the Lease Area, as evidenced by mapping of VMS data for those fishing shown in Figure 7.4-8 and Figure 7.4-15. Any such effects are anticipated to be temporary. It is expected that commercial fishing vessels transiting the Offshore Project Area will be able to avoid cable installation vessels and safety zones though routine adjustments to planned navigation routes.

During O&M, routine (e.g., annual surveys) and non-routine (e.g., cable reburial) maintenance procedures will occur (see Section 5.0 of Volume I). Many maintenance activities will be based on the WTGs or OSSs and will not require in-water work other than vessels transporting technicians. More significant and less frequent maintenance procedures may require in-water work and vessels to support those procedures. When necessary, temporary safety zones will be established around maintenance vessels and activities; however, O&M activities will be on a much smaller scale than during construction. Like construction, commercial fishing vessels transiting the Offshore Project Area would be expected to avoid any limited vessels and safety zones though routine adjustments to planned navigation routes.

Installation and maintenance of new structures and cables may also have the potential to affect commercially significant species through temporary increases in suspended sediments and habitat alteration. These potential effects are described in Section 4.6 Finfish, Invertebrates, and Essential Fish Habitat.

During decommissioning, the Project WTGs and OSSs will be removed. The offshore cables may be retired in place or removed. If offshore cable removal is required, the cables will be removed from their embedded position in the seabed and reeled up onto barges or vessels. Effects from Project decommissioning are expected to be like those experienced during construction.

#### 7.4.4.3 Presence of Structures

The presence of structures (including WTGs, OSSs, offshore cables, scour protection, and cable protection) may affect navigation within the Lease Area by commercial and for-hire recreational fisheries; however, the layout has been developed to accommodate vessel transit to local fishing ports and offshore fishing grounds. Additionally, the Lease Area and ECCs will be open to marine traffic during O&M, and no permanent restrictions to commercial or for-hire recreational fishing are proposed. As stated, limited restrictions may occur during some maintenance activities where temporary safety zones may be established around maintenance vessels and activities.

Atlantic Shores is siting Project infrastructure to avoid concentrated areas of fishing activity to the maximum extent practicable. Prior to the segregation of Lease Area OCS-A 0549 from Lease Area OCS-A 0499, an independent study was conducted by Last Tow LLC on behalf of representatives of the New Jersey surf clam industry to provide Oceanside Marine (a clam fishing fleet based in Atlantic City) and LaMonica Fine Foods (a seafood processor in Millville, New Jersey) with a better understanding of fishing vessel traffic characteristics within the original Lease Area (Azavea 2020). Azavea (2020) found that fishing density is low within the Lease Area (Figure 7.4-17).

Atlantic Shores has developed the layout of the Project in consideration of commercial fishing patterns and in close coordination with the surf clam/quahog dredging fleet, which is the predominant commercial fishery within the Lease Area. The Azavea (2020) ana lysis is based on 2008-2019 Vessel Monitoring System (VMS) data for several surf clam/quahog fishing vessels that operate in the Lease Area, the study found that a significant majority of fishing vessel traffic (towing and transiting) had headings between east to west and east-northeast to west-southwest (with an average heading of 80 degrees from true north). This finding was supported by an analysis of VMS data for period 2014 to 2019 conducted by BOEM for original Lease Area as well as by an analysis of six years (2016-2021) of Automatic Identification System (AIS) data, as described in Section 7.6 of Volume II which showed that 46% of fishing vessels transit the Lease Area along tracks that range in orientation between east to west and northeast to southwest (Figures 7.4-18 and 7.4-19). The remaining fishing vessel traffic (approximately 34%) and a significant proportion of the recreational vessel traffic transit north to south; this traffic will be accommodated by the approximately north to south corridors. The study resulted in a consistent layout of facilities with east – northeast and west – southwest transit corridors across both Lease Area OCS-A 0549 and OCS-A 0499.[65]

The findings of Azavea (2020) were corroborated by the analysis of three years (2017-2019) of AIS data which showed that approximately half (46%) of fishing vessels transit the Lease Area along tracks that range in orientation from east to west and northeast-southwest. While the primary direction of fishing vessel traffic varies somewhat across the Lease Area (a northeast to southwest heading is more frequent in the northern portion of the Lease Area whereas a southeast to northwest heading is more common farther south, primarily within Lease Area OCS-A 499), commercial fishermen have indicated a preference for a uniform layout across the Lease Area.

Based upon consultations with commercial fishermen and analyses of VMS and AIS data, including Azavea (2020), The WTGs for the Project will be aligned in a uniform grid with multiple lines of orientation allowing straight transit through the Lease Area. The uniform grid is a continuation of the grid area of the adjacent lease area to ensure continuity between projects and to facilitate vessel traffic between the projects. The primary east-northeast to west-southwest transit corridors through the Lease Areas were selected to align with the predominant flow of vessel traffic; accordingly, WTGs will be placed along east-northeast to west-southwest rows spaced 1.0 nautical mile (nm) (1.9 km) apart to allow for two-way vessel movement (see Figure 1.1-2). The proposed grid also facilitates north to south transit by positioning WTGs along rows in an approximately north to south direction spaced 0.6 nm (1.1 km) apart. The WTG grid will also create diagonal corridors of 0.54 nm (1.0 km) running

[65] The north to south rows are oriented at 357 degrees true north.

approximately northwest to southeast as well as diagonal corridors of 0.49 nm (0.9 km) running approximately north-northeast to south-southwest..

USCG recommended guidelines for corridor spacing to allow two-way transit (USCG 2020) include two navigation paths that are each four vessel lengths wide, two collision avoidance zones that are each 1.5 vessel lengths wide, two safety margins that are each six vessel lengths wide, and a 164 ft (50 m) or 820 ft (250 m) safety zone around each WTG (Figure 7.4-20). Under these guidelines, the 1 nm (1.9 km) east-northeast corridors are sufficiently sized to accommodate all sizes of fishing vessels currently transiting through the Lease Area. The 0.6 nm (1.1 km) and 0.54 nm (1.0 km) corridors are sufficiently sized to accommodate between 25% and 98% of the fishing vessels currently transiting through the Lease Area, depending on whether the additional safety buffer is assumed to be 164 ft (50 m) or 820 ft (250 m).

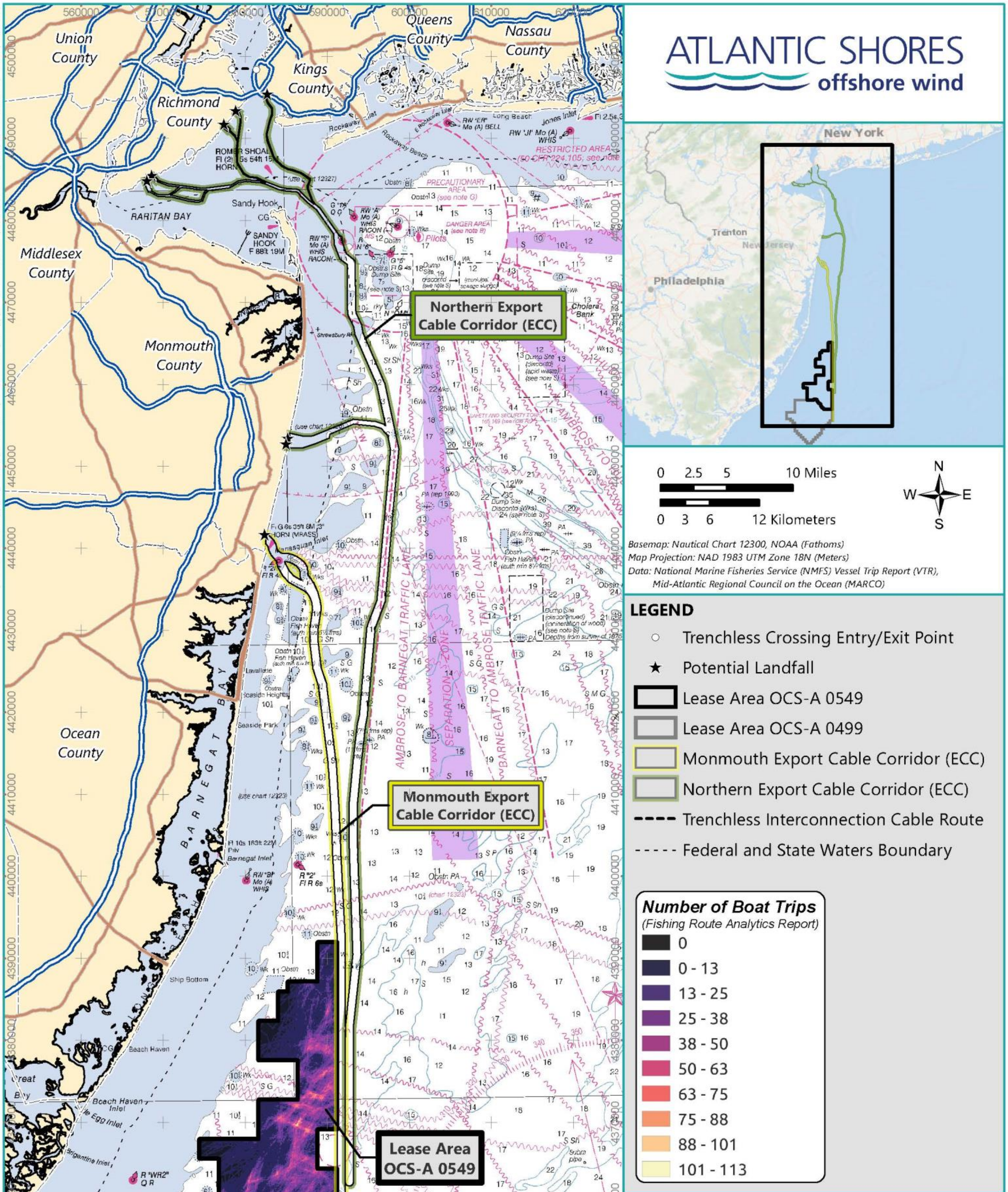



**Figure 7.4-17**

*Density of Commercial Vessels Fishing within the Lease Area 2008-2019*

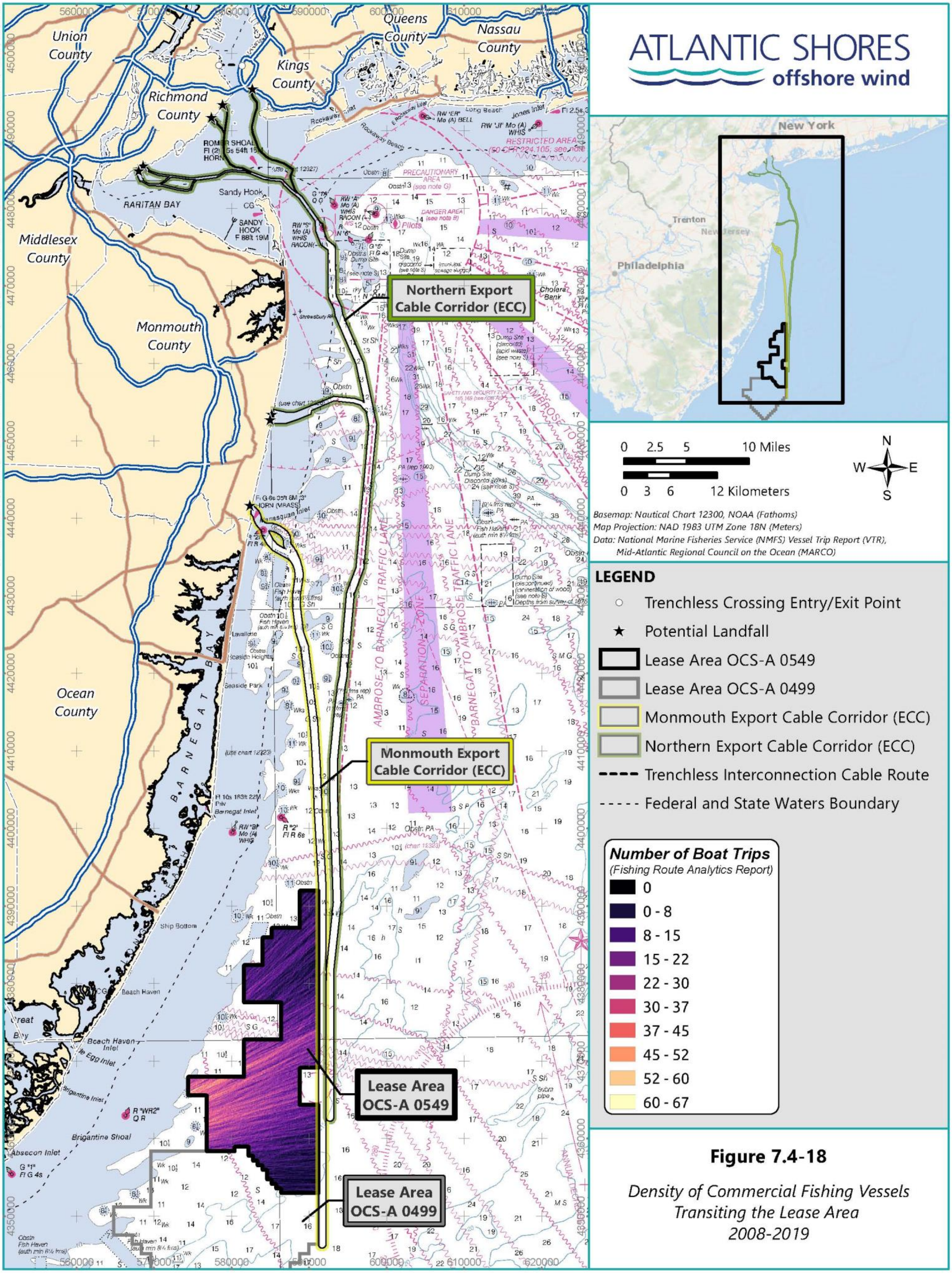



**Figure 7.4-18**

*Density of Commercial Fishing Vessels Transiting the Lease Area 2008-2019*

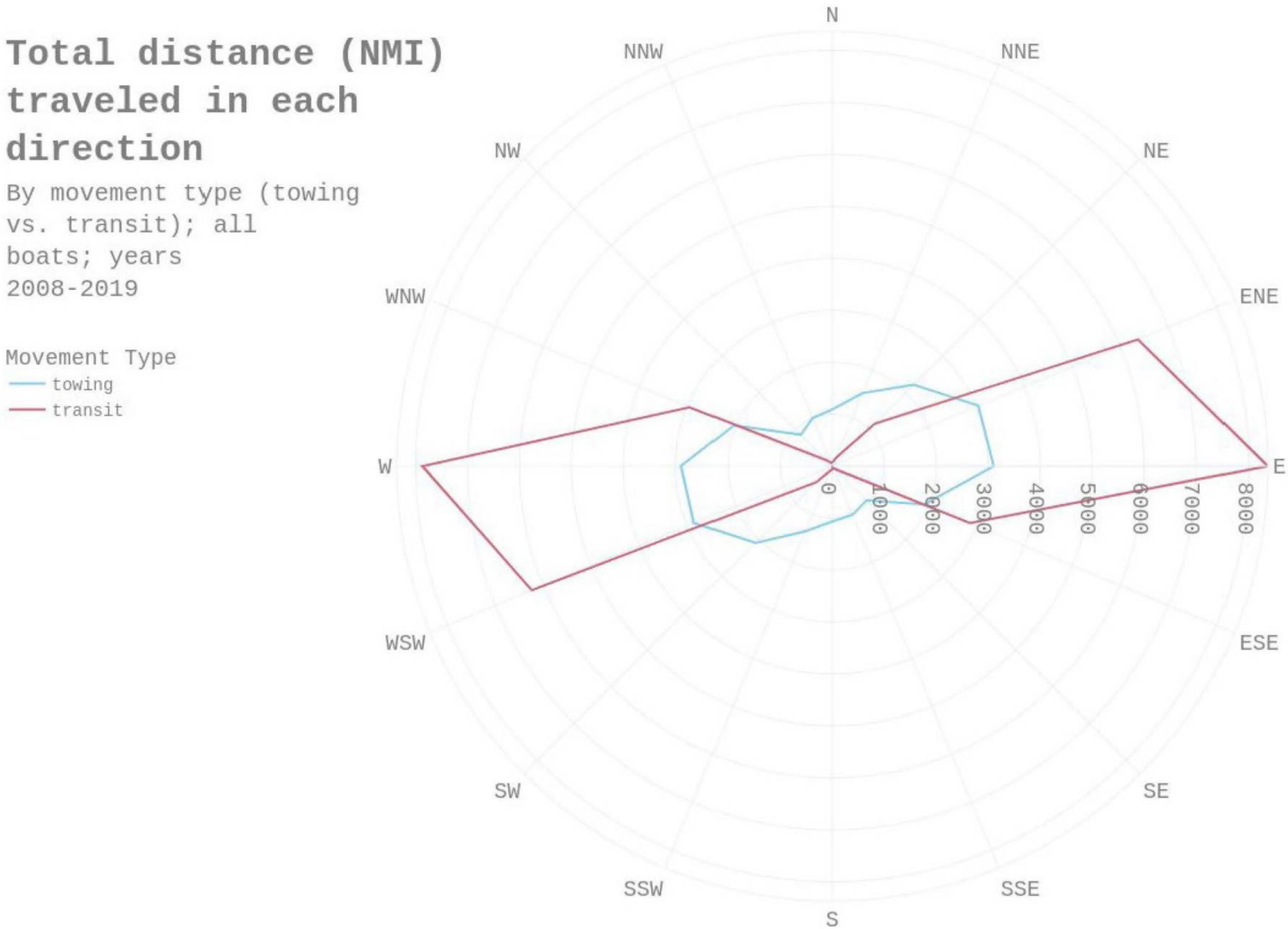
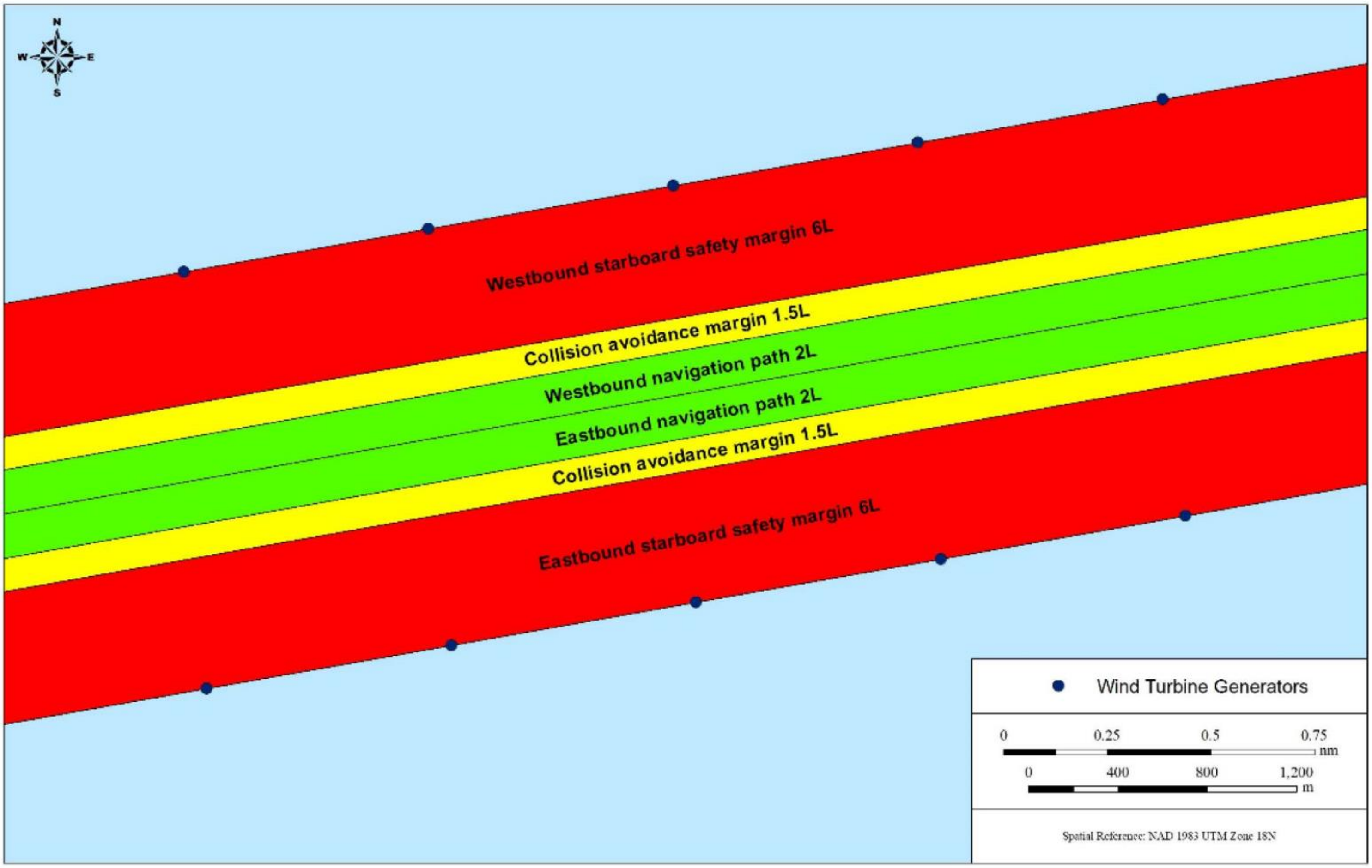



**Figure 7.4-19**

*Travel Directions for Commercial Fishing Vessels within the Lease Area*




Notes:

1. The USCG NJPARS (2022) provided turbine corridor width calculations based on the PIANC (2018) guidance as an illustration of what would be considered safe navigation parameters for the majority of commercial fishing vessels that transit to/from New Jersey inlets and the offshore fishing grounds should these vessels choose to transit through a wind farm. These calculations considered the following spacing provisions:

- Sufficient navigational spacing of two ship lengths in two directions. It was recognized that this spacing, which would accommodate up to 4,400 vessel transits in a single corridor, is conservative and gives additional buffering space and allowances for inclement weather and vessel emergencies. Under existing conditions, there are less than 4,400 vessels per year that transit through the Lease Area (and would be much less through a single corridor).
- A collision avoidance zone on either side of 1.5 vessel lengths.
- A safety margin of six ship lengths on either side of the corridor to allow for a full round turn.

Therefore, although vessel maneuverability within the Lease Area depends on many factors (including vessel size, fishing gear or method used, and weather conditions), the proposed layout is expected to accommodate fishing patterns observed in the Lease Area as shared with Atlantic Shores by the surf clam industry. While it is expected that fishing vessels can transit through the Lease Area, if fishing vessels choose to transit around the Lease Area, minor increases in transit time (typically 15 to 20 minutes or less) may occur (see Section 8.2 of Appendix II-S). Additional detail regarding commercial fishing vessel traffic in the Offshore Project Area is provided in Appendix II-S.

The presence of structures in the Lease Area is anticipated to have only a minor impact on recreational fishing vessels transit routes. With input from the FIR, the potential rerouting of recreational fishing vessels through and around the Lease Area was analyzed. Based on this analysis, there would be very little change in overall distance traveled if vessels elected to navigate through the Lease Area, routing around turbines where and if necessary, though it is assumed vessels may operate at slower speeds when traveling within the Lease Area. If vessels elect to transit around the Lease Area, it is anticipated that rerouting will have a small effect on travel distance and time. Several routes would not be impacted by the Lease Area and for most routes, transiting around the Lease Area would result in less than 0.7 nm (1.3 km) of additional distance traveled.

Atlantic Shores also has minimized effects to commercial and for-hire recreational fishing from the presence of offshore cables. All offshore cables will have a target minimum burial depth of 5 to 6.6 ft (1.5 to 2 m). The cable burial depth is based upon a cable burial risk assessment that considers activities such as commercial fishing practices and anchor use to develop a safe target burial depth for the cables. Atlantic Shores has determined that the target burial depth is sufficient to protect the cables from expected commercial fishing practices including hydraulic dredging, so the presence of these cables is not anticipated to interfere with any typical fishing practices except in limited locations where cable protection may be required.

Additionally, while fiber optic cables are present in the northern portion of the Lease Area (see Figure 4.5-10 of Volume I) and there is evidence that fishing activities regularly occur in the vicinity of these cables, Atlantic Shores is not aware of any cable faults or fishing gear snags that have occurred. As a further point of reference, the Tata Global Network Atlantic (TGN-A) North cable, located to the north of the Lease Area, has not experienced any faults (inclusive of fishing gear snags) within the U.S. EEZ during its operational lifespan (SUBCOM 2019).

As described in Section 4.5 of Volume I, cable protection may be necessary if the target burial depth cannot be achieved for any reason (e.g., due to sediment properties or a cable joint). Cable protection may also be required to support the crossing of existing marine infrastructure such as submarine cables or pipelines (see Section 4.5.8 of Volume I). While Atlantic Shores will minimize the amount of cable protection required, up to 10% of the export cables, inter-array cables, and inter-link cables are conservatively estimated to require cable protection where sufficient burial depth is not achieved. Cable protection will be designed to minimize effects to fishing gear to the maximum extent practicable, and fishermen will be informed of the areas where cable protection is installed.

As described more fully in Sections 4.5 Benthic Resources and 4.6 Finfish, Invertebrates, and Essential Fish Habitat, the presence of structures and cable protection will alter existing habitats.

The creation of structured habitat is expected to benefit species such as American lobster, striped bass, black sea bass, and Atlantic cod and potentially increase their habitat. Similarly, the presence of foundations may increase habitat and provide forage and refuge for some migratory finfish and invertebrate species.

For-hire recreational fishermen may see some benefits (i.e., potential for increases in localized fish abundance) as a result of the Project. By providing additional structure for species that prefer hard, complex bottoms the WTG and OSS foundations may function as fish aggregating devices (BOEM 2012) and provide a potential benefit to for-hire recreational fishermen. Additionally, interest in visiting the Lease Area may result in an increased number of fishing trips originating from New Jersey ports. These additional vessel trips could support an increase in angler expenditures at shoreside facilities servicing for-hire recreational fishermen (Kirkpatrick et al. 2017).

To facilitate safe navigation in the Offshore Project Area, all foundations will contain marine navigation lighting and marking in accordance with USCG and BOEM guidance. To aid mariners navigating within and near the Lease Area, each WTG position will be maintained as a Private Aid to Navigation (PATON). Atlantic Shores will work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities. Based on USCG District 5 Local Notice to Mariner (LNM) 45/20 and BOEM (2021) Guidance on Light and Marking of Structures, Atlantic Shores expects to include unique alphanumeric identification on each foundation, lights on each foundation that are visible in all directions, and sound signals on select foundations. AIS will be used to mark each WTG position. The number, location, and type of AIS transponders will be determined in consultation with USCG. Additionally, WTG and OSS foundations will be equipped with access ladders to allow distressed mariners access to an open refuge area. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors.

Some survey work by Federal or State fisheries agencies to inform stock assessments and fishing quotas and otherwise support a variety of marine research may occur within the Lease Area. NEFSC seasonal trawl surveys, as well as surf clam and ocean quahog survey dredging for NEFSC Resource Survey Reports, are conducted offshore New Jersey, and may be conducted occasionally within the Lease Area. Depending on the size of the vessels used for survey work, modifications to existing survey protocols may be required. Such modifications may include using smaller vessels or relocating survey transects outside of the Lease Area. Such modifications, if necessary, would be expected to allow for sufficient data collection. Atlantic Shores will continue to consult with appropriate Federal and State fisheries agencies on expected effects to fisheries survey work, if any. Atlantic Shores is also proposing to conduct its own fisheries surveys; this effort is described in Appendix II-K.

#### 7.4.4.4 Summary of Proposed Environmental Protection Measures

Atlantic Shores understands the socioeconomic importance of commercial and for-hire recreational fishing to the State of New Jersey and is committed to achieving coexistence with those who fish within Atlantic Shores Offshore Project Area. Atlantic Shores has developed the following proposed environmental protection measures:

- A desktop assessment of commercial fishing activity in the Offshore Project Area was conducted using publicly available data (AIS, VTR, and VMS), reports, academic studies, information from fishermen, and consultations with government agency representatives and stakeholders to select a layout that will facilitate ongoing transit and fishing activities.
- Atlantic Shores is a founding member of the ROSA, which advances regional research and monitoring of fishery and offshore wind interactions. Findings from these efforts will inform the Project design and will help to build data and communication tools for fishermen that support accurate, real-time information on offshore wind projects.
- Atlantic Shores signed a Memorandum of Understanding (MOU) with Stockton University to sponsor research to investigate technology development related to the development of offshore wind energy and to investigate potential fisheries benefits resulting from offshore wind structures. Findings from this research will be used to support the design and implementation of pre-, during, and post-construction fisheries monitoring.
- Information from industry conversations, direct data gathering exercises with fishermen, consultations with government agency representatives, and analysis of public data have been compiled and used to guide the siting, design, O&M, and decommissioning of the Project.
- The proposed layout was developed in close coordination with commercial fishermen to align with the predominant flow of vessel traffic.
- Project infrastructure is being sited and oriented to avoid concentrated areas of fishing activity to the maximum extent practicable.
- The amount of cable protection will be limited. Cable protection will be designed to minimize effects to fishing gear to the maximum extent practicable, and fishermen will be informed of the areas where cable protection is installed.
- Offshore cables will be buried at a sufficient depth of 5 to 6.6 ft (1.5 to 2 m) to avoid interaction with fishing gear.
- To facilitate safe navigation, all offshore structures will include marine navigation lighting and marking in accordance with USCG and BOEM guidance. Atlantic Shores will continue to work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities.
- Each foundation will include unique alphanumeric identification and lights that are visible in all directions, and sound signals on select foundations.
- WTG, OSS, meteorological (met) tower, and met buoy positions will be maintained as PATONs.
- WTG and OSS foundations will be equipped with access ladders to allow distressed mariners access to an open refuge area above the splash zone. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors.
- AIS will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG.

- A Fisheries Communication Plan has been developed that defines outreach and engagement with fishing interests during all phases of the Project, from development through decommissioning.
- Atlantic Shores employs an active commercial fisherman, Captain Kevin Wark, as the FLO and an active recreational fisherman, Captain Adam Nowalski, as the Recreational FIR.
- A Gear Loss Avoidance Program has been developed to identify gear located within the Project area and to develop a cooperative plan with fishermen to avoid, remove, or relocate fishing gear within areas of Project activity. This plan includes direct outreach to fishermen and a scout boat plan to identify fishing gear located within areas of Project activity. A gear loss form and policy has been made accessible on the Project website.
- A "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and FLO and FIR contact information.
- Specific methods for communicating with offshore fishermen while they are at sea are being established, including a 24-hour phone line to address any real-time operational conflicts and/or safety issues.
- Updated asset and operational awareness bulletins will be regularly distributed showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines and relevant contact information. Atlantic Shores will also publish announcements and share updates with print and online industry publications and local news outlets.
- Atlantic Shores distributed a formal RFI to identify fishing businesses that had available docks and port real estate to support the Project.
- A Marine Coordinator will be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. The Marine Coordinator will be responsible for coordinating with the USCG for any required NTMs.

## 7.5 Land Use and Coastal Infrastructure

This section describes land use and coastal infrastructure present in the Onshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning.

Atlantic Shores has designed the Project to be compatible with surrounding land use and communities, and to safeguard environmentally and culturally sensitive areas. Atlantic Shores has located onshore interconnection cable route options and infrastructure primarily along existing roadways and/or utility rights-of-way (ROWs).

Potential visual effects of the Project are discussed in Section 5.0 Visual Resources.

### 7.5.1 Affected Environment

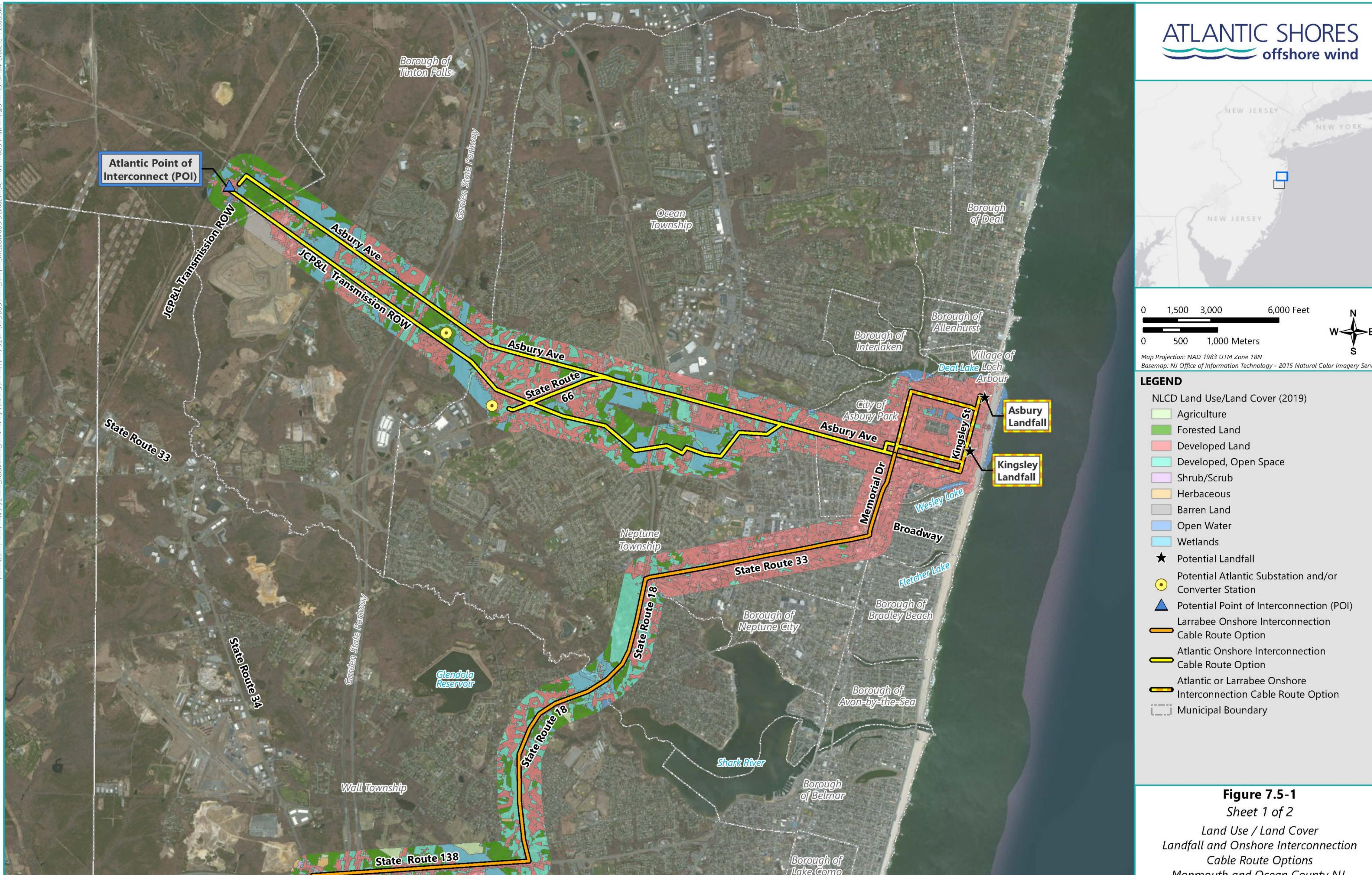
Atlantic Shores has identified two counties in New Jersey (Monmouth and Ocean) and two counties in New York (Richmond and Kings) where onshore facilities may be located. Atlantic Shores has also identified potential port facilities that may be used in New Jersey, New York, the Mid-Atlantic, New England, and the U.S. Gulf Coast, to support Project construction and/or O&M. This section describes the affected environment within those portions of Ocean and Monmouth Counties, New Jersey and Kings and Richmond Counties, New York where onshore Project components may be located, followed by a description of potential port facilities.

#### 7.5.1.1 Ocean and Monmouth Counties, New Jersey

Onshore Project components in Ocean and Monmouth Counties, New Jersey include up to two potential points of interconnection (POI), potential landfall locations, substation and/or converter station sites, and associated onshore interconnection cable route options. All of the proposed facility infrastructure locations have been collocated within developed roadways, transmission line ROWs, and other commercial/industrial developed areas that are consistent with existing utility infrastructure in the area. Land uses mapped at these locations are shown on Figure 7.5-1.

#### 7.5.1.2 Richmond and Kings Counties, New York

Onshore Project components located in Richmond and Kings Counties, New York include the two potential POIs, potential landfall locations, substation/conversation station sites and associated onshore interconnection cable route options. All of the proposed facility infrastructure locations have been collocated within developed roadways and other commercial/industrial developed areas that are consistent with existing utility infrastructure within the area. Land uses mapped at these locations are shown on Figure 7.5-2.

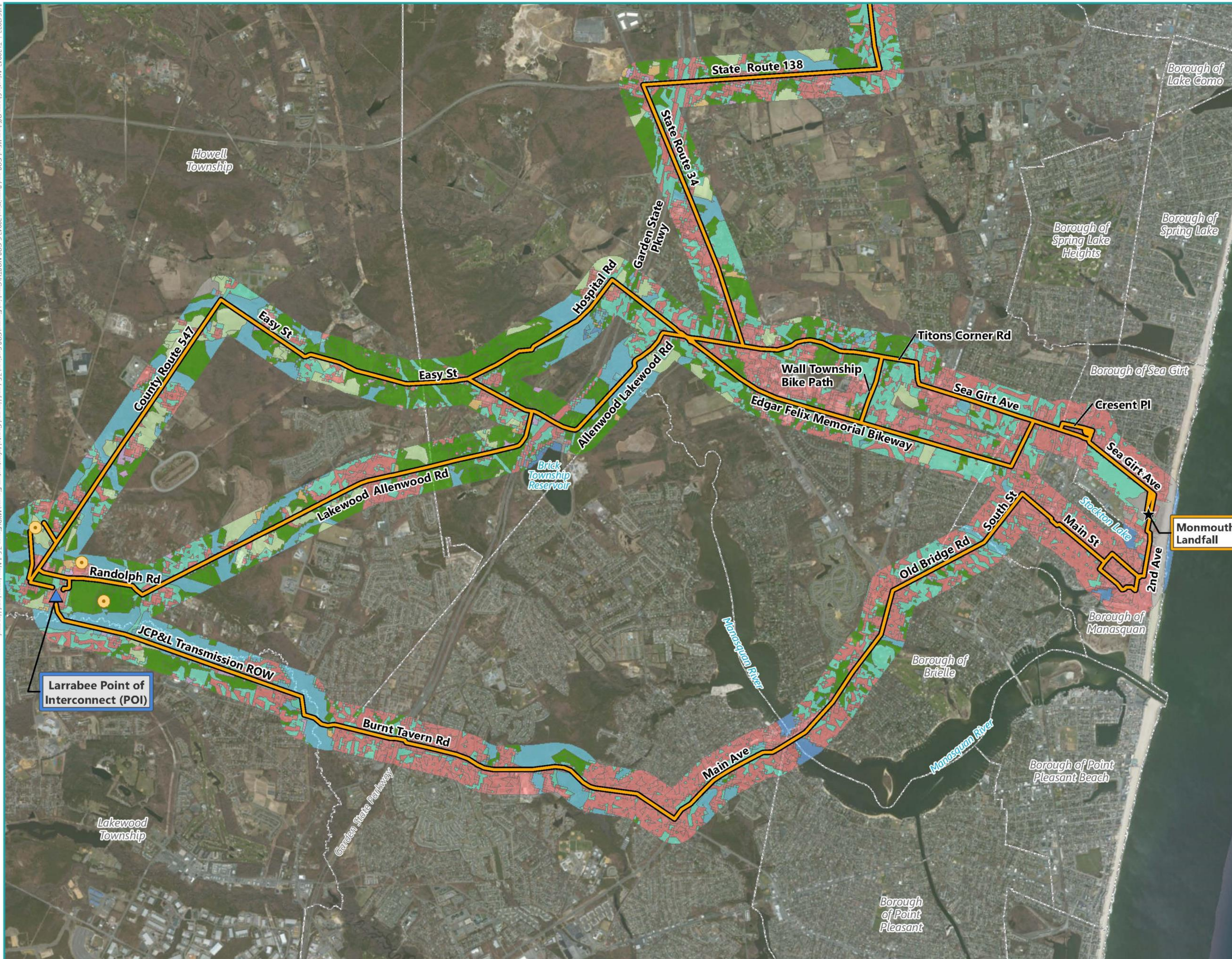



ATLANTIC SHORES offshore wind

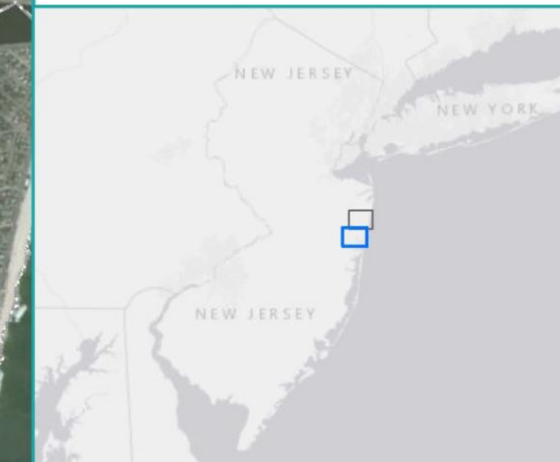
**Figure 7.5-1**

*Sheet 1 of 2*

*Land Use / Land Cover Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County NJ*




ATLANTIC SHORES offshore wind




0 1,500 3,000 6,000 Feet

0 500 1,000 Meters

Map Projection: NAD 1983 UTM Zone 18N
Basemap: NJ Office of Information Technology - 2015 Natural Color Imagery Service

**LEGEND**

NLCD Land Use/Land Cover (2019)

- Agriculture
- Forested Land
- Developed Land
- Developed, Open Space
- Shrub/Scrub
- Herbaceous
- Barren Land
- Open Water
- Wetlands
- Potential Landfall
- Potential Larrabee Substation and/or Converter Station
- Potential Point of Interconnection (POI)
- Larrabee Onshore Interconnection Cable Route Option
- Municipal Boundary

**Figure 7.5-1**

*Sheet 2 of 2*

*Land Use / Land Cover Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County NJ*

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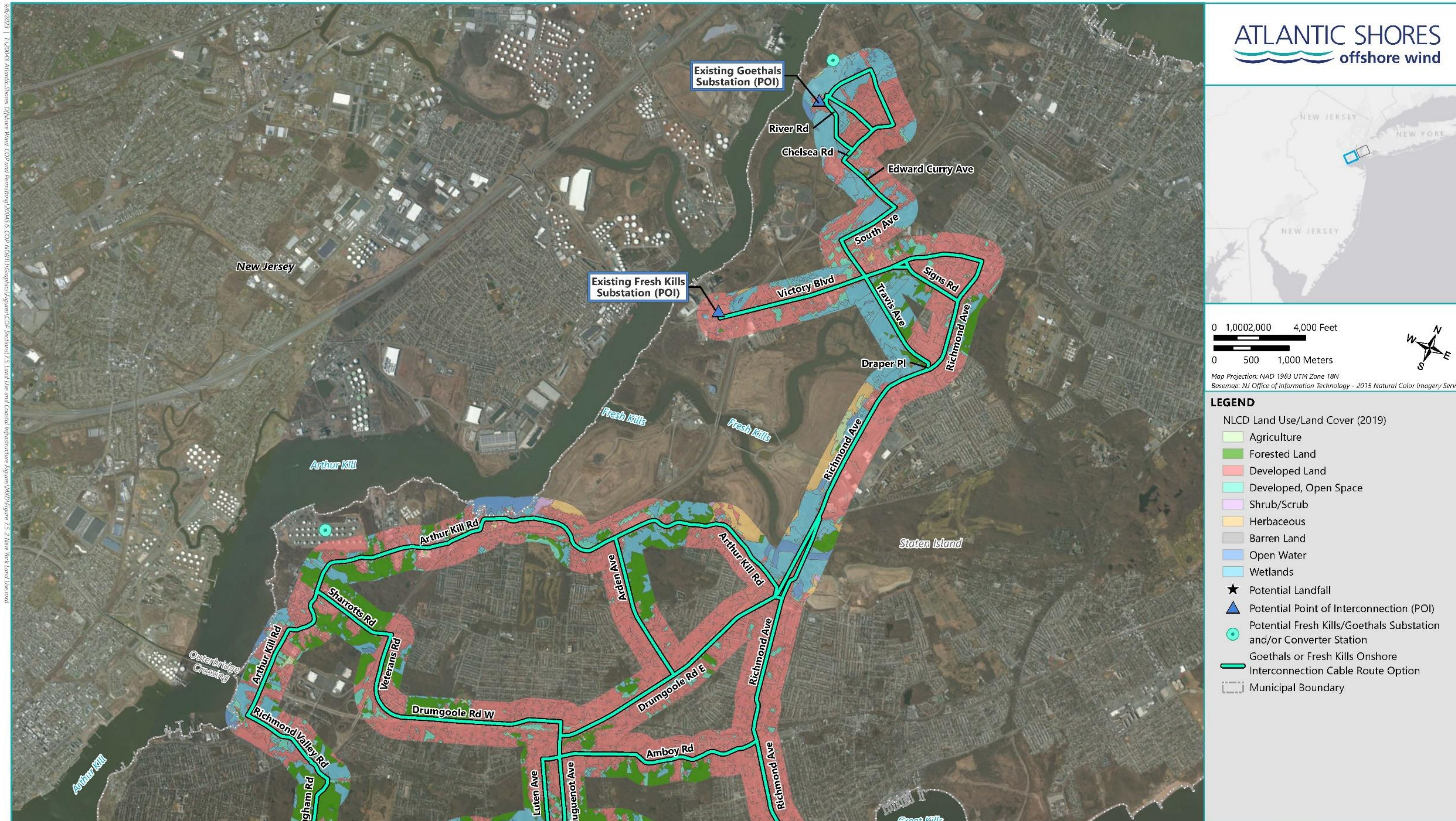
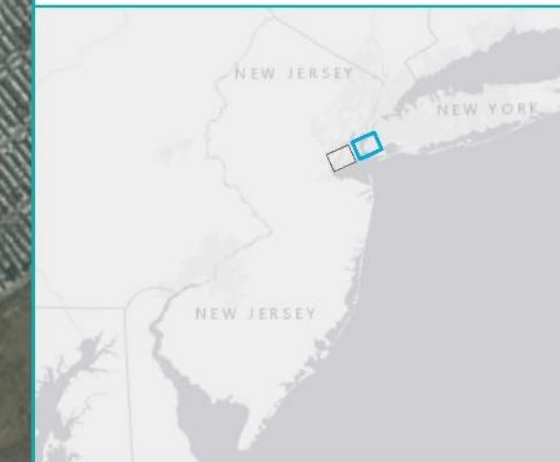



**Figure 7.5-2**

*Sheet 1 of 2*

*Land Use / Land Cover*
*Landfall and Onshore Interconnection*
*Cable Route Options*
*Richmond County, NY*


ATLANTIC SHORES offshore wind




0 1,000 2,000 4,000 Feet

0 500 1,000 Meters

Map Projection: NAD 1983 UTM Zone 18N

Basemap: NJ Office of Information Technology - 2015 Natural Color Imagery Service

**LEGEND**

NLCD Land Use/Land Cover (2019)

- Agriculture
- Forested Land
- Developed Land
- Developed, Open Space
- Shrub/Scrub
- Herbaceous
- Barren Land
- Open Water
- Wetlands
- Potential Landfall
- Potential Point of Interconnection (POI)
- Potential Gowanus Substation and/or Converter Station
- Gowanus Onshore Interconnection Cable Route Option
- Municipal Boundary

**Figure 7.5-2**

*Sheet 2 of 2*

*Land Use / Land Cover*
*Landfall and Onshore Interconnection Cable Route Options*
*Richmond and Kings County, NY*

9/6/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.5 Land Use and Coastal Infrastructure Figures\MXD\Figure 7.5-2 New York Land Use.mxd

### 7.5.1.3 Port Utilization

Atlantic Shores has identified several port facilities in New Jersey, New York, the Mid-Atlantic, and New England that may be used for major construction staging activities for the Project. In addition, some components, materials, and vessels could come from U.S. Gulf Coast or international ports.

Construction ports will be utilized for the following functions:

- crew transfers;
- component fabrication and assembly;
- receiving and offloading shipments of Project components;
- storing Project components;
- preparing Project components for installation;
- loading Project components onto installation vessels or other suitable vessels for delivery to the Offshore Project Area for installation; and/or
- preparing vessels to tow floating components to the Lease Area.

A list of U.S. ports considered for temporary use during major construction staging activities is provided in Table 7.5-1 and depicted on Figure 4.10-1 of COP Volume I; it is likely that only some of the ports identified will be utilized for Project construction.

Other industrial ports not identified in Table 7.5-1 may be utilized for limited, basic activities associated with marine construction in general rather than offshore wind specifically. These activities may include, but are not limited to, refueling (although some refueling is expected to occur offshore), restocking supplies, and sourcing parts for repairs.

All port facilities being considered to support Project construction are located within industrial waterfront areas with existing marine industrial infrastructure or where such infrastructure is proposed for development within the required Project timeframe. Some port requirements specifically pertaining to offshore wind construction projects include:

- high load-bearing ground and deck capacity, especially quayside;
- adequate vessel berthing parameters, including depth of berths to accommodate large installation vessels; and
- suitable laydown and fabrication space, which may require grading and resurfacing.

It is important to identify a wide range of construction ports for the Project because many port entities have plans to upgrade or further develop port facilities in support of the burgeoning offshore wind industry. It is essential for the Project to have the ability to utilize the most appropriate port facilities for construction given uncertainties regarding which planned port upgrades will be completed within the Project's development schedule and competing projected demands for the port facilities by other offshore wind developers. While Atlantic Shores anticipates that a subset of the ports identified in Table 7.5-1 will be utilized for Project construction, the ports ultimately selected for use will depend on the status of port upgrades and final construction logistics planning.

### Table 7.5-1 Ports that May be Used During Project Construction

| Port | Location | WTG | OSS | Foundation | Offshore Cables |
|---|---|---|---|---|---|
| **New Jersey Wind Port** | Lower Alloways Creek, New Jersey | Includes full tower assembly | • | For piled, suction bucket, and gravity foundations | • |
| **Port of Paulsboro** | Paulsboro, New Jersey | • | For smaller OSS types | For piled and gravity foundations | • |
| **Repauno Port & Rail Terminal** | Greenwich Township, New Jersey | • | For smaller OSS types | For piled and gravity foundations | • |
| **Portsmouth Marine Terminal** | Portsmouth, Virginia | Includes full tower assembly | • | For piled, suction bucket, and gravity foundations | • |
| **Ingleside** | Ingleside, Texas | | • | For piled, suction bucket, and gravity foundations | |
| **Atlantic City O&M Facility** | Atlantic City, New Jersey | | | | |
| **Arthur Kill Terminal** | Staten Island, New York | Includes full tower assembly | • | For piled, suction bucket, and gravity foundations | • |
| **Port of Albany** | Albany, New York | • | | For piled and gravity foundations | • |
| **Port of Coeymans Marine Terminal** | Coeymans, New York | • | | For piled and gravity foundations | • |

Atlantic Shores will likely establish a long-term CTV base at the O&M facility in Atlantic City. If Atlantic Shores employs an SOV-based O&M strategy, those SOVs would likely be operated out of existing ports in New York or New Jersey or another industrial port identified in Table 7.5-1 that has suitable water depths and quayside facilities to support an SOV. Atlantic Shores may also use the other ports listed in Table 7.5-1 to support O&M activities.

While it is anticipated that ports listed in Table 7.5-1 can support the Project's needs, use of other U.S. or international ports may be required if significant non-routine maintenance is needed for the Project.

### 7.5.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect land use and coastal infrastructure during Project construction, O&M, or decommissioning are presented in Table 7.5-2.

**Table 7.5-2. Impact Producing Factors for Land Use and Coastal Infrastructure**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Land Disturbance | ● | ● | ● |
| Port Utilization | ● | ● | ● |
| Presence of Structures | ● | | ● |

The maximum Project Design Envelope (PDE) analyzed for potential effects to land use and coastal infrastructure is the maximum onshore and offshore build-out of the Project as defined in Section 4.11 of Volume I.

#### 7.5.2.1 Land Disturbance

Short-term and localized land disturbance will occur from construction, O&M, and decommissioning of the proposed landfall sites, onshore interconnection cables, and new substations and/or converter station sites, as well as potential upgrades to the POIs. To minimize land disturbance, Atlantic Shores has collocated to the extent practicable the onshore interconnection cable route options with existing roadways or electric transmission utility ROWs. Similarly, the proposed landfall sites, substation/converter station sites, and other associated onshore infrastructure will be located in previously disturbed/developed areas. Land disturbance associated with Project construction will be temporary and disturbed areas along the onshore interconnection cable routes and at the landfall sites will be returned to their original conditions, except for manholes that are installed for maintenance access. Land disturbance at converter/substation sites during construction will be conducted in accordance with approved soil erosion and sedimentation control plans.

**Landfall Sites and Onshore Interconnection Cable Routes**

As further described in Section 4.7.1 of Volume I, the offshore-to-onshore transition at the landfall sites will be accomplished using horizontal directional drilling (HDD). The HDD activity will involve establishing a staging area at the landfall site, where drilling will be initiated within an excavated pit. Drilling will then proceed from the staging area and under the beach or waterfront to the HDD exit location. Land disturbances during construction will be temporary and limited to the localized HDD staging area. Atlantic Shores will work with municipal officials to develop the construction schedule and hours in accordance with municipal noise ordinances. Certain activities, such as conduit pull-in, cannot stop once commenced, so work may need to occur for extended hours on these limited occasions. All disturbed areas will be restored to their previous condition following completion of HDD.

From the landfall site to the POI, the onshore interconnection cables will be contained within a buried concrete duct bank. As described in Section 4.8 of Volume I, installation of the concrete duct bank for onshore interconnection cables will typically be accomplished via open trenching with a temporary trench up to 15 ft (4.5 m) wide and 12 ft (3.5 m) deep. These dimensions are also sufficient for the installation of splice vaults where necessary. Trenchless installation techniques (e.g., HDD, pipe jacking, and jack-and-bore) are anticipated at unique features such as busy roadways and wetlands/streams and are further described in Section 4.8.3 of Volume I.

The onshore interconnection cable route options were selected to primarily use existing roadway or electric utility ROWs to minimize effects on existing land use. At any given time, construction and the associated land disturbance will be limited to discrete areas and will therefore only affect a specific area for a short period of time. Atlantic Shores is proposing to adhere to voluntary seasonal construction restrictions for appropriate portions of the onshore interconnection cable routes where seasonal use is most concentrated; no summer construction (generally from Memorial Day to Labor Day) will occur in the beach communities of New Jersey and New York.

Construction laydown areas have not yet been identified, but Atlantic Shores will preferentially select previously disturbed parcels. As such, construction laydown is not expected to result in new land disturbance.

Mitigation measures such as erosion and sedimentation controls will be utilized during construction in accordance with an approved soil erosion and sediment control plan at the landfall sites and along the onshore interconnection cable routes. No permanent effects to land use are expected upon completion of construction because all temporarily disturbed areas will be fully restored and all Project infrastructure will be entirely underground except for at-grade manhole covers. Effects during decommissioning are expected to be similar to effects during construction and will be temporary in nature.

During O&M, periodic maintenance of the onshore facilities may be required. Any necessary maintenance will be accessed through manholes, thereby avoiding land disturbance.

**New Substations, Converter Stations and Points of Interconnection**

Potential substation locations have not yet been finalized, however areas of similar land uses within Howell and Colts Neck Townships, New Jersey and Staten Island and Brooklyn Boroughs, Richmond and Kings Counties, New York are being considered. These proposed substation locations will be sited in areas with consistent land uses (commercial/industrial) to minimize effects to surrounding properties. These sites will also attempt to utilize areas that have been previously disturbed/developed. Visual screening surveys will be constructed for the potential substations, converter stations, and points of interconnection, as needed. As described further in Section 4.9 of Volume I, temporary land disturbance will occur within the footprint of any proposed substation, converter station, and/or POI sites and could include land clearing, grading, trenching, and installation of equipment and equipment foundations. Appropriate erosion/sedimentation controls will be used during construction in accordance with an approved soil erosion and sediment control plan and a job-site safety program will be implemented to prevent public access to the construction site.

Once the onshore substations, converter stations, and POIs are operational, a security plan will be implemented to control site access. Site access will be controlled by employing features such as fencing (with earth grounding), screening barriers, camera systems, signage, and other physical barriers. Existing vegetative buffers will be enhanced to the extent practicable (only native vegetative species will be used) and setback, landscaping, buffering, screening, and/or lighting will be provided along exposed sides of the site. Atlantic Shores expects to coordinate with local authorities regarding the use of vegetative buffers at the onshore substations and converter station sites.

Once the substations, converter stations and POIs are operational, periodic maintenance activities will likely occur within the substation site and appropriate environmental protection measures, such as erosion and sedimentation control, will be used. During decommissioning, effects are expected to be similar to construction.

The scope of modifications at the proposed POIs is not yet known but may range from expanding existing substations by adding additional breaker bay(s) to upgrading the existing high voltage section of the substation to a breaker and a half configuration. Such activities, if required, are anticipated to occur within the footprint of the existing POI or in the immediate vicinity.

#### 7.5.2.1 Port Utilization

Project construction, O&M, and decommissioning will require the use of existing ports. Atlantic Shores has identified several ports to be utilized for Project construction and O&M (Table 7.5-1). Potential ports for the Project have been chosen that have existing adequate infrastructure (including high load-bearing ground and deck capacity, adequate vessel berthing parameters, and suitable laydown and fabrication space), or where such infrastructure is proposed for development by other entities within the Project’s timeframe. Atlantic Shores has identified several ports for potential use because many port entities have plans to upgrade or further develop port facilities in support of the burgeoning offshore wind industry. It is essential for the Project to have the ability to utilize the most appropriate port facilities for construction given uncertainties regarding which planned port upgrades will be completed within the Project’s development schedule and projected demand for the port facilities by other offshore wind developers.

Vessel operations and transit frequency, as well as onshore traffic, may increase near the port facilities during construction, O&M, and decommissioning. Section 7.6 Navigation and Vessel Traffic, as well as the Navigation Safety Risk Assessment (NSRA) in Appendix II-T, describe vessel navigation in detail and Section 7.9 Onshore Transportation and Traffic describes potential onshore traffic. Vessel use during O&M is not anticipated to affect or interfere with normal port operations. The potential ports and surrounding waterways are expected to have the necessary capacity for the potential vessel traffic. Atlantic Shores will employ a Marine Coordinator to manage vessel movements and will also utilize additional mitigation measures as described in Section 7.6 Navigation and Vessel Traffic to avoid or minimize effects.

#### 7.5.2.2 Presence of Structures

The presence of structures is not anticipated to have any permanent effect on land use onsite or within the general surroundings during Project construction, O&M, and decommissioning. The Project includes the presence of transmission cable infrastructure, specifically, underground onshore cables and vaults at the proposed landfall and along the onshore interconnection cable route options. The cable infrastructure will be located underground (underground infrastructure is typical in urban areas where the cable route has been sited) and is therefore consistent with land uses of the surrounding areas and is not anticipated to interfere with land uses or coastal infrastructure. Placing this critical infrastructure underground provides a protective benefit during inclement weather events. The facilities will be regularly monitored, and repairs and maintenance will be conducted promptly. Any necessary repairs on the interconnection cables will be accessed through manholes and repairs will be completed within the installed transmission infrastructure. Atlantic Shores is selecting onshore substation sites to minimize effects to surrounding land uses.

#### 7.5.2.3 Summary of Proposed Environmental Protection Measures

Atlantic Shores understands the importance of land use and coastal infrastructure and has worked to design the Project to be compatible and consistent with surrounding land use and communities and to safeguard environmentally and culturally sensitive areas. Project construction, O&M, and decommissioning activities are designed to minimize effects to land use and coastal infrastructure.

**Offshore**

- A Marine Coordinator will be used to manage any increase in vessel movements during Project construction, O&M, and decommissioning.

**Onshore**

- A desktop assessment has been conducted of the relevant land uses and coastal infrastructure to avoid and minimize effects.
- HDD cable installation will be used at the landfall sites to minimize land disturbance. Land disturbance will be temporary and disturbed areas will be restored to their previous condition, except for the proposed manholes that will be used for access to maintain the cables.
- Onshore interconnection cable route options have been collocated primarily along previously disturbed roadways and utility ROWs.
- Onshore substations and/or converter stations will be sited on previously disturbed lands to the extent practicable to minimize effects to surrounding land uses and to be compatible with the existing zoned use.
- Design elements will be implemented (e.g., certified enclosures, natural barriers, and landscaping around the onshore substations and/or converter stations) to minimize effects to surrounding land uses and communities.

- Access for repairs on the interconnection cables will take place through manholes and repairs will be completed within the installed transmission infrastructure, thus minimizing land disturbance.
- Voluntary seasonal construction restrictions for onshore interconnection cable installation will be followed at the landfall sites and onshore interconnection cable routes within beach communities.
- Erosion and sedimentation control measures will be utilized during construction at the landfall sites, along the onshore interconnection cable routes, and onshore substation/converter station sites.
- A job-site safety program will be implemented to prevent public access to the Project's construction site.

# 7.6 Navigation and Vessel Traffic

This section describes maritime navigation and vessel traffic in the Offshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operation and maintenance (O&M), and decommissioning. The marine and coastal waters of the Mid-Atlantic have a rich maritime history, and the waters off the New Jersey and New York coasts have and continue to support maritime activities and commerce including commercial (non-fishing) and military traffic, recreational traffic, and fishing vessels. Lease Area OCS-A 0549 (Lease Area) is located directly north of Lease Area OCS-A 0499 and was cited by the Bureau of Ocean and Energy Management (BOEM) to avoid high marine traffic areas and minimize effects to existing marine users (see Section 1.3.1 of Volume I). The overall traffic density within the Lease Area is relatively low, with two or more Automatic Identification System (AIS)-equipped vessels present in the 81,129-acre (328.3 square kilometer [$km^2$]) Lease Area for only 16.6% of the time (1,460 hours per year on average).

Atlantic Shores supports the appropriate mixed use of ocean waterways and has actively considered existing marine traffic patterns during all phases of Project development. Atlantic Shores has also engaged in extensive and proactive coordination with the U.S. Coast Guard (USCG), mariners, fishermen, and other stakeholders using multiple communication channels to better understand both navigation and vessel traffic within the Lease Area and mariner concerns.

This navigation risk assessment considered the proposed development for the Project within the Lease Area in its entirety and thus evaluated the installation of up to 157 wind turbine generators (WTG), up to eight small, 4 medium or 3 large offshore substations (OSS), two metocean buoys and up to one permanent meteorological tower (Met Tower) to be situated on the southwestern perimeter of the Lease Area. Construction of the Project will result in modification to vessel traffic patterns and a change to the overall risk profile.

## 7.6.1 Affected Environment

The maritime navigation and vessel traffic information contained in this section is supported by the following study:

- **The Navigation Safety Risk Assessment.** The Navigation Safety Risk Assessment (NSRA), presented in Appendix II-T of this COP, identifies existing navigation patterns and potential effects of the Project during the construction, O&M, and decommissioning phases. Information in the NSRA is based on the USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), which provides guidance on the information and factors to be considered when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI), such as the proposed Project. Key considerations evaluated in the NSRA include: (1) safety of navigation, (2) the effect on traditional uses of the waterway, and (3) the impact on maritime search and rescue activities by the USCG and others.

The Offshore Project Area considered for the purposes of assessing marine navigation and vessel traffic is the broader geographic region offshore from the New Jersey and New York coasts surrounding the Monmouth and Northern Export Cable Corridors (ECCs) and the Lease Area.

The following subsections provide an overview of current maritime navigation in the Offshore Project Area (see Section 7.6.1.1), followed by a detailed discussion of existing vessel traffic patterns (see Section 7.6.1.2).

### 7.6.1.1 Navigation

Private Aids to Navigation (PATONs), Federal Aids to Navigation (ATONs), and radar transponders are located throughout the Offshore Project Area (Figure 7.6-1). These aids to navigation consist of lights, sound horns, buoys, and onshore lighthouses. They are intended to serve as visual and audible references to support safe maritime navigation.

ATONs are developed, operated and maintained or regulated by the USCG to assist mariners in determining their position, identify safe courses, and warn of dangers and obstructions. ATONs are marked on the National Oceanic and Atmospheric Administration (NOAA) nautical charts.

Most private and Federal ATONs in the Offshore Project Area, including a historic lighthouse demarcating Barnegat Inlet, are located inshore relative to the Lease Area. There are no ATONs or PATONs in the Lease Area; however, there are two PATONs associated with met buoys to be located south of the Lease Area within the adjacent Lease Area OCS-A 0499. There is an ATON located 5.65 nm (10.5 km) west of the southern portion of the Lease Area indicating the presence of a wreck on the seabed. There are also two ATONs located approximately 6 nm (11.1 km) northwest of the northern end of the Lease Area, near Barnegat Inlet. Also, a single permanent met tower may be constructed within the Lease Area and, during construction, up to two meteorological and oceanographic (metocean) buoys may be temporarily located within the Lease Area (see Section 4.6 of Volume I). Figure 7.6-2 shows potential met tower and metocean buoy locations for the Project.

The Lease Area is in relatively deep water 55.8 to 118.1 feet (ft) (17 to 36 meters [m]), and there are no impediments to navigation through this area presently. There is a demarcated danger zone located on the eastern edge of the Lease Area where no fishing, dragging or anchoring may occur. Presently there are no demarcated waterways adjacent to or within the Lease Area; however, there is the Ambrose-Barnegat Traffic Separation Scheme (TSS) leading to and from New York City. The outlet of the outbound lane of the TSS is located approximately 5.4 nm (10.0 km) north-northeast of the Lease Area. A TSS separates opposing streams of vessel traffic by creating separated, unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting to and from major ports.

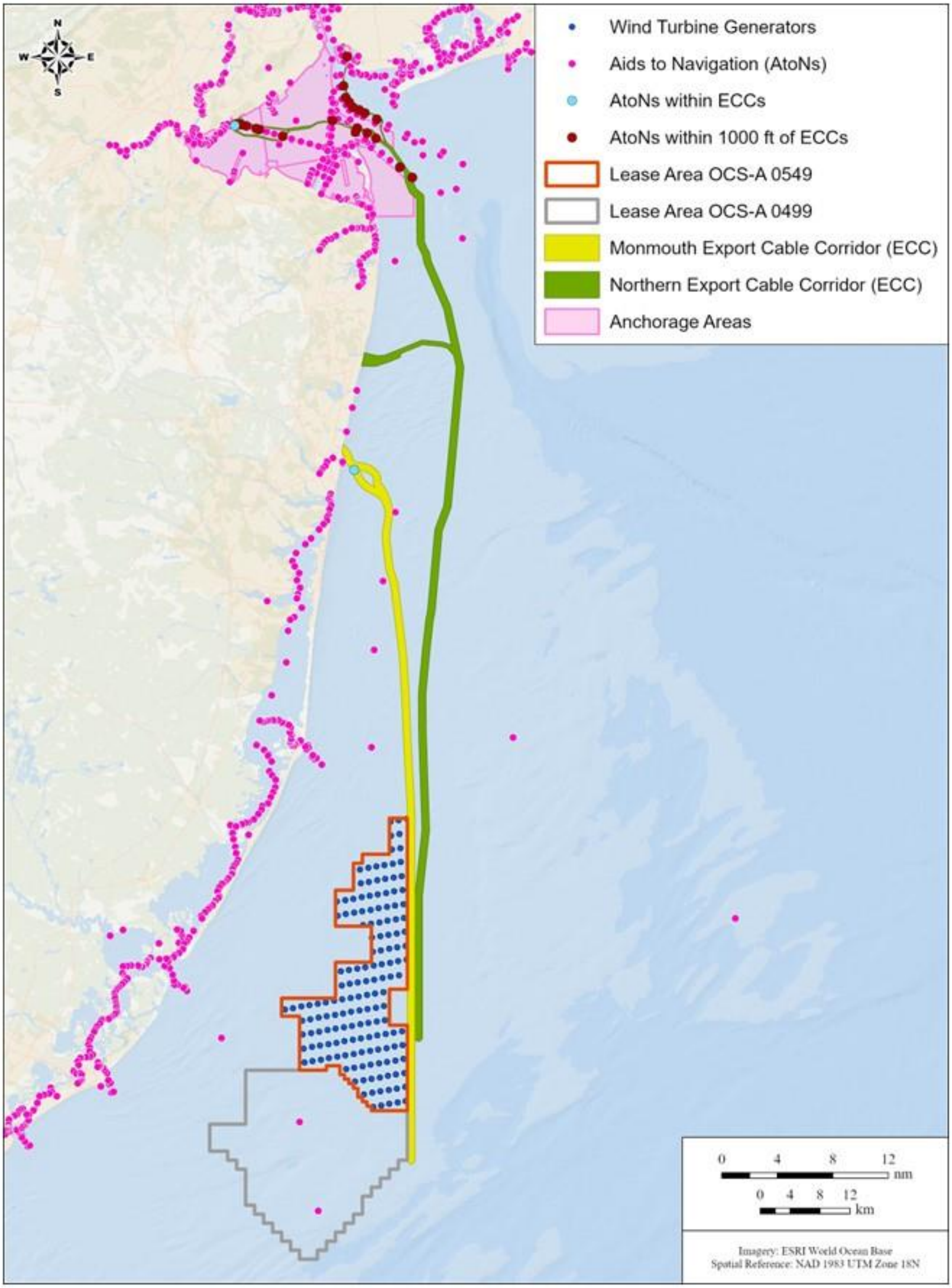
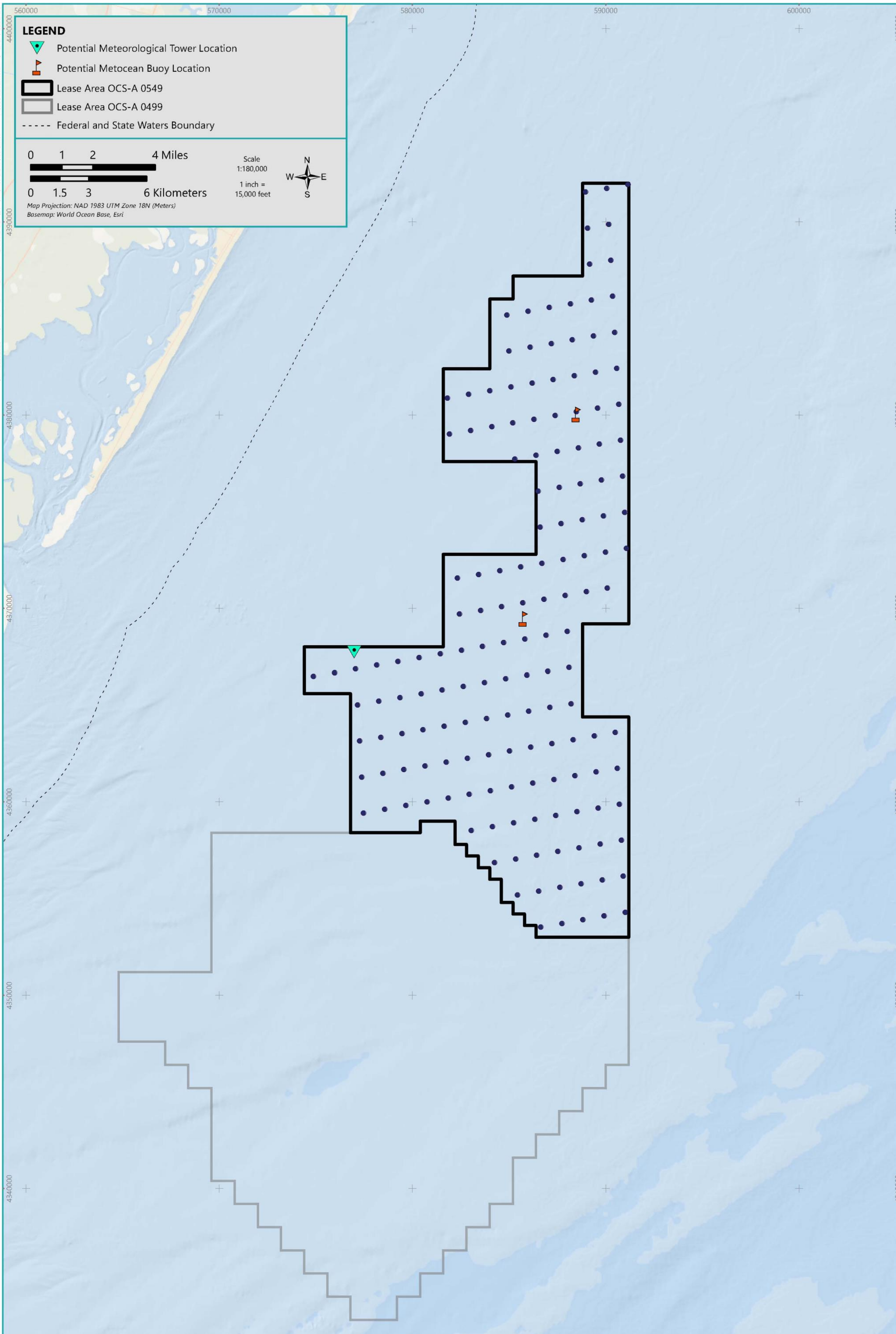





**Figure 7.6-1**

*Existing Aids to Navigation within the Region*




ATLANTIC SHORES
offshore wind

**Figure 7.6-2**
*Potential Met Tower and Metocean Buoy Locations*

The Lease Area boundary meets the distance requirements from the terminus of a TSS, thereby providing sufficient space for vessels departing the TSS to diverge in direction. The TSS entry and exit is also located to the east of the eastern boundary of the Lease Area and would not affect any vessels on a northbound or southbound course.

#### 7.6.1.2 Vessel Traffic

Vessel traffic in the Offshore Project Area makes use of waterways, ports, and other coastal infrastructure to move goods and passengers and is essential for the region's economy and security. Vessel traffic includes a variety of types including dry cargo and tanker vessels, recreational vessels, fishing vessels, and tug-barge vessels. Each of the specific vessel types operate differently and may have operational and navigational requirements that present unique needs based on other uses and activities within the Offshore Project Area.

The NSRA presents an assessment of vessel traffic within the Offshore Project Area based on AIS data from January 2016 through and including September 2021. AIS is not required for vessels shorter than 65 ft long, so not all vessels, particularly smaller fishing and recreational vessels, are equipped with AIS. For the NSRA, estimates were made of percentage of AIS and non-AIS equipped fishing and recreational vessels expected to transit the Lease Area. To address the fact that not all fishing and recreational vessels may have AIS, the AIS traffic volumes assumed in the risk modeling (see Section 7.6.2.4) were increased by 100% to account for fishing and recreational vessels. In addition, BOEM provided polar histograms (plots of the frequency of vessel tracks by track heading) developed from six years of VMS fishing vessel data (2014 to 2019, inclusive) that were considered.

Based on the NSRA, unique vessel types identified by AIS in the Lease Area include recreational craft, cargo vessels, commercial fishing vessels, tankers, tug-barge tows, other (misc. vessel categories), and passengers ships, in descending order of frequency. The AIS data indicated that most unique vessels entering the Lease Area were recreational craft (43%) and cargo (21%); however, most unique vessel tracks that traversed the Lease Area were by commercial fishing vessels (40%) and cargo (19%). Table 7.6-1 shows vessel types within the Lease Area based on the 2016-2021 AIS Data.

**Table 7.6-1. Vessel Types within the Lease Area Based on 2016–2021 AIS Data**

| Vessel Type | Unique Vessels | | Unique Tracks | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Cargo Vessels | 1,072 | 21% | 4,506 | 19% |
| Tankers | 264 | 5% | 447 | 2% |
| Passenger Vessels | 107 | 2% | 501 | 2% |
| Tug-barge Vessels | 243 | 5% | 1,770 | 8% |
| Recreational Vessels | 2,179 | 43% | 3,963 | 17% |
| Fishing Vessels | 522 | 10% | 9,398 | 40% |
| Other Vessels | 172 | 3% | 1,011 | 4% |
| Unspecified AIS Type | 515 | 10% | 1,841 | 8% |

| Vessel Type | Unique Vessels | | Unique Tracks | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Total (2016–2021) | 5,074 | 100% | 23,437 | 100% |
| Annual Average Vessel Tracks | - | - | 4.076 | - |

AIS data were used to determine vessel traffic densities in the Offshore Project Area, and the results of this analysis will be plotted and presented graphically in the NSRA. The traffic density for all vessels is concentrated in the nearshore and harbor areas west of the Lease Area and moderately heavy on north-south routes to the east of the Lease Area, as shown in Figure 7.6-3. The Lease Area itself is in a less traveled area between the nearshore areas to the west and the north-south routes to the east. The overall traffic density within the Lease Area was found to be relatively low, with two or more vessels present in the 81,129-acre (328.3 km$^2$) Lease Area for only 16.6% of the time (1,460 hours per year on average).

Larger ships, specifically cargo vessels, are the predominate users of the north-south routes to the east of the Lease Area, as shown in Figure 7.6-4. Some of this larger ship traffic has historically transited more densely through the far eastern part of the Lease Area. As shown in Figure 7.6-5, the primary tug-barge north-south route is closer to shore to the west of the Lease Area.

Smaller vessels, including recreational and fishing vessels (when transiting), tend to concentrate their traffic in the nearshore areas west of the Lease Area, with significantly less traffic within the Lease Area. Traffic densities for recreational vessels are shown in Figure 7.6-6; traffic densities for fishing vessels (when transiting) are shown in Figure 7.6-7. Traffic densities for fishing vessels (when transiting) are noticeably high in the vicinity of three major New Jersey commercial fishing ports: Manasquan-Shark Inlet, Long Beach-Barnegat, Atlantic City, and Cape May-Wildwood. Fishing vessels (when fishing) are active within and to the east of the Lease Area, as shown in Figure 7.6-8.

Vessel densities relative to the ECC locations are shown in Figure 7.6-9 for the Monmouth ECC and Figure 7.6 10 for the Northern ECC. Vessel crossings occur across the length of the Monmouth ECC, but overall vessel traffic density along the Monmouth ECC is relatively low, with the highest concentration of traffic in the nearshore area adjacent to the cable landfall and offshore of Barnegat. Similarly, vessel crossings also occur across the length of the Northern ECC, with the highest concentration of traffic occurring nearshore at the landfall in New Jersey and within the confines of the New York Harbor to Sandy Hook, New Jersey.

AIS data were also queried within the Lease Area to establish a representative profile of seasonal and year-round activity. There is seasonality as to the number of vessels collectively transiting the Lease Area, varying from 6.7 transits per day on average in the winter to 13.1 transits per day in the summer. This seasonality is primarily driven by the fishing and recreational vessels as the transits of commercial (non-fishing) vessels were relatively consistent from month to month. Detailed descriptions of vessel traffic within the Offshore Project Area are provided within the NSRA.

Recently, the USCG has completed several Port Access Route Studies (PARS) to better define key navigational corridors along the Atlantic Coast with consideration of the various offshore wind lease areas. The *Atlantic Ocean Port Access Routing Study* (ACPARS), completed by the USCG in 2017, reviewed navigational traffic patterns over the entire eastern seaboard from Maine to Florida and outlined a series of navigational improvements including the creation of new fairways, traffic separation schemes (TSSs), and precautionary areas. In addition, a set of planning guidelines were developed to assist in the development of future recommendations with respect to the navigation of vessels near OREIs. Subsequently, the USCG undertook four supplemental PARS to examine port approaches and international entry and departure areas along the Atlantic Coast. One of these studies was the *Port Access Route Study for the Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware* (NJPARS). The NJPARS, finalized in March 2022, examined potential traffic fairways for the New Jersey and Delaware coastal waters to manage the navigation of large commercial vessels and the linkages to the offshore fairways. The study included extensive outreach to other government agencies and stakeholders, review of 10 years of search and rescue and marine data, analyses of AIS and VMS data, navigational risk modeling, and consideration of present vessel routing measures as well as the proposed changes under ACPARS. Interfaces with offshore renewable energy installations, anchorage practices, fishing vessel activity and offshore mineral exploration and mining were examined. Of importance to the Project, NJPARS endorsed the proposed ACPARS vessel routing measures but with some adjustment of the fairways to minimize conflicts with the offshore wind lease areas.

While the supplemental PARS were ongoing, the USCG published an *Advanced Notice of Proposed Rulemaking* (ANPRM, USCG 2020) seeking comments regarding the creation of the fairways identified in the ACPARS. On August 31, 2022, the USCG published the *Consolidated Port Approaches and International Entry and Departure Transit Areas Port Access Route Studies* (CPAPARS) that consolidated the recommendations of the four supplemental PARS, including NJPARS, with approved recommendations and alternatives for a comprehensive system of shipping safety fairways and routing measures along the Atlantic Coast.

Of relevance to this Project, three additional fairways are recommended, but not presently designated, by the CPAPARS in the immediate proximity of the Lease Area, as shown in Figure 7.6-11. The proposed New Jersey to New York Connector Fairway is located immediately west of the Lease Area. This fairway was proposed in the NJPARS primarily for tug/tows and other vessels which typically stay closer to shore when transiting from Delaware Bay to the Ambrose to Barnegat TSS (and the reverse course). The St. Lucie to New York Fairway is likewise proposed for vessels transiting from Florida to New York (and the reverse course). Lastly, the Barnegat to Narragansett Fairway is proposed immediately north of the northern edge of the Lease Area.

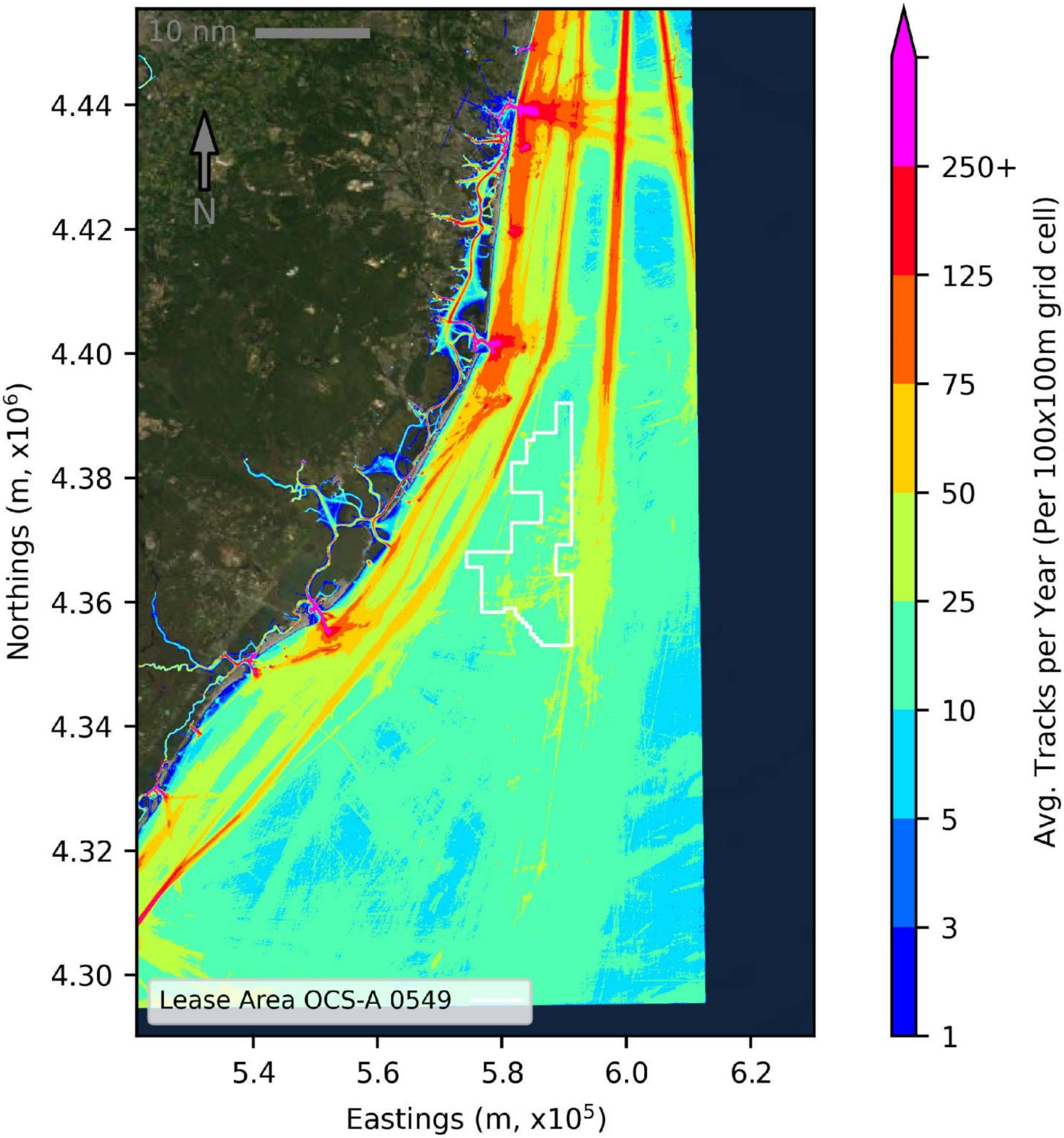





**Figure 7.6-3**
*AIS Vessel Traffic Density for All Vessels in the AIS Coverage Area*

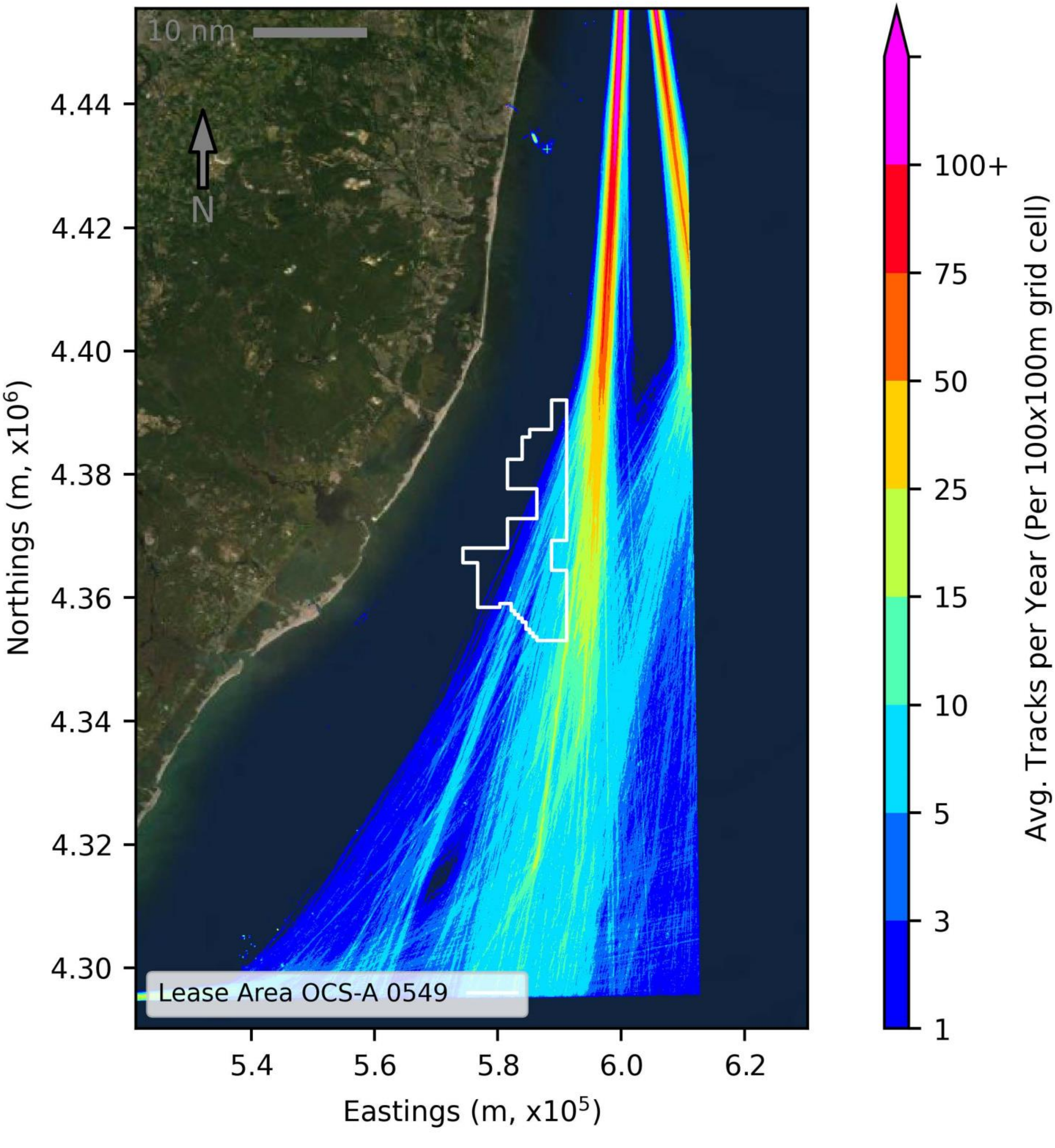





**Figure 7.6-4**
*AIS Vessel Traffic Density for Cargo Vessels in the AIS Coverage Area*

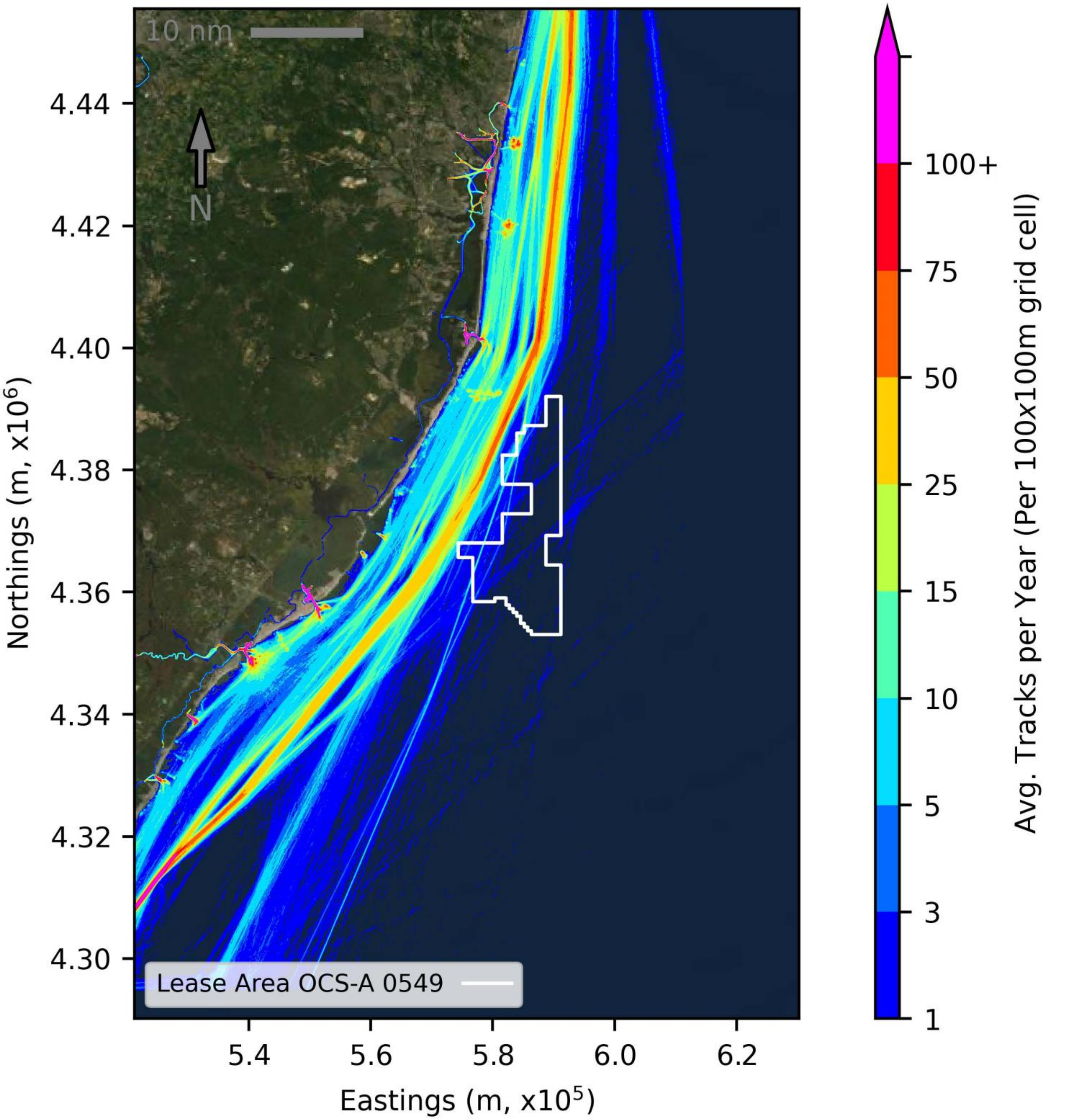





**Figure 7.6-5**
*AIS Vessel Traffic Density for Tug Tows*

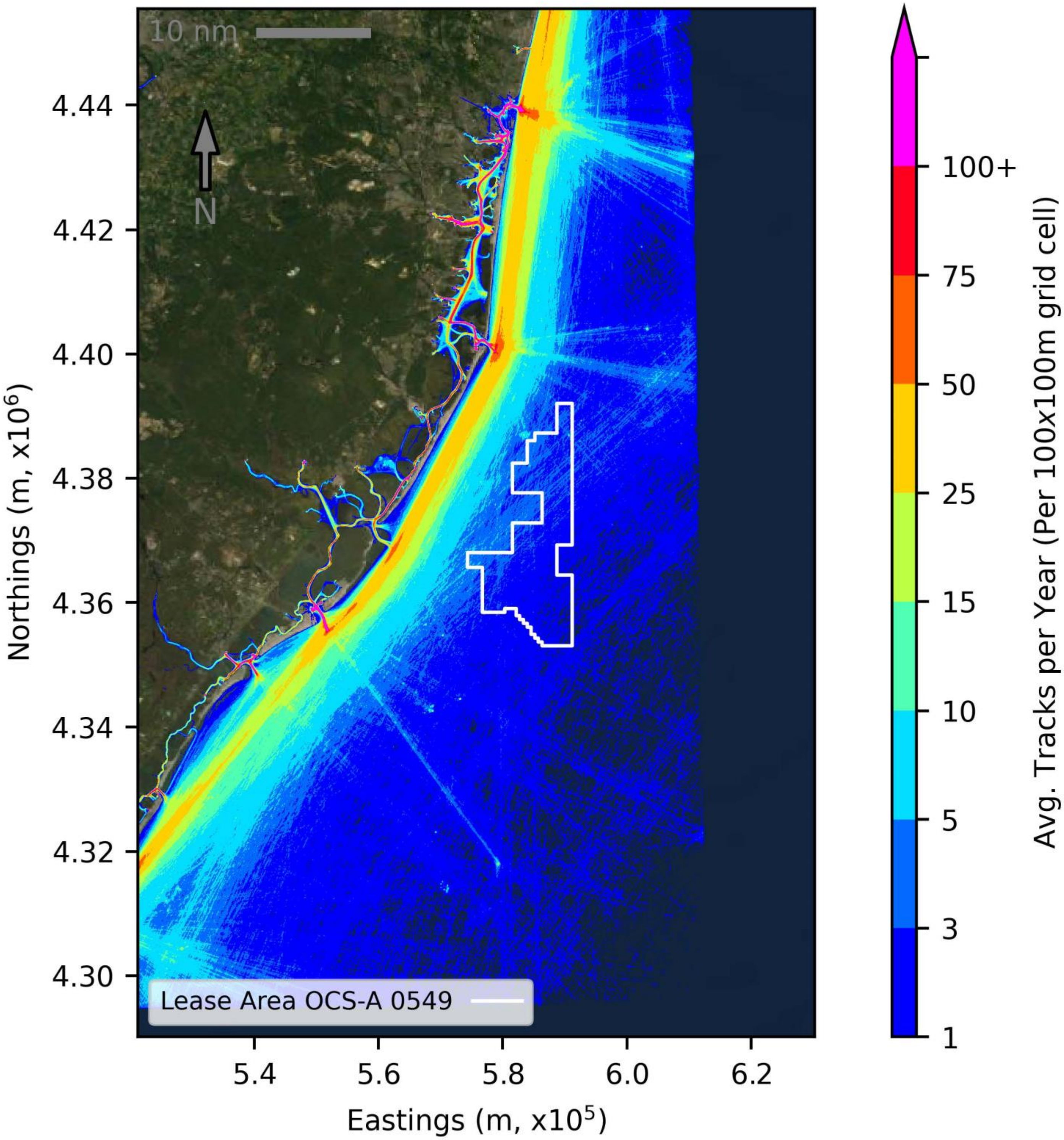





**Figure 7.6-6**
*AIS Vessel Traffic Density for Recreational Vessels*

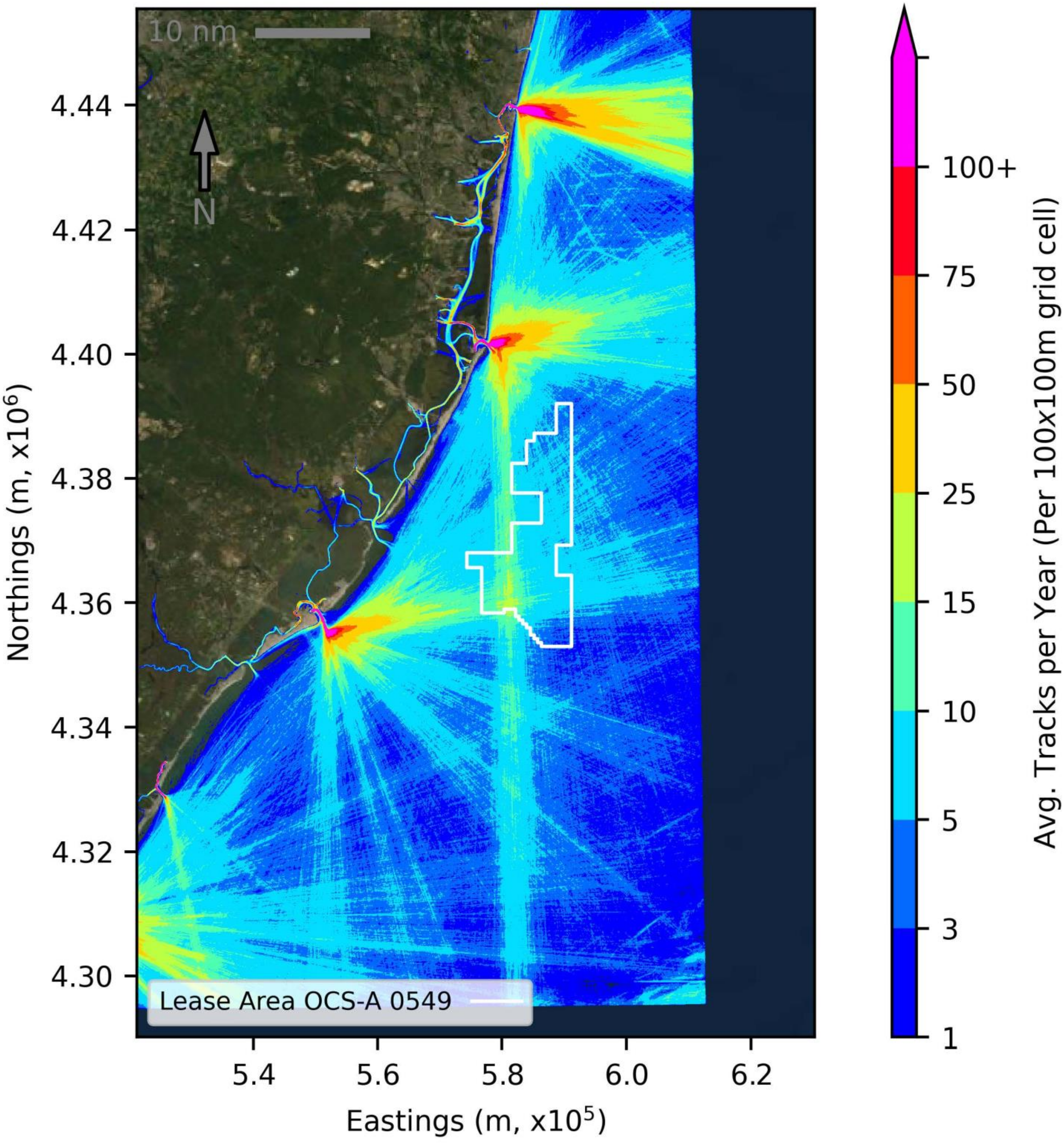





**Figure 7.6-7**

*AIS Vessel Traffic Density for Transiting Fishing Vessels (Greater Than 4 Knots) Through the AIS Coverage Area*

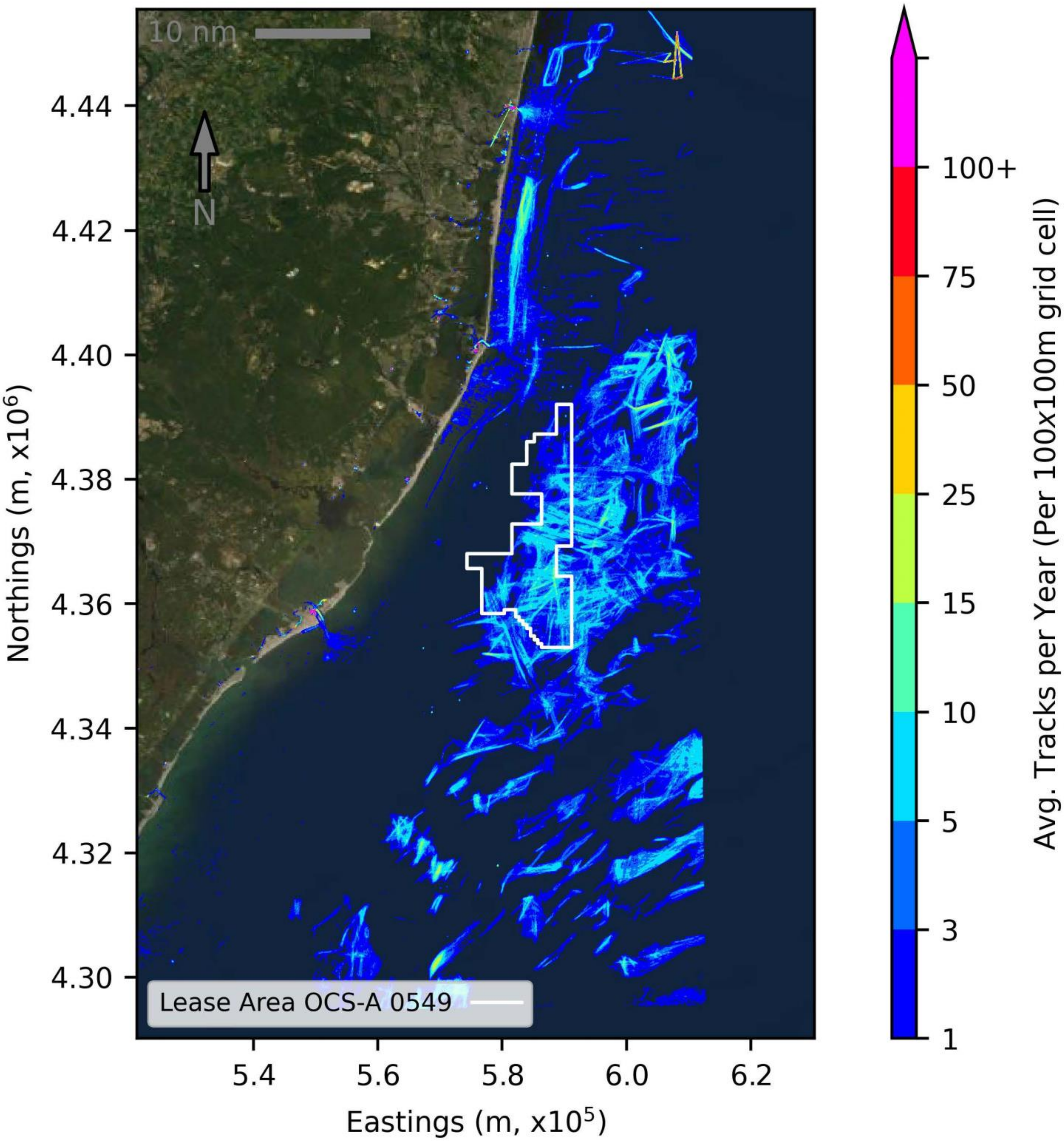





**Figure 7.6-8**
*AIS Vessel Traffic Density for Fishing Vessels (Less Than 4 Knots) in the AIS Coverage Area*

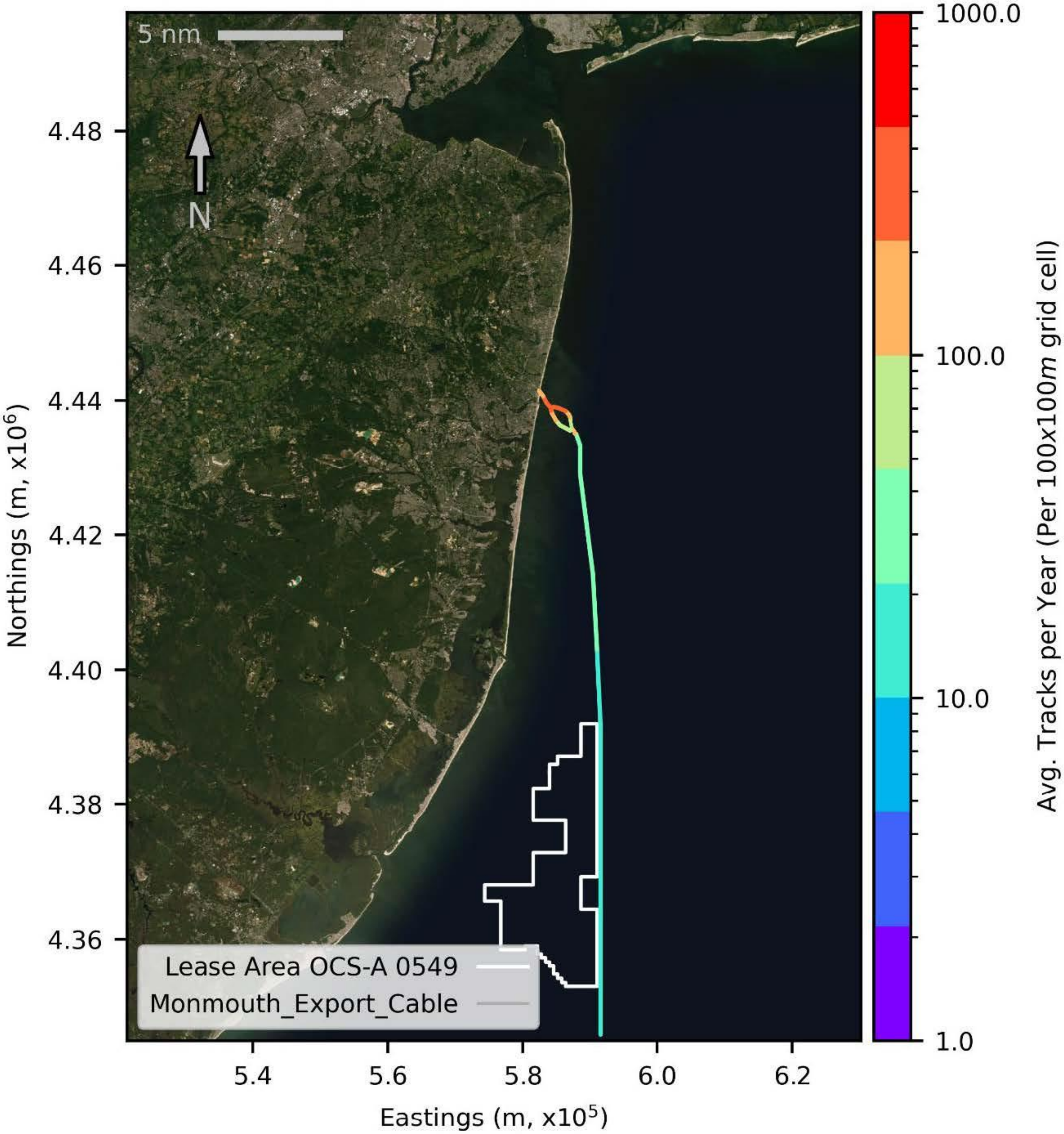





**Figure 7.6-9**
*Track Density for Vessels Crossing the Monmouth ECC*

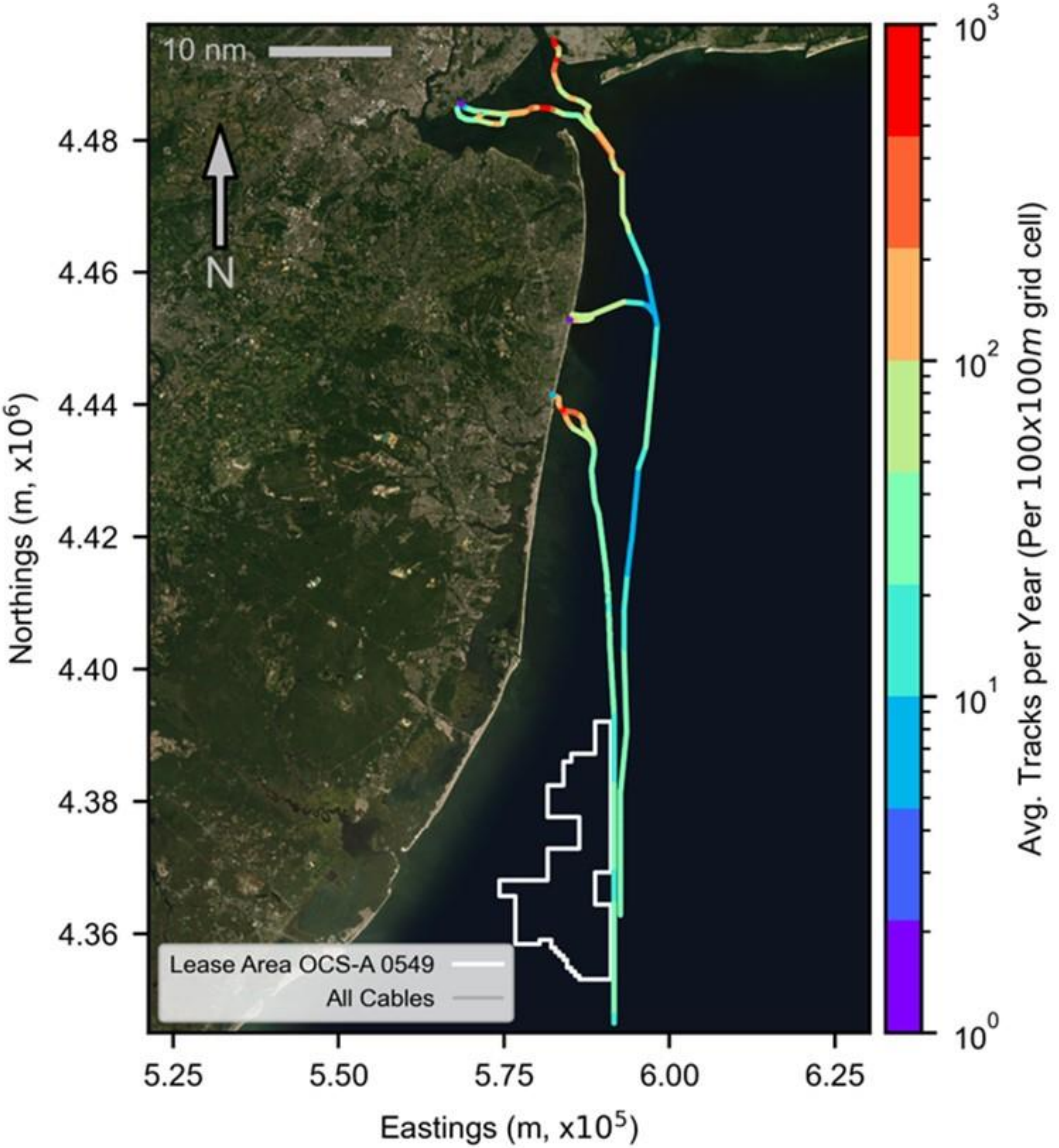





**Figure 7.6-10**

*Track density for Vessels Crossing the Monmouth and Northern ECCs*

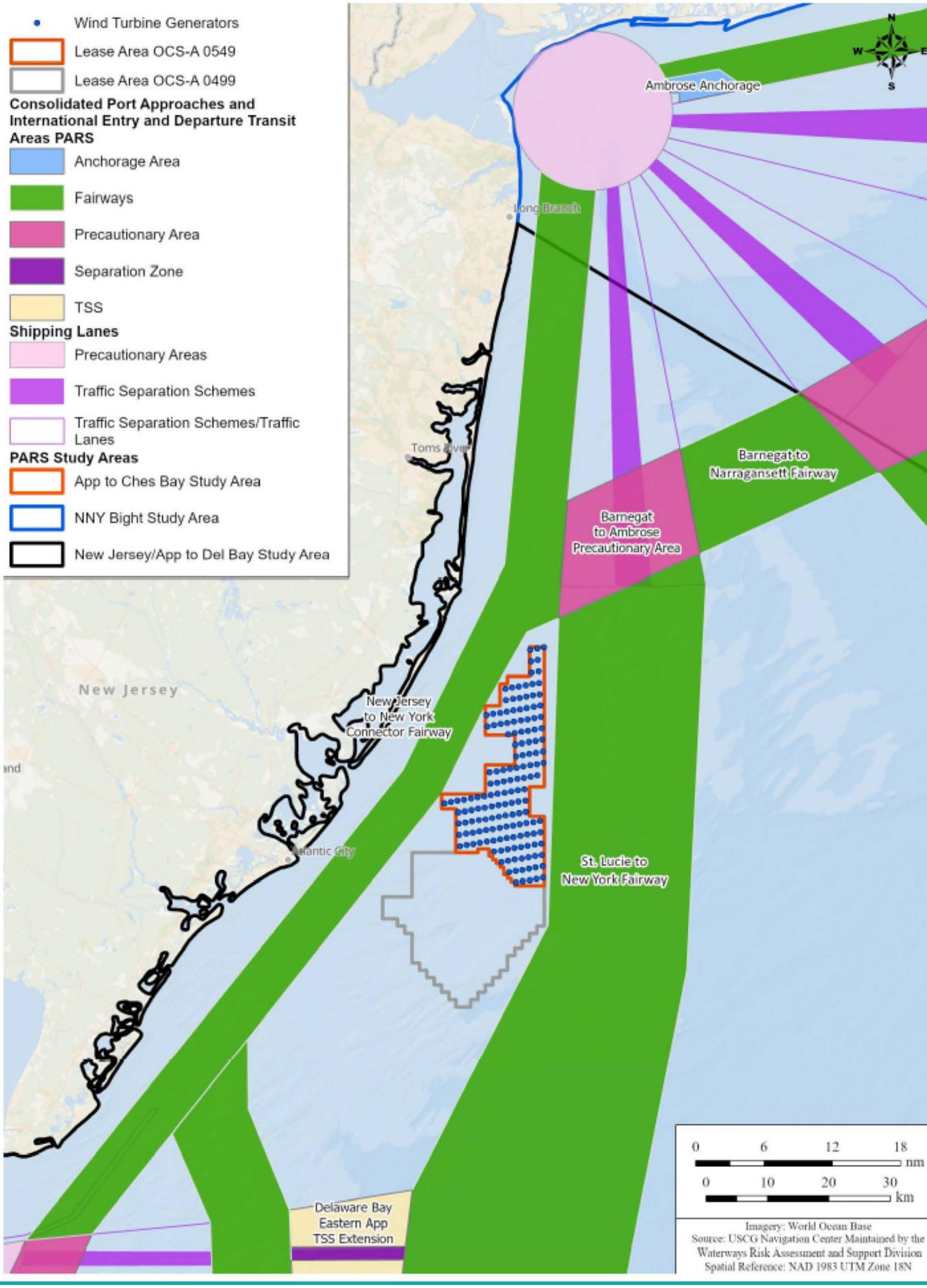





**Figure 7.6-11**
*Existing and Proposed Transit Routes*

### 7.6.2 Potential Impacts and Proposed Environmental Protection Measures

The potential IPFs which may affect navigation and vessel traffic during Project construction, O&M, or decommissioning are presented in Table 7.6-2.

**Table 7.6-2. Impact Producing Factors for Navigation and Vessel Traffic**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel and Aircraft Traffic | ● | ● | ● |
| Installation and Maintenance of New Structures and Cables | ● | ● | ● |
| Presence of Structures | ● | ● | ● |
| Collisions and Allisions | ● | ● | ● |

The maximum Project Design Envelope (PDE) analyzed for potential effects to navigation and vessel traffic is the maximum offshore build-out of the Project (see Section 4.11 of Volume I).

#### 7.6.2.1 Vessel and Aircraft Traffic

Project construction, O&M, and decommissioning will require use of vessels and aircraft that will affect navigation in the Offshore Project Area including transiting vessels and vessels that are actively fishing. During construction, a variety of vessels will be needed to support the installation of major Project components including foundations, offshore substations (OSSs), wind turbine generators (WTGs), scour protection, and offshore cables. Vessels to support fuel bunkering may also be used. Representative vessel types that may be used for each of these activities are provided in Table 4.10-1 of Volume I and include jack-up vessels, heavy lift vessels, tugs, barges, cable laying vessels, dredgers, feeder vessels, fall pipe vessels, crew transfer vessels (CTVs), service operations vessels (SOVs), and others. Helicopters may also be used for crew transfer or visual inspection of equipment.

The actual level of vessel activity within the Lease Area and ECCs during construction will depend on the final design of the offshore facilities and on selection of specific vessel types and logistics approaches. Currently, maximum estimates for the total number of vessels required for any single offshore construction activity range from two vessels for scour protection installation to up to 16 vessels for offshore substation installation. For the export cable installation, it is currently estimated that up to six vessels could be operating at once. In the unlikely event that all construction activities were to occur simultaneously, a total of 24 vessels could be present at any one time. These estimated counts do not reflect vessel movement, as some construction vessels will work stationary for longer periods of time. The Project will collectively require a total of approximately 4 to 12 daily transits (equivalent to 2 to 6 daily round trips) between construction staging port facilities under consideration and the offshore construction areas. Because many of the construction activities are sequential both within and across the Project, not all vessels involved in a given activity will be operating simultaneously. Additionally, many of the construction vessels will remain in the Lease Area or ECCs for days or weeks at a time and will not be transiting to construction staging port facilities on a frequent basis.

Vessel use during O&M will be based around either a CTV or SOV logistical approach. As described further in Section 5.6 of Volume I, CTVs enable faster, more practical transport of personnel and equipment to offshore Project infrastructure, while SOVs are relatively large vessels that offer considerable capacity for crew and spare parts, allowing for service trips that are several weeks in duration. Representative images of CTVs and SOVs are shown on Figure 5.6-1 in Volume I. In addition, SOVs commonly use smaller daughter craft and can have helipads to support use of helicopters to shuttle personnel and equipment to, from and within the Lease Area.

In addition to the use of CTVs and SOVs, survey vessels will likely be used for routine inspections. Surveying, monitoring, and inspection may also be conducted by unmanned aerial vehicles (UAVs), remotely operated vehicles (ROVs), and underwater drones. Larger support vessels (e.g., jack-up vessels) may be used infrequently to perform routine maintenance activities, periodic corrective maintenance, and significant repairs (if needed). Cable laying vessels may also be used to support cable repairs if needed.

An estimated five to 11 vessels are expected to operate in the Offshore Project Area at any given time during normal O&M activities in support of the Project, though additional vessels (a maximum of up to 22 vessels) may be required in other maintenance or repair scenarios. The total annual estimated round trips for the Project ranges from 550 to 2,050 depending on if SOVs or CTVs are primarily used, respectively. The average number of vessel round trips per day in support of the Project is estimated at two for SOV use or six for CTV use (equivalent to four to 12 transits; each round trip consists of two transits). These vessel trips may be supplemented by helicopters to assist in personnel transport. The actual level of vessel activity during O&M activities will depend on the specific maintenance needs that develop as well as the final design of the offshore facilities.

Vessel operations and frequency may increase near the port facilities during construction, O&M, and decommissioning. Vessel and port utilization will be highest during construction and decommissioning. Also, use of larger vessels will be more prevalent during the installation phase. The potential ports and surrounding waterways are expected to have the capacity for potential vessel traffic during all Project-related activities. Further, Atlantic Shores has defined a wide range of port options, which will allow use of the most appropriate port facilities for a given activity, including consideration of the capacity of a port to accommodate the planned vessel traffic.

Atlantic Shores is proposing to utilize existing port and maintenance facilities for O&M activities. If Atlantic Shores employs Service Vessels, they would likely be operated out of existing ports such as Atlantic City and/or Lower Alloways Creek Township in New Jersey, the Port of New Jersey/New York, or another industrial port identified in Table 4.10-2 in Volume I.

To ensure minimum effect on existing maritime activities, Atlantic Shores will establish a Marine Coordinator who will be charged with monitoring daily vessel movements, implementing communication protocols with external vessels both in port and offshore to avoid conflicts, and monitoring safety zones. Communications with external vessels will begin prior to construction and will continue throughout the construction process. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. To provide construction zone control, the Marine Coordinator will employ radio communications and safety vessels to address any vessels entering the construction zone.

The Marine Coordinator will be responsible for coordinating with the USCG for any required Local Notices to Mariners (LNMs), and, during construction, will be the primary point of contact with the USCG, port authorities, State and local law enforcement, marine patrol, port operators, and commercial and for-hire fishing vessel operators. As described below, Atlantic Shores will inform mariners of construction activities, including the anticipated locations of those activities by the Marine Coordinator, allowing vessels to alter their navigation routes if needed to avoid affected areas. Measures to minimize effects to mariners include:

- Atlantic Shores will regularly distribute updated asset and operational awareness bulletins showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines, and relevant contact information.
- Atlantic Shores will also publish announcements and share updates with print and online industry publications and local news outlets.
- All construction and installation vessels and equipment will display the required navigation lighting and day shapes[66] and make use of AIS as required by the USCG.
- Atlantic Shores has developed a "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) containing the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and Fisheries Liaison Officer (FLO) and Fisheries Industry Representative (FIR) contact information.
- Atlantic Shores also expects to establish specific methods for communicating with fishermen while they are at sea including establishing a 24-hour phone line to address any real-time operational conflicts and/or safety issues.
- Atlantic Shores will also engage with fishing tournament organizers to make them aware of planned Project vessel activity.

Additional mitigation measures are provided within the NSRA (Appendix II-T).

#### 7.6.2.2 Installation and Maintenance of New Structures and Cables

Project-related vessels will need to be positioned within defined work areas during installation and maintenance of new offshore structures (primarily the WTGs and OSSs) and offshore cables (export, inter-link, and inter-array). Atlantic Shores will coordinate with the USCG to designate Safety Zones at working areas, or other means as considered appropriate, that may result in minor disruptions to navigation. These Safety Zones will only cover a small portion of the Lease Area at any one time.

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66 Day shapes are mast head signals visually indicating the status of a vessel to other vessels on navigable waters during daylight hours whether making-way, anchored, or aground.

During construction, temporary disruptions to navigation may occur in the Lease Area due to installation activities, with vessel usage mostly concentrated around specific WTG and OSS locations during installation of foundations, OSS topsides, WTGs, and scour protection. Similarly, minor disruptions to navigation will occur along ECCs due to the temporary presence of cable laying vessels. The Northern ECC may encroach into the Ambrose to Barnegat TSS outbound lane by up to 1,640 ft (500 m) over a distance of approximately 12 nm (22.2 km) in order to avoid impinging on designated sand resource extraction areas and other seabed constraints. The TSS lane does have a width ranging from 11,000 ft (3,353 m) to greater than 18,000 ft (5,486 m) in this area, and it is not expected that the cable laying operation will have a significant effect on commercial traffic. All construction areas will have temporary safety buffer zones where other traffic will be temporarily precluded. Atlantic Shores anticipates that only a limited area surrounding the installation activity will be affected at any given time, leaving surrounding areas available for navigation. Similar effects and activities will take place during decommissioning.

During O&M, many maintenance activities will be based from the WTGs or OSSs and will not require in-water work other than vessels transporting technicians. More significant and less frequent maintenance procedures may require in-water work and vessels to support those procedures; however, Atlantic Shores expects that vessel use during the O&M phase will be reduced relative to vessel use during construction or decommissioning. When WTG, OSS, or cable maintenance or repair is needed, temporary safety zones will be established around maintenance vessels and activities. Minor changes to vessel traffic patterns and transit times may occur within the Lease Area or in the vicinity of the ECC as vessels route around the O&M vessel and its associated safety buffer zone temporarily during maintenance repair work. Survey vessels will also be used during the O&M phase for annual inspections, but any potential disruption to navigation from survey vessel use will be limited.

Through Atlantic Shores' efforts to issue timely updates on Project activities through its Marine Coordinator as described in Section 7.6.2.1, Atlantic Shores expects that vessels transiting the Offshore Project Area will be able to avoid any Project vessels and associated safety zones by adjusting departure and arrival times, courses, and/or planned routes.

#### 7.6.2.3 Presence of Structures

The presence of structures (including WTGs, OSSs, offshore cables, cable protection, and scour protection) may affect vessel traffic, search and rescue (SAR) activities, marine radar and communications, and other activities.

##### Effects on General Navigation

During O&M, the Lease Area and ECCs will be open to marine traffic, other than any temporary safety zones required during limited maintenance activities. As described in Section 7.6.1.2, the Lease Area is not generally subject to dense traffic, which limits the scale of potential navigational effects.

The WTGs will be aligned in a uniform grid pattern with multiple lines of orientation allowing straight transit through the Lease Area for vessel traffic. The WTG layout provides uniform rows in an east-northeast to west-southwest direction spaced 1.0 nm (1.9 km) apart and rows in an approximately north to south direction spaced 0.6 nm (1.1 km) apart. Additionally, the WTG grid will create diagonal corridors oriented approximately northwest-southwest that are 0.54 nm (1.0 km) wide and diagonal corridors oriented approximately north-northeast that are 0.49 nm (0.9 km) wide (Figure 7.6-11). The OSSs will also be located along the same east-northeast to west-southwest rows as the WTGs, thereby preserving 1.0 nm-wide (1.9 km-wide) corridors between structures. Atlantic Shores will position the OSSs within a maximum of two north to south corridors to preserve the spacing in the majority of the north to south transit corridors. Potential OSS locations are shown on Figure 7.6-13.

The proposed WTG and OSS layout has been designed to facilitate the transit of vessels through the Lease Area based on a review of existing traffic patterns. The 1.0 nm (1.85 km) east-northeast corridors will accommodate all the existing AIS-equipped fishing fleet and 99.6% of the AIS-equipped recreational vessels. A 0.60 nm (1.1 km) corridor will accommodate 99.5% of the fishing fleet and 97% of the recreational vessels. A 0.54 nm (1.0 km) diagonal corridor will accommodate 98.5% and 94.8% of the fishing and recreational vessels, respectively.

Atlantic Shores anticipates that larger commercial vessels (e.g., cargo, tanker, passenger, and tug-barge vessel[s]), which have dominant north-south headings, will route around the Lease Area and not through it. While rerouting around the Lease Area may add to transit time for these vessels, the increase in duration is typically 15 to 20 minutes or less.

Atlantic Shores has developed the layout of the Project in consideration of commercial fishing patterns and in close coordination with the surf clam/quahog dredging fleet, which is the predominant commercial fishery within the Lease Area (Section 7.4 Commercial Fisheries and For-Hire Recreational Fishing). Prior to the segregation of Lease Area OCS-A 0549 from Lease Area OCS-A 0499, an independent study was conducted by Last Tow LLC on behalf of representatives of the New Jersey surf clam industry to provide Oceanside Marine (a clam fishing fleet based in Atlantic City) and LaMonica Fine Foods (a seafood processor in Millville, New Jersey) with a better understanding of fishing vessel traffic characteristics within the original Lease Area (Azavea 2020). Based on 2008-2019 Vessel Monitoring System (VMS) data for several surf clam/quahog fishing vessels that operate in the Lease Area, the study found that a significant majority of fishing vessel traffic (towing and transiting) had headings between east to west and east-northeast to west-southwest (with an average heading of 80 degrees from true north). This finding was supported by an analysis of VMS data for period 2014 to 2019 conducted by BOEM for original Lease Area as well as by an analysis of three years (2017-2019) of Automatic Identification System (AIS) data to be included in the Project's NSRA, which showed that 48% of fishing vessels transit the Lease Area along tracks that range in orientation between east to west and northeast to southwest. A large proportion of the fishing vessel traffic (approximately 40%) and the recreational vessel traffic (50%) also transit approximately north to south (a sector defined by track orientations of north-northwest to south-southwest and north-northeast and south-southwest); this traffic will be accommodated by the approximately north to south corridors. Based on the findings of those studies and consultation with USCG and commercial fishing representatives, Atlantic Shores developed a uniform grid layout of facilities with east – northeast and west – southwest transit corridors across both Lease Area OCS-A 0549 and OCS-A 0499.[67]

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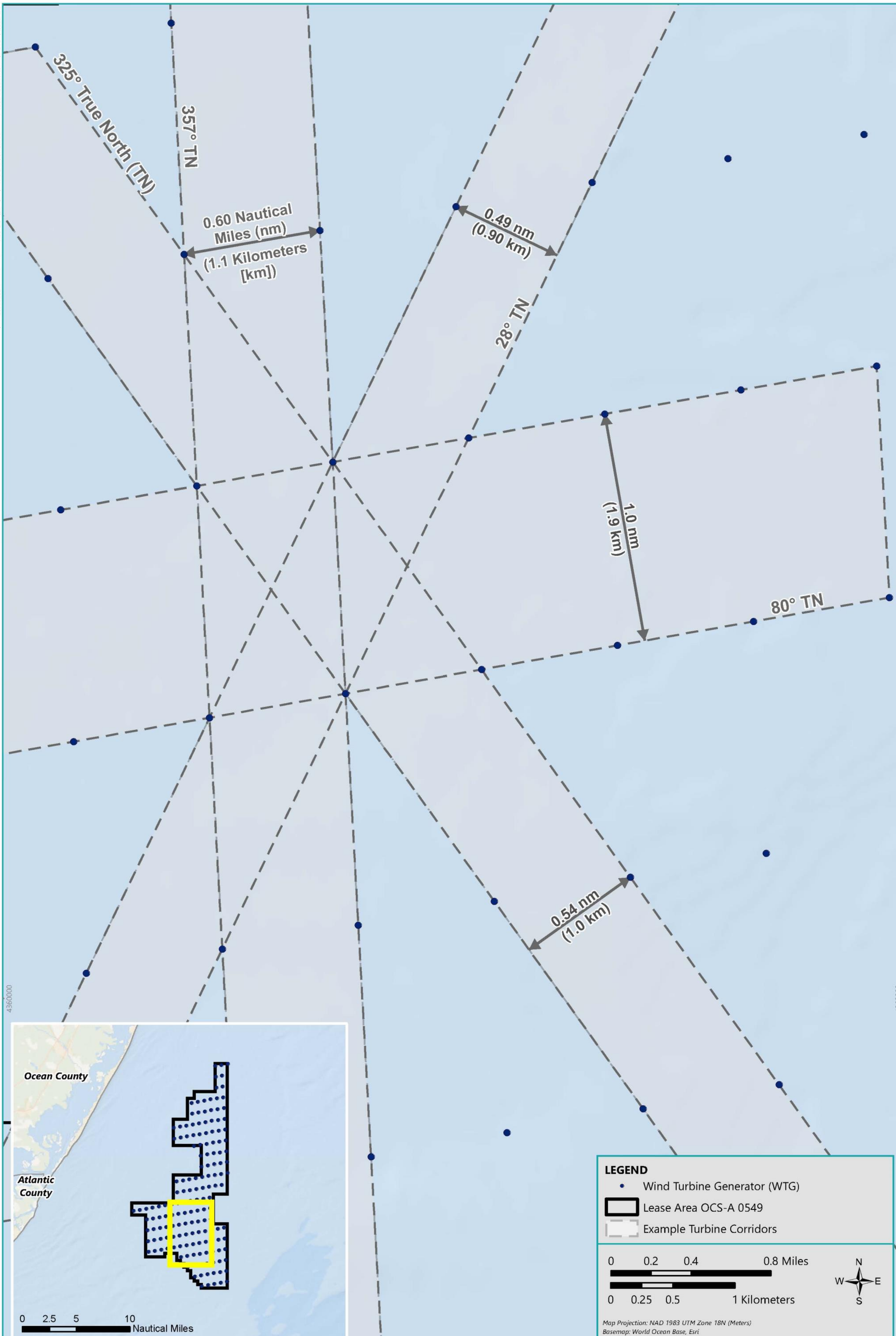
[67] The north to south rows are oriented at 357 degrees true north.

While the layout is designed to facilitate existing vessel traffic patterns, Atlantic Shores recognizes that the presence of the WTGs and OSSs may affect commercial and recreational fishing. Potential effects are described in Section 7.3 - Recreation and Tourism and Section 7.4 - Commercial Fisheries and For-Hire Recreational Fishing.

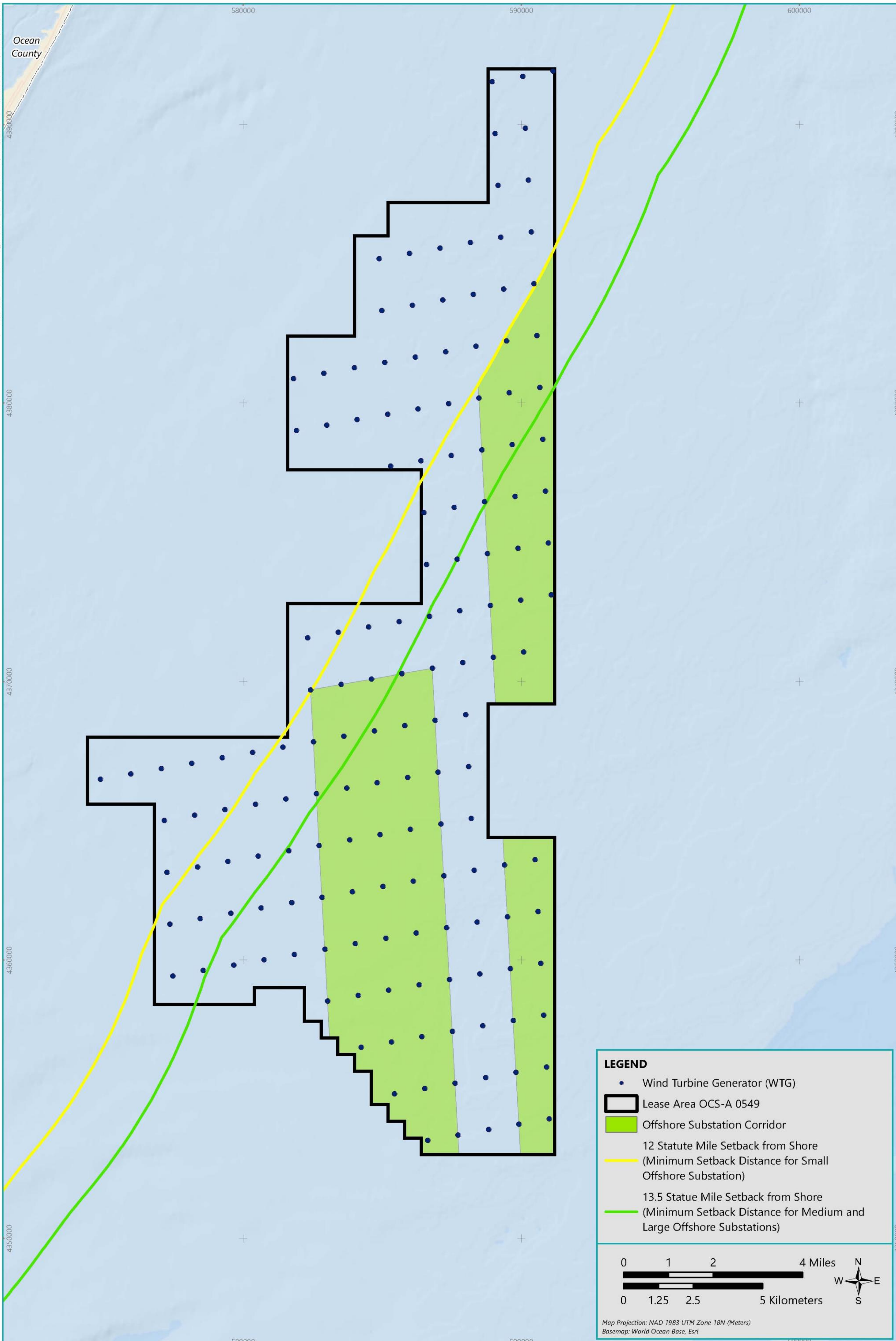
Sailboat excursions will need to consider the presence of Project components in the Lease Area. Large sailing craft transiting in this region may have mast heights that exceed the minimum rotor tip clearance from water surface and may elect to travel around the WTG field rather than through it. The minimum rotor tip clearance is 72.2 ft (22.0 m) relative to Highest Astronomical Tide (HAT) or 78 ft (23.8 m) relative to Mean Lower Low Water (MLLW). This clearance assumes calm conditions and presence of waves will reduce the clearance further. Atlantic Shores will provide information on the air draft restrictions in the Lease Area to the USCG and NOAA, so that these restrictions can be identified by means of LNMs and on navigational charts. Note that sailing vessels are at little risk of interacting with the WTGs under normal conditions.

In addition to selecting a layout to facilitate vessel transit through the Lease Area, Atlantic Shores will further minimize and mitigate effects by marking and lighting all structures in accordance with BOEM and USCG guidelines. To aid mariners navigating within and near the Lease Area, each WTG position will be maintained as a PATON. Atlantic Shores will work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities. Based on USCG District 5 LNM 23/22and BOEM (2021) Guidance on Light and Marking of Structures, Atlantic Shores expects to include unique alphanumeric identification on each WTG and/or foundation, lights on each foundation that are visible in all directions, and sound signals on select foundations. AIS will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG. Additionally, Atlantic Shores is engaged in conversations with the fishing industry and other offshore wind developers to provide consistency in lighting and marking across projects and is also working with NOAA Coast Survey on hydrographic charting tools to label foundations. Hydrographic charts are becoming all virtual, and replacing paper charts, providing near real-time information for mariners.




ATLANTIC SHORES offshore wind

**Figure 7.6-12**
*Lease Area Layout*




ATLANTIC SHORES offshore wind

**Figure 7.6-13**
*Offshore Substation Locations*

## Effects on Search and Rescue

Using vessel and helicopter assets, the USCG conducts SAR missions for incidents including vessels capsizing, disabled vessels, vessels taking on water, and persons in water. A review of 10 years (2011 to 2020) of historical USCG SAR data for the coastline of New Jersey documented that there were five SAR incidents within the Lease Area during this 10-year period. This is an average frequency of 0.5 incidents per year. Commercial salvors also conduct operations to assist disabled vessels in the area.

The WTG layout may have some effect on the operation of USCG marine assets (or commercial salvors vessels) that are in use in the area, although it is expected that these assets will be able to safely navigate and maneuver adequately within the Lease Area. However, search patterns would need to be adapted for the presence of the structures and would be constrained by the WTG layout. Atlantic Shores anticipates that the Project will not affect travel times to and within the Lease Area by vessels responding to SAR distress calls.

The Project is not expected to preclude helicopter use in the Lease Area. The USCG (2020) Massachusetts and Rhode Island Port Access Route Study (MARIPARS) undertook a detailed assessment of the effect of WTG spacing on aerial SAR and identified that a 1 nm (1.9 km) corridor spacing was sufficient for safe use. To address aerial SAR, a Risk Assessment Workshop was held in July 2021 to methodically review the potential impacts of the proposed offshore wind projects within the Lease Area on USCG SAR operations and to identify safeguards and additional recommended measures to mitigate identified concerns. The workshop was held over a two-day period with participation by the USCG, BOEM, Atlantic Shores, and the New Jersey Department of Environmental Protection. The workshop team evaluated 13 hazardous scenarios in four hazard categories and identified 16 recommendations to support the reduction of overall risk to USCG aerial SAR missions (See Appendix II-T4). Atlantic Shores will review these recommendations in coordination with the USCG and key stakeholders and may elect to implement recommendations that could meaningfully reduce risk to manageable levels and meet other Project criteria. As part of this work, various possible mitigations to aid in detection of disabled vessels or persons in water are being considered, as summarized below. The Project includes significant measures to avoid, minimize, or mitigate effects to SAR, all of which were evaluated in the Risk Assessment Workshop:

- a Marine Coordinator to liaise with the USCG as required during SAR activity within Lease Area, particularly with emergency braking of selected WTG rotors
- clear alphanumeric marking of WTGs and OSSs to assist in communication of location(s)
- provision of access ladders on Project structures for distressed mariners to access an open refuge area above the splash zone. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors
- possible mitigations to assist in search detection, including installation of very high frequency (VHF) direction finding equipment, real-time weather measurements (waves, wind, currents), and high-resolution infrared detection systems to assist in location of persons in water and/or vessels

- development of an Emergency Response Plan (ERP) to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.

**Effects on Marine Radar and Communications**

Studies have been conducted to evaluate concerns that the WTGs may affect some shipborne radar systems, potentially creating false targets on the radar display or causing vessels navigating within the Lease Area to become "hidden" on radar systems due to shadowing created by the WTGs. The effectiveness of radar systems and any effects from WTGs will vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel). As has been identified in previous studies of this issue in Europe (BWEA 2007), the potential effects of WTGs may be reduced through adjustment of the radar gain control.

In 2021, at the request of BOEM, the National Academy of Sciences (NAS) conducted a study of the effects of WTGs on marine vessel radar based on a review of technical literature, information gathering sessions held with key stakeholders and analyses of radar data. It was identified that WTGs can affect marine radar systems in a situation-dependent manner. Distinctions were drawn between the older magnetron-based radar systems and the newer solid-state systems that can incorporate more sophisticated processing techniques. It was noted that there have been no field tests in offshore wind farms of these newer systems, and the NAS made recommendations for more comprehensive data collection efforts. A number of possible mitigations were identified including improved operator training, the requirement for smaller vessels to carry radar reflectors to improve detectability, the deployment of reference buoys adjacent to wind farms to give a reference target for appropriate adjustment of the radar gain, and the standardization of radar mounting procedures on vessels. The NAS also encouraged the development of improvements in solid-state radar design by manufacturers, noting that solid-state radar technology allows for signal processing methods and filtering to create WTG-resilient systems.

Accordingly, Atlantic Shores expects that radar operator training and dissemination of information regarding proper installation and adjustment of equipment will avoid or minimize effects to radar systems. The use of radar reflectors on small craft will be encouraged. Additionally, Atlantic Shores plans to use AIS to mark the presence of WTGs, which will further limit potential effects.

NOAA maintains a network of high-frequency radar (HF Radar) stations along the coastline, which are capable of inferring currents and wave heights offshore in high temporal and spatial resolution. These systems provide data that is used for a variety of purposes, including as input to USCG SAR missions, oil spill response, and marine navigation. HF Radar measurements may be affected by WTGs. To address this issue, a High Frequency Radar Wind Turbine Interference Community Working Group was established through funding by BOEM (Cahl et al., 2019) to examine potential mitigation strategies including additional signal filtering and various software improvements.

Based on a review of various studies conducted for existing offshore wind fields, the WTGs are expected to have little effect on VHF and digital select calling (DSC) communications or AIS reception.

### Other Effects on Marine Transportation

Other potential effects on marine transportation associated with the WTGs, OSSs, offshore cables, and other Project components include anchoring risk, attraction of more fishing activity to the Lease Area, and potential increased tour vessel traffic. The presence of offshore cables within the Lease Area and the ECCs is not anticipated to interfere with any typical anchoring practices, as there are no designated anchoring areas in the proximity of the Lease Area and ECCs. All offshore cables will have a target minimum burial depth of 5 to 6.6 ft (1.5 to 2 m) and a standard maximum cable burial depth of approximately 10 ft (3 m). Export cable burial depths may be increased to accommodate federal dredge channel requirements where necessary. The cable burial depth is based upon a cable burial risk assessment that considers vessel types and anchor use to develop a safe, protective target burial depth for the cables (see Appendix II-A3). Atlantic Shores has determined that the target burial depth is sufficient to protect the cables from unexpected anchoring, so anchoring is not expected to interfere with the presence of cables and O&M of the Project.

The presence of structures in the Lease Area may become an attraction for fishing. The foundations may create an artificial reef effect which could cause fish aggregation (see Sections 7.3 Recreation and Tourism and 7.4 Commercial Fisheries and For-Hire Recreational Fishing). This in turn could result in an increase in certain types of commercial and recreational fishing in the Lease Area.

#### 7.6.2.4 Collisions and Allisions

The frequency of collisions and allisions of marine vessels may be influenced by increased vessel traffic associated with the Project and the presence of new offshore structures (e.g., WTGs, OSS, etc.). Atlantic Shores conducted a quantitative risk assessment for existing conditions and post-construction within the Lease Area using Baird's proprietary Navigational and Operational Risk Model (NORM). The model utilizes raw AIS, wind, current, and visibility data as inputs along with the geometric layout and Project specific dimensions of the WTGs and OSSs. To account for non-AIS equipped vessels, fishing and recreational traffic volumes were conservatively increased by 100%, based on an analysis of the likelihood of AIS use for these vessel types. The model computes the risk of vessel collision and allision with an offshore structure or vessel-by-vessel category. Three different types of possible collision directions are considered: (1) head-on; (2) overtaking; and (3) crossing. Two types of allision are considered: (1) "drifting" allisions in which the vessel loses propulsion and/or steerage (i.e., mechanical failure); and (2) "powered" allisions in which the vessel strikes the turbine under power. The study area included the Lease Area as well as an approximate 3.8 nm (7 km) perimeter around combined area of Leases OCS-A 0549 and -0499 to best capture only the vessel traffic that may be appreciably affected by the installation. For this risk modeling, it was assumed that Lease Area OCS-A 0499 was fully constructed, and the calculated risk was the incremental risk created by the construction of Lease Area OCS-A 0549.

The NORM model estimated that the risk of accidents before and after construction of the WTGs and OSSs within the Lease Area may theoretically increase by a small amount in the future. The frequency of accidents changed from 0.090 accidents per year under existing conditions (a 11-year return period) to 0.103 to 0.107 accidents per year post-construction (a 9.7- to 9.4-year return period, respectively). This risk of accidents includes both risk to existing traffic and risk to Atlantic Shores' O&M vessels.

Considering only the risk to existing vessel traffic (i.e., excluding collisions between O&M vessels themselves or allisions by O&M vessels), the overall post-construction accident frequency drops to 0.101 to 0.103 accidents per year (a 9.9 to 9.7-year return period, respectively). This change from existing conditions represents one additional accident every 77 to 94 years, depending on the foundation type. Although the large commercial vessels (cargo, tug-barge, passenger, etc.) are anticipated to route around the Lease Area, the number of encounters, and hence risk of collision, with smaller craft (fishing and recreational vessels) is expected to remain about the same. The presence of the WTG/OSS structures does cause a small allision risk, but the routing of the fishing and recreational craft down defined corridors tends to offset this risk.

As noted, much of the increase in risk is associated with the increased volume of traffic due to the transits of O&M CTVs. It has been estimated that the Project will require a total of approximately four to 12 additional daily transits (equivalent to two to six round trips per day) in the Lease Area will occur due to these vessels, depending on the type of vessel utilized. For the purposes of the modeling, the upper end of the estimates (12 transits per day) was assumed, which was based on the use of CTVs staged from Atlantic City. It was also assumed that 12 CTV daily transits will occur to Lease Area OCS-A 0499. It is important to recognize that the CTVs will be modern, highly specialized vessels manned by professional crew. They will be outfitted with recent technology in terms of marine radar, AIS and chart display. These vessels also will have specified weather thresholds in which transits will not be carried out. These additional safety factors associated with the CTVs have not been considered in the modeling.

Atlantic Shores will minimize the risk of collisions and allisions by following the mitigation measures described in Sections 7.6.2.1 and 7.6.2.2. These include marking and lighting all structures in accordance with BOEM and USCG guidelines, maintaining each WTG position as a PATON, using AIS to mark each WTG position, including unique alphanumeric identification on each foundation, providing lights on each foundation that are visible in all directions, and including sound signals on select foundations. Atlantic Shores will continue to coordinate with BOEM and USCG on measures to maintain safe navigation.

#### 7.6.2.5 Summary of Proposed Environmental Protection Measures

Atlantic Shores is committed to avoiding, minimizing, and mitigating navigational risk and potential navigational use conflicts. This commitment includes the following environmental protection measures:

- A NSRA was conducted to assess navigation safety.
- An aerial SAR risk assessment with associated mitigation measures was prepared in coordination with the USCG, BOEM and other relevant stakeholders (see Appendix II-T4).
- All construction and installation vessels and equipment will display the required navigation lighting and day shapes[68] and make use of AIS as required by the USCG.

[68] Day shapes are mast head signals visually indicating the status of a vessel to other vessels on navigable waters during daylight hours whether making-way, anchored, or aground.

- The proposed WTG and OSS layout has been developed in consideration of commercial fishing patterns and in close coordination with the surf clam/quahog dredging fleet. The layout is designed to facilitate the transit of vessels through the Lease Area based on a review of existing traffic patterns.
- To facilitate safe navigation, all offshore structures will include marine navigation lighting and marking in accordance with USCG and BOEM guidance. Atlantic Shores will continue to work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities.
- Each foundation will include unique alphanumeric identification and lights that are visible in all directions, and sound signals on select foundations.
- AIS will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG.
- WTG, OSS, met tower, and met buoy positions will be maintained as PATONs.
- WTG and OSS foundations will be equipped with access ladders to allow distressed mariners access to an open refuge area above the splash zone. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors.
- The feasibility of installing VHF direction finding equipment, real time weather measurements, and high-resolution infrared detection systems to assist in detection of persons in water or vessels is being evaluated.
- An ERP will be developed to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.
- Updated asset and operational awareness bulletins will be regularly distributed showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines and relevant contact information. Atlantic Shores will also publish announcements and share updates with print and online industry publications and local news outlets.
- Prior to construction, Atlantic Shores will develop a mariner communication and outreach plan for vessel users / operators (commercial, vessels, military vessels, tug / tow vessels, etc.) that are not involved in the fishing industry (https://atlanticshoreswind.com/mariners).
- A "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and FLO and FIR contact information.
- Specific methods for communicating with offshore fishermen while they are at sea are being established, including a 24-hour phone line to address any real-time operational conflicts and/or safety issues.
- Offshore cables will be buried at a target depth of 5 to 6.6 ft (1.5 to 2 m). The cable burial depth is based upon a cable burial risk assessment that considers vessel types and anchor use to develop a safe, protective target burial depth for the cables (see Appendix II-A5).

- A Marine Coordinator will be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project Area. The Marine Coordinator will be responsible for coordinating with the USCG for any required LNMs.

## 7.7 Other Marine Uses and Military Activities

This section describes the various marine and military activities within the Offshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations and maintenance (O&M), and decommissioning. The Offshore Project Area includes the Lease Area, the Monmouth Export Cable Corridor (ECC), and the Northern ECC.

The State and Federal waters associated with the Offshore Project Area support a variety of marine-based uses. This section specifically addresses military facilities, sand resources, offshore energy, cables and pipelines, and scientific research and surveys occurring within or proximate to the Offshore Project Area.

Marine uses associated with recreation and tourism, commercial fisheries and for-hire recreational fishing, navigation and vessel traffic, and aviation and radar are addressed separately in Sections 7.3, 7.4, 7.6, and Section 7.8, respectively.

### 7.7.1 Affected Environment

Existing marine uses and military activities occur in the outer continental shelf (OCS) waters of the Lease Area to the nearshore and intertidal waters along the ECCs to each landfall site. The characterization of other marine uses in the affected environment is based on targeted assessments, State and Federal agency publications, online data portals, and mapping databases.

### 7.7.2 Military Facilities

Of the United States Armed Forces with installations and operations in the vicinity of the Project, the U.S. Navy and U.S. Coast Guard (USCG) (Department of Homeland Security [DHS]) have the most significant presence in and around the Offshore Project Area. Figure 7.7-1 shows the location of military facilities within New Jersey and the southern area of New York and Table 7.7-1 provides a brief description of each military Facility's mission and/or purpose. Atlantic Shores has been conducting outreach to the Department of Defense (DoD), inclusive of the U.S. Army, Navy, Marines, and Air Force, to discuss Projects within their Lease Areas since 2019. Atlantic Shores has also been in regular contact with the USCG, especially with respect to navigational safety and Search and Rescue (SAR) efforts. See Appendix I-A which includes a summary of coordination with agencies.

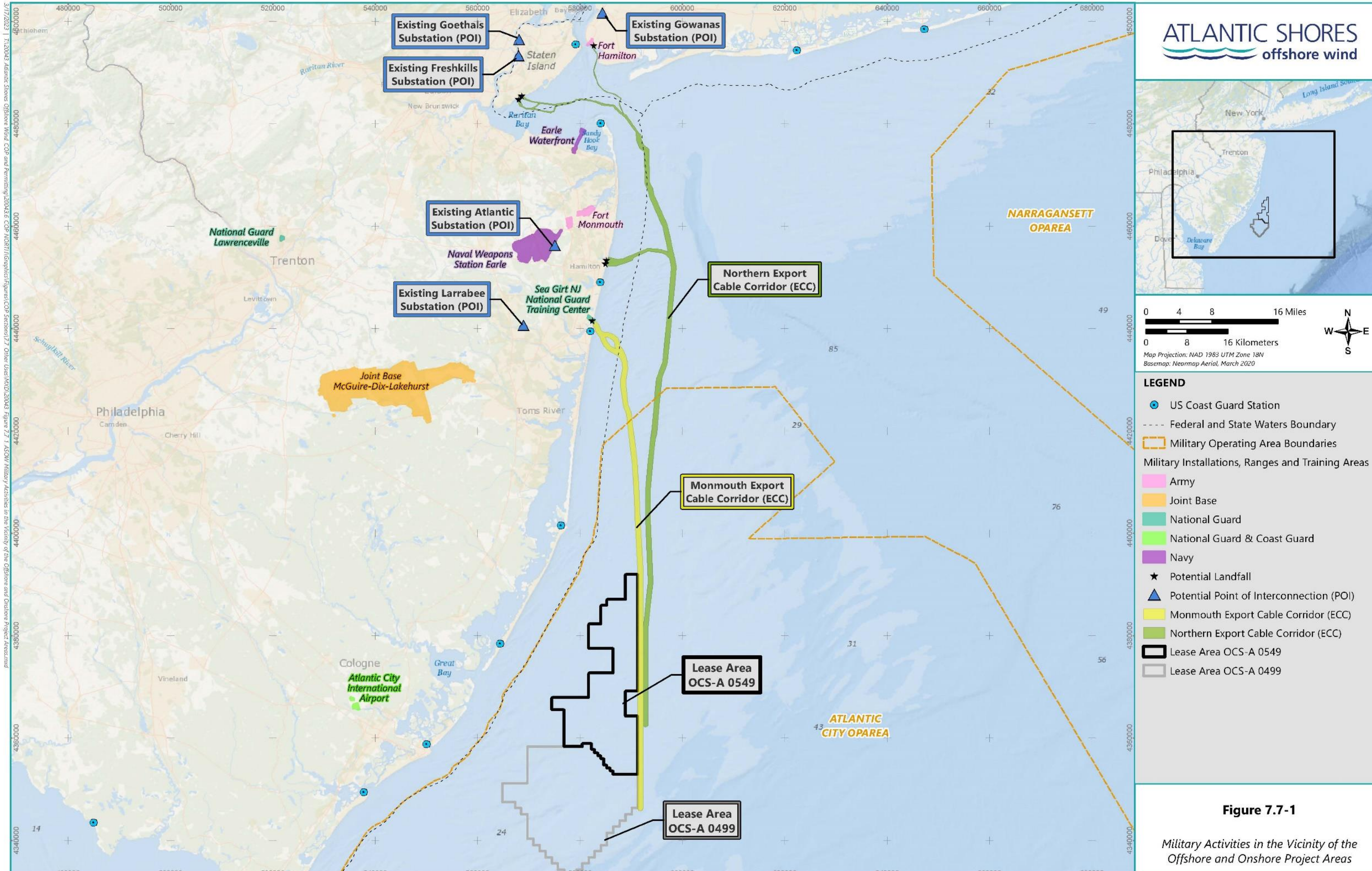



**Figure 7.7-1**

*Military Activities in the Vicinity of the Offshore and Onshore Project Areas*

## Table 7.7-1. Military Facilities in Proximity to the Project

| U.S. Military Branch | Facility Name/Location | Mission/Purpose |
|---|---|---|
| Air Force, Navy, Army | Joint Base McGuire-Dix-Lakehurst, Trenton, Burlington and Ocean Counties, New Jersey | Provide installation support to all mission commanders and provide mission-ready, motivated, expeditionary Airmen to combatant commanders (Joint Base McGuire-Dix-Lakehurst [2020]). |
| Army | Picatinny Arsenal, Wharton, Morris County, New Jersey | Provide products and services to all branches of the U.S. military and participate in research, development, acquisition, and lifecycle management of advanced conventional weapon systems and ammunition (U.S. Army 2019). |
| Army | Fort Hamilton, Brooklyn, New York | Management of government resources to support mission readiness, improve infrastructure, preserve the environment, and ensure the well-being and safety of service members, civilians, and family members (Military Installations 2021). |
| Navy | Earle Naval Weapons Station, Earle's Waterfront, New Jersey | Provide ordnance for all Atlantic Fleet Carrier and Expeditionary Strike Groups and support strategic DoD ordnance requirements (U.S. Navy, 2020). |
| Marine Corps Forces Reserve | 6$^{th}$ Battalion, Brooklyn New York | Provide communication support to Marine Expeditionary Force Headquarters Group (MHG) or to a designated Joint Task Force (JTF) command element and provide Ground Mobile Forces Satellite support to Force Headquarters Group in the conduct of its mission (Marines 2022). |
| Army National Guard | Army National Guard Training Center, Sea Girt, New Jersey | Provide training for and instruction to New Jersey's citizens soldiers, airmen, and law enforcement professionals (New Jersey Department of Military and Veterans Affairs 2020). |
| Air National Guard | Atlantic City Air National Guard Base, 177$^{th}$ Wing, Egg Harbor, New Jersey (Atlantic City International Airport) | Participation in air-to-air and air-to-ground operations designed to support ground forces, gain control of enemy airspace, and support Air Support Operations, Tactical Air Control Party (TACP) and Explosive Ordnance Disposal (GOANG, 2020). |

| U.S. Military Branch | Facility Name/Location | Mission/Purpose |
| --- | --- | --- |
| Army National Guard | Army National Guard Joint Operations Center, Lawrenceville, New Jersey | Coordinate missions for the New Jersey National Guard and act as a liaison between state leaders and the National Guard (National Guard 2020). |
| U.S. Coast Guard | Atlantic City Air Station, Egg Harbor, New Jersey (Atlantic City International Airport) | Support a wide range of U.S. Coast Guard operations, such as search and rescue, law enforcement, port security, and marine environmental protection for both District One and District Five of the USCG (USCG [2020 (b)]). |
| U.S. Coast Guard | Station Manasquan - Station #105 (Point Pleasant Beach) Atlantic City U.S. Coast Guard Station; Barnegat Light Station; Beach Haven Station; Fortescue Station; Ocean City Station 146; USCG Shark River Station 103, (Avon-by-the-Sea) Townsend Inlet Station 130; Sandy Hook Station 97 | Ensure the Nation's maritime safety, security, and stewardship (USCG, [date unknown (c)]). Perform search and rescue, enforce laws and treaties, and enforce recreational boating safety (USCG [date unknown(a)]). |
| U.S. Coast Guard | USCG Training Center, Cape May, New Jersey | Train and provide mission support to tenant commands (USCG [date unknown (d)]). |

In addition to the military facilities summarized in Table 7.7-1, there is a designated U.S. Navy at-sea area referred to as an Operating Area (OPAREA) located off the coast of New Jersey. The Atlantic City OPAREA, extends from Seaside Heights to Sea Isle City and encompasses the Lease Area and the southern portions of the Monmouth and Northern ECCs (see Figure 7.7-1). Comprised of surface sea space, subsurface sea space, and special use airspace (SUA), this approximately 640-acre area is used primarily for training and testing exercises by the Naval Atlantic Fleet and nearby U.S. Air Force base units (NOAA 2019). The Atlantic City SUA, within the OPAREA, is used for surface-to-air gunnery exercises and is, therefore, designated as a Warning Area for nonparticipating pilots (BOEM 2012). Additional information on aviation resources is provided in Section 7.8 Aviation and Radar.

Given the historical military practices conducted along the northern Atlantic Coastline there is potential for the presence of munitions and explosives of concern (MEC) in the Offshore Project Area. The potential presence of MEC is discussed further in Section 2.1 Geology.

### Anchorage Areas

Anchorage areas are designated locations that allow for boats and ships to safely drop anchor, typically within navigable waterways (NOAA 2017). The USCG and U.S. Army Corps of Engineers (USACE) have designated multiple anchorage areas in the Lower New York Bay and Raritan Bay (Figure 7.7-2). Up to eight anchorage areas, all of which are designated by the USCG, may be crossed by the Offshore Project Area. All but one of the eight anchorage areas that could be crossed are designated as unrestricted. The Gravesend anchorage area is designated as a temporary anchorage area. While many of the anchorage areas in the Lower New York Bay and Raritan Bay are used by commerce vessels as they wait for berthing availability, inspections, favorable weather and tidal patterns, the Gravesend anchorage area also serves as an inspection area for the USCG to conduct mandatory inspections for select vessels prior to them entering the port of New York and New Jersey (USACE 2019). Atlantic Shores has, and will continue to, consult with the USCG to determine best practices for crossing anchorage areas in the Lower New York Bay and Raritan Bay. The most recent meeting with the USACE on the topic of anchorage areas occurred on September 20, 2022, to discuss interactions within the Gravesend Bay anchorage area.

**Sand Resources**

Offshore sand and gravel are important resources managed by Federal and State agencies and used for coastal protection and restoration, beach nourishment, and habitat reconstruction purposes. Within or adjacent to the Offshore Project Area, BOEM, USACE, New Jersey Department of Environmental Protection (NJDEP), New Jersey Geological and Water Survey (NJGWS), New York State Department of Environmental Conservation (NYSDEC) and New York City coordinate the management of areas of potential and confirmed sand resources for these coastal management and restoration activities (Figure 7.7-2). Beach nourishment and coastal storm risk reduction projects are common along the coasts of New Jersey and New York, with many active and proposed projects located in the vicinity of the landfall sites and ECCs (NOAA 2020a, USACE 2022).

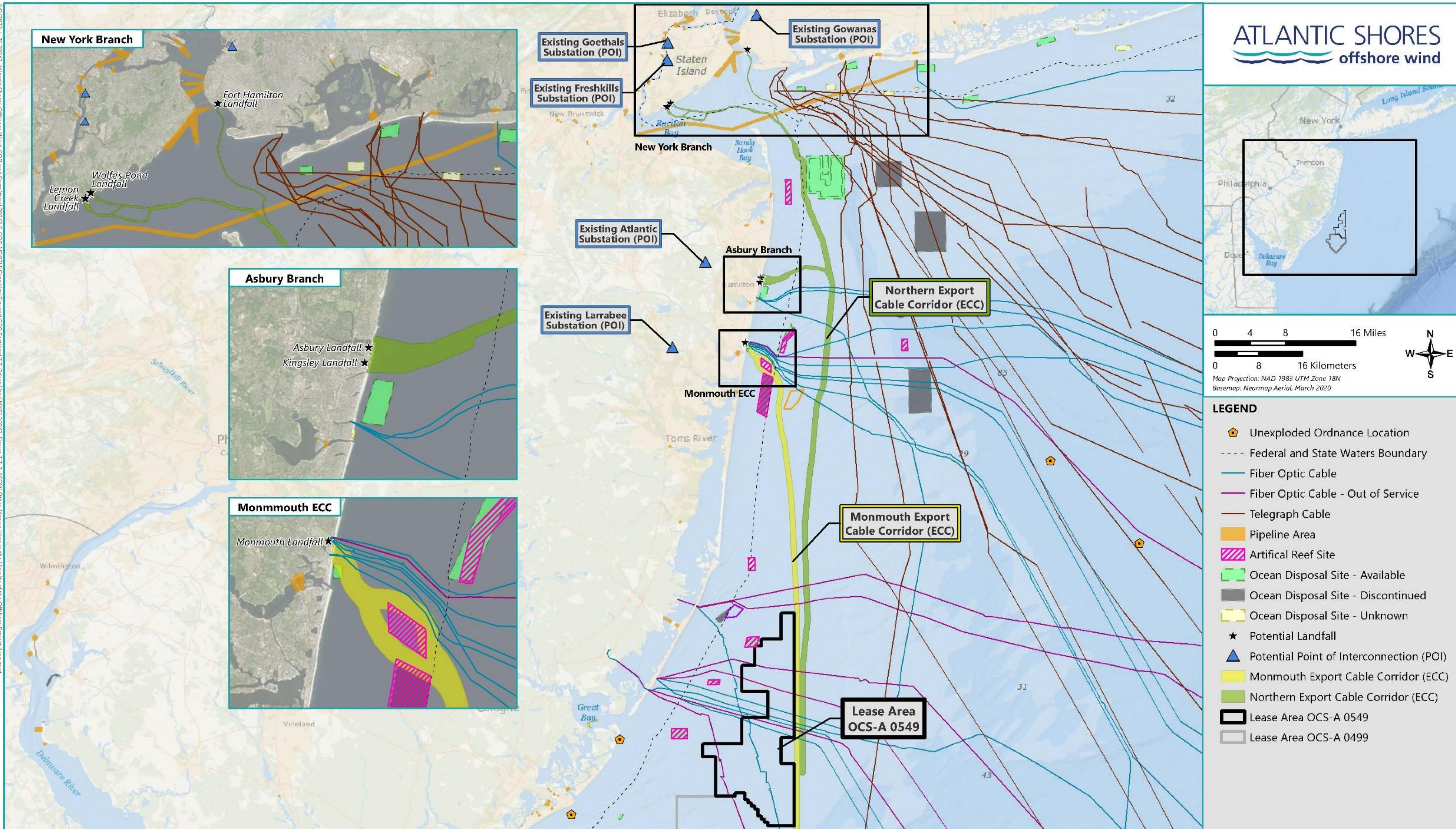



**Figure 7.7-2**

*Other Marine Uses in the Vicinity of the Offshore and Onshore Project Areas*

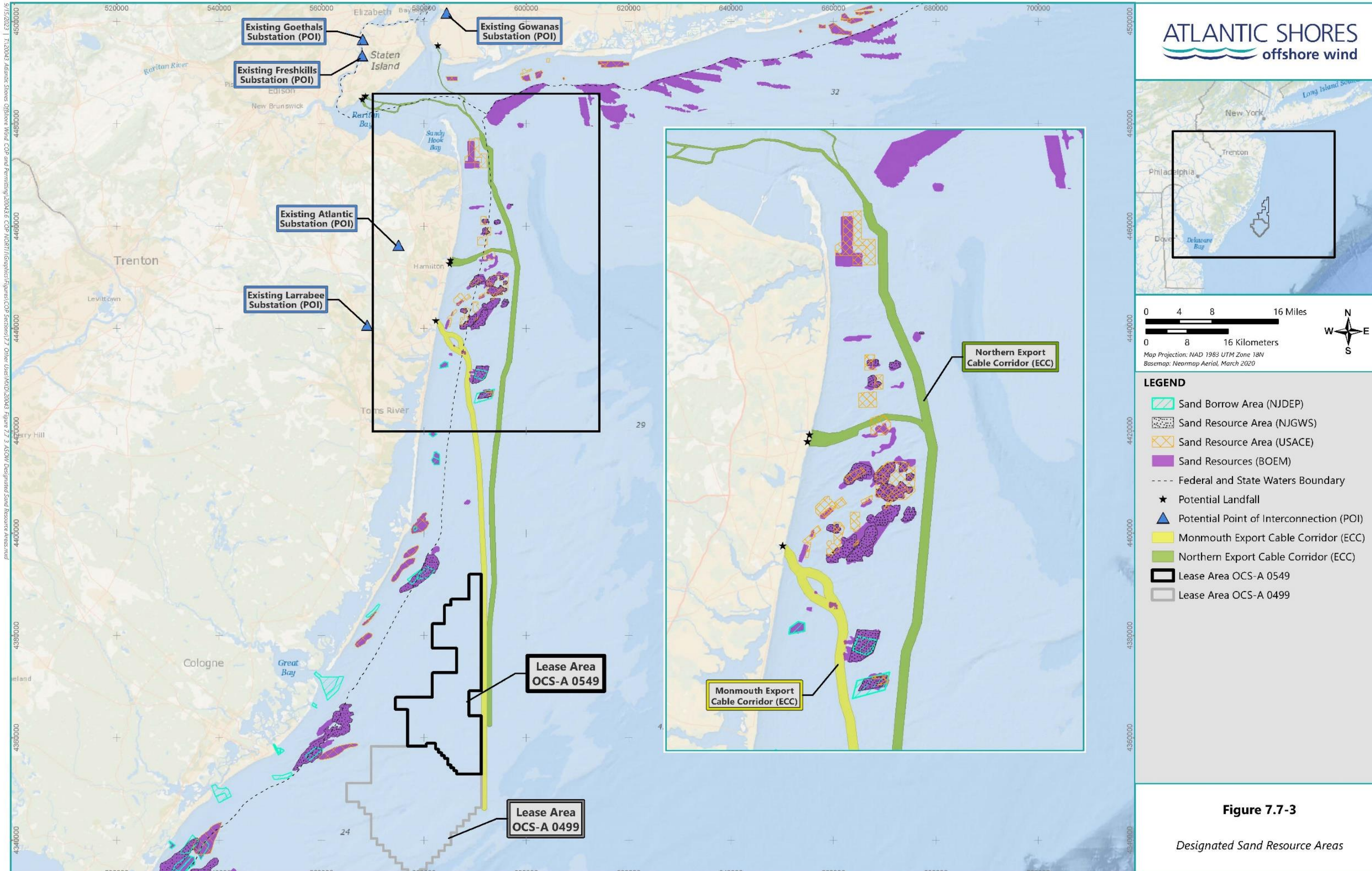



**Figure 7.7-3**

*Designated Sand Resource Areas*

The Project's ECCs were routed to avoid most Federal and State designated sand resource areas (see Figure 7.7-3). However, there are small segments of the ECCs that cross or are very close to mapped designated sand resource and borrow areas (see BOEM 2020b). Atlantic Shores is actively coordinating with BOEM, NJDEP, NYSDEC and USACE regarding project interactions with sand resources in these areas and intends to collaborate to devise a cable layout strategy that meets Federal and State requirements and industry BMPs. Joint Agency Meetings, which included attendance by representatives from BOEM, USACE and NJDEP, were held on August 29 and September 30, 2022. Additional information is presented in Section 2.1 Geology.

### 7.7.3 Offshore Energy

Figure 1.2-1 of Volume 1 – Project Information illustrates the BOEM Lease Areas and associated offshore wind projects in proximity to New Jersey and New York. In addition to Atlantic Shores portfolio of projects within three lease areas, there are eight active offshore Mid-Atlantic wind energy projects in development: Empire Wind I and II (Equinor and BP), Ocean Wind I (Orsted and PSEG), Ocean Wind II (Orsted), Skipjack Wind (Orsted), Sunrise Wind (Orsted and Eversource), Garden State Offshore Wind (Orsted), and US Wind (US Wind Inc.) as well as the six other New York Bight leases recently awarded in February 2022. These six developable lease areas were awarded to the following developers: OW Ocean Winds East, LLC (OCS-A 0537), Attentive Energy, LLC (OCS-A 0538), Community Offshore Wind, LLC (OCS-A 0539), Atlantic Shores Offshore Wind Bight, LLC (OCS-A 0541), Invenergy Wind Offshore, LLC (OCS-A 0542) and Vineyard Mid-Atlantic, LLC (OCS-A 0544). The only operating offshore wind facility along the Mid-Atlantic coast is the 12 MW Coastal Virginia Offshore Wind Project located approximately 180 miles (mi) to the south of the Lease Area.

### 7.7.4 Cables and Pipelines

As described in Section 4.5.8 of Volume I, the ECCs will cross existing marine infrastructure, including submarine cables and pipelines (see Figures 2.1-4 and 7.7-2). The Monmouth ECC could have up to 28 cable or pipeline crossings from the Lease Area to the Monmouth Landfall Sites. The Northern ECC from the Lease Area to the Landfall Sites in New York (inclusive of the Asbury Branch in New Jersey) could have up to 93 cable or pipeline crossings. Atlantic Shores anticipates that there will also be inter-array and inter-link cable crossings required for the Project.

Any cable or pipeline crossing will be surveyed in accordance with applicable industry standards and practices and, if the cable is still active, Atlantic Shores will seek to enter into a crossing agreement with its owner. The crossing agreement will address crossing methods, setback requirements, and other parameters. Atlantic Shores is currently coordinating with cable owners regarding crossing methods and/or setbacks. Additional detail is provided in Section 2.1.2.4.

Atlantic Shores has also coordinated with the Naval Seafloor Cable Protection Office (NSCPO) and the North American Submarine Cable Association (NASCA) regarding locations of naval submarine cable infrastructure. After review, NSCPO did not have any comments on the Project (C. Creese, personal communication June 26, 2020). Atlantic Shores will continue coordinating with these organizations as the Project progresses.

### 7.7.5 Scientific Research and Surveys

Off the coasts of New Jersey and New York, agency-sponsored research and survey efforts are conducted by the Northeast Fisheries Science Center (NEFSC), NJDEP, NYSDEC, New York State Natural Heritage Program (NYSNHP), New York State Department of State (NYSDOS), New York State Department of Public Service (NYSDPS), the Hudson River Foundation, and the Northeast Area Monitoring and Assessment Program (NEAMAP) led by the Virginia Institute of Marine Sciences.

The following in-water studies have historically traversed the Offshore Project Area: NEFSC multi-species bottom trawls, NJDEP trawls, NYSDEC nearshore trawls and passive acoustic surveys, NEFSC clam surveys, NEFSC scallop dredge survey, and NEAMAP trawl surveys (NOAA 2020b; NJDEP 2018; NYSDEC 2022a; NYSDEC 2022b; NOAA 2023 NOAA 2022).

In addition to in-water surveys, aerial surveys to measure the abundance of marine mammals and sea turtles are conducted from Maine to the Florida Keys as part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS) by NOAA. NOAA NEFSC conducts these surveys within the Offshore Project Area utilizing aircraft that fly 600 feet (ft) (183 meters [m]) above the water surface at 110 knots (203 kilometers per hour [km/h]) (NEFSC 2020). The NYSDEC also conducts aerial surveys in the vicinity of the Offshore Project Area. These surveys utilize a small aircraft flown at 1,000 ft above the water surface at 100 to 110 knots (approximately 185 to 203 km/h) (NYSDEC 2022c).

### 7.7.6 Potential Impacts and Proposed Environmental Measures

The potential IPFs which may affect other marine uses, including commercial, recreational, and scientific uses and military activities, during construction, O&M, or decommissioning of the Project are presented in Table 7.7-2.

**Table 7.7-2. Impact Producing Factors for Other Marine Uses**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Vessel Traffic | • | • | • |
| Anchoring and jack-up vessels | • | • | • |
| Installation and maintenance of new structures and cables | • | | • |
| Presence of structures and cables | | • | |

The maximum Project Design Envelope (PDE) analyzed for all IPFs is the maximum offshore build-out of the Project as described in Section 4.11 of Volume I.

### 7.7.7 Vessel Traffic

Construction, O&M, and decommissioning of the Project will introduce additional vessels and vessel movements in the Offshore Project Area. The construction period will see the greatest increase in offshore vessel traffic.

Increased vessel traffic will occur during construction, O&M, and decommissioning, as described in detail in Section 7.6 Navigation and Vessel Traffic. On average, approximately six vessel round trips per day between shore and the Offshore Project Area are expected during construction and O&M. Decommissioning vessel traffic is anticipated to be similar to construction vessel traffic. Atlantic Shores will manage vessel activities to minimize disruptions to the maximum extent practicable.

Atlantic Shores has completed a Navigation Safety Risk Assessment (NSRA) in support of the Project (see Section 7.6 Navigation and Vessel Traffic). The NSRA identifies potential hazards to navigation and associated consequences that might be created by the Projects during its lifecycle. A range of vessel types navigate the Offshore Project Area, including commercial (cargo), commercial (fishing), recreational, military, scientific and passenger vessels. A Project-specific vessel traffic analysis and navigational risk modeling analysis were introduced in Section 7.6 Navigation and Vessel Traffic and are included in the NSRA as Appendix II-T.

Vessels associated with other marine uses, including military activities, operating in or near the Offshore Project Area, could experience short-term, localized disruption due to the avoidance of Project vessel traffic during construction, O&M, and decommissioning. However, based on the AIS data evaluated for the NSRA, military vessel traffic makes up a small proportion of recorded vessel traffic within the Offshore Project Area. The majority of vessel traffic documented in the Lease Area from AIS data were cargo, commercial fishing, and recreational vessels. Most non-fishing vessel traffic is located to the east or west of the Lease Area and generally moves in north-south or north- southwest courses. Vessel traffic from other marine use and military activities is expected to have a very low risk of interacting with vessels during any phase of the Project.

Atlantic Shores has actively engaged marine user groups, including the DoD and DHS, throughout Project development and has adopted navigational safety risk mitigation strategies to decrease the already low potential for vessel-related effects in the Offshore Project Area. These strategies are based on data collection and analysis, USCG consultations, and input from mariners across various industries including commercial and recreational fisheries, marine trades, and recreational boating. The strategies developed to date include the following:

- Construction vessels will display appropriate navigation lights and day shapes as per regulatory requirements.
- Coordination with USCG and mariners to enhance information flow about Project activities to decrease navigational risks during all Project phases:
- An Emergency Response Plan will be developed in coordination with the USCG. The emergency plan will outline all the emergency response protocols and points of contact, and it will be revised annually through a face-to-face meeting with the USCG to ensure the familiarity of key personnel. The emergency plan will influence and help guide many of the elements listed directly below.
- A Marine Coordination Center will be established, led by a Marine Coordinator. The Marine Coordinator will be the Atlantic Shores' primary point of contact with USCG, port authorities, State and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).

- A construction communications plan is to be developed with details for working (radio) channels, crisis communications, and other communication protocols.
- Non-regulatory and regulated safety buffers will be demarcated around working areas and communicated to stakeholders.
- Atlantic Shores will regularly coordinate with the USCG and NOAA on chart updates as components (e.g., foundations, WTGs, OSSs) are constructed and regarding the issuance of Local Notices to Mariners (LNM).
- Coordination will occur with local port authorities on the development of vessel traffic management plans for the various staging ports.
- Coordination will occur with USCG on operational protocols for the WTG braking system, and any SAR activity that might occur within the Lease Area or working areas. Additional information on ways Atlantic Shores is coordinating with USCG on SAR is provided in Section 7.6 Navigation and Vessel Traffic.
- Per Lease requirements regarding National Security and Military Operations, Atlantic Shores will conduct activities in recognition of safety and security issues and military agency notification mandates.
- Coordination between Atlantic Shores and the DoD Military Aviation and Installation Assurance Clearinghouse, Army National Guard, and the USCG, is ongoing and will continue through the permitting construction, O&M, and decommissioning phases. Additional details regarding vessel use and traffic is provided in Section 7.6 Navigation and Vessel Traffic.

### 7.7.8 Anchoring and Jack-Up Vessels

Anchoring and jack-up vessels may interact with existing submarine cables, submarine pipelines, sand resources, and MEC through direct seafloor disturbance. These effects will be greatest during construction, as routine O&M and decommissioning activities would have limited interaction with these other uses.

To address human safety and environmental risks associated with anchoring and jack-up vessel interactions with these other uses, Atlantic Shores has incorporated avoidance strategies into the design of the Project. Atlantic Shores will also continue coordinating with cable and pipeline owners that have assets within the Offshore Project Area regarding crossing methods and setbacks and resource agencies that manage the sand resources. Atlantic Shores is also committed to completing pre-construction HRG surveys to detect and implement risk management steps to avoid MEC (see Section 2.1 Geology).

### 7.7.9 Installation and Maintenance of New Structures and Cables

The installation and maintenance of new foundation structures and offshore cables includes installation of associated scour and cable protection. These activities may interact with submarine cables, pipeline areas, sand resources, and MEC through direct seafloor disturbance. Potential effects from installation and maintenance of new structures (i.e., WTGs, OSSs, and meteorological [met] tower) and cables include the potential damage to existing cables or pipelines, restricting access to sand resources, and MEC interactions (see Section 2.1 Geology). These effects will be greatest during construction, as routine maintenance activities would have limited interaction with these other uses.

The installation of new structures, particularly the submarine cables, will require crossing of several existing submarine cables and pipeline areas, as described in Section 7.7.4. Any cable crossing will be carefully surveyed and, if the cable or pipeline is still active, Atlantic Shores will develop a crossing agreement with its owner. At each crossing, before installing the Atlantic Shores cable, the area around the crossing will be cleared of any marine debris. Depending on the status of the existing cable or pipeline and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable or pipeline and Atlantic Shores' overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. It is likely that the presence of an existing cable or pipeline will prevent Atlantic Shores' cable from being buried to its target burial depth. In this case, cable protection may be required on top of the proposed cable at the crossing location. Cable protection infrastructure is discussed in detail in Section 4.5.8 of Volume I. Examples of cable protection infrastructure may include rock placement, grout-filled bags, rock bags, half-shell pipes for mechanical protection, and concrete mattresses. Final crossing details of existing cables and pipelines will be determined in consultation with the respective owners/operators. Following installation of the proposed cables, the cable crossing will be surveyed again to ensure proper installation.

### 7.7.10 Presence of Structures and Cables

Within the Offshore Project Area, the presence of installed structures (including WTGs, OSSs, offshore cables, cable protection, and scour protection) may affect vessel traffic (including military and scientific research vessels) during the O&M stage of the Project.

Atlantic Shores has participated in several meetings with military staff (e.g., Air Force, Navy, Marine Corps), U.S. Fleet Forces Command, and the DoD Clearinghouse, to present Project information, receive feedback and guidance to support Lease Area development activities, and establish a strategy for information sharing and engagement. Atlantic Shores will continue to coordinate with military staff and DoD throughout the life of the Project.

The presence of cables, cable protection, and scour protection may result in impediments to other, future marine uses such as submarine energy and telecommunications infrastructure and sand borrowing.

Some fisheries research and surveys conducted by Federal or State agencies may occur within the Lease Area and Atlantic Shores will continue to consult with these agencies to avoid and minimize any possible effects to this work. The proposed WTG and OSS layout for the Project has been designed to facilitate the transit of vessels through the Lease Area based on a review of existing traffic patterns. Further, Atlantic Shores' construction and O&M monitoring will provide additional contributions to scientific surveys and research.

The presence of structures and cables may also limit sand borrowing in very small portions of designated sand resource areas along the Monmouth ECC

### 7.7.11 Sand Resources

There are several USACE and BOEM Marine Minerals Program (MMP) mapped sand resource areas located along the Monmouth ECC and Northern ECC. Table 7.7-3 provides details on the assumed amount of cubic yards of sand that would be committed to both ECCs and the assumed amount of cubic yards of sand that would be reserved for use by USACE and/or the MMP. These calculations are based on assumptions of the current design, with an assumed 6-foot depth for the entirety of the ECCs. These calculations do not currently take into account that only the cable installation would result in disturbance to the seafloor and that the entirety of the ECC will not be disturbed. These calculations will be further refined once the design is progressed to a level that can identify specific locations for the cable installations within the ECCs.

## Table 7.7-3. Sand Resources within the Monmouth ECC and Northern ECC

| ECC Location | ECC Total Acres/Square Feet | ECC Cubic Yards (cy)[69] | USACE Sand Borrow Area Total Area (acres/ft²) | USACE Sand Borrow Area within ECC (acres/ft²) | USACE Sand Borrow Area within ECC (cy)[70] | Cubic Yards Reserved for Use by USACE | MMP Sand Resource Area Total Area (acres/ft²) | MMP Sand Resource Total Volume in Cubic Yards (cy)[71] | MMP Sand Resource Area within ECC (acres/ft²) | MMP Sand Resource Area within ECC (cy)[72] | Cubic Yards Reserved for Use by MMP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Federal Waters | 51,622.0 acres (2,248,645,957.0 ft²) | 499,699,101.6 cy | ID #Belmar 11: 930.0 acres (40,408,881.4 ft²) | ID #Belmar 11: 235.5 acres (10,259,931.6 ft²) | ID #Belmar 11: 2,279,984.8 cy | -[73] | ID# F2: 1,705.2 acres (74,276,712.0 ft²)<br><br>ID# Shoal 236: 94.4 acres (4,111,397.0 ft²) | ID# F2: 33,006,945.0 cy<br><br>ID# Shoal 236: 1,510,069.0 cy | ID# F2: 41.3 acres (1,801,039.6 ft²)<br><br>ID# Shoal 236: 75.3 acres (3,278,803.7 ft²) | ID# F2: 400,231.0 cy<br><br>ID# Shoal 236: 728,623.0 cy | ID# F2: 32,606,714.0 cy<br><br>ID# Shoal 236: 781,446.0 cy |

[69,2,3,4] Cubic yard calculations are based on the assumption of a 6-foot depth of disturbance within the ECCs.

[5] The total area, including total cubic yards, of the Belmar 11 Resource Area was not publicly available at the time of COP development and publication.

| ECC Location | ECC Total Acres/Square Feet | ECC Cubic Yards (cy)[69] | USACE Sand Borrow Area Total Area (acres/ft$^2$) | USACE Sand Borrow Area within ECC (acres/ft$^2$) | USACE Sand Borrow Area within ECC (cy)[70] | Cubic Yards Reserved for Use by USACE | MMP Sand Resource Area Total Area (acres/ft$^2$) | MMP Sand Resource Total Volume in Cubic Yards (cy)[71] | MMP Sand Resource Area within ECC (acres/ft$^2$) | MMP Sand Resource Area within ECC (cy)[72] | Cubic Yards Reserved for Use by MMP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monmouth ECC State Waters | 7,101.4 acres (309,336,126.2 ft$^2$) | 68,741,361.4 cy | - | - | - | - | ID# Shoal 235: 17.1 acres (746,193 ft$^2$)<br><br>ID# Shoal 236: 94.4 acres (4,111,397.0 ft$^2$) | ID# Shoal 235: 1,288,737 cy<br><br>ID# Shoal 236: 1,150,069.0 cy | ID# Shoal 235: 11.3 acres (491,225.0 ft$^2$)<br><br>ID# Shoal 236: 20.1 acres (874,115.1 ft$^2$) | ID# Shoal 235: 109,161.1 cy<br><br>ID# Shoal 236: 194,247.8 cy | ID# Shoal 235: 1,179,576.0 cy<br><br>ID# Shoal 236: 1,315,821.0 cy |
| Northern ECC State Waters | 1,697.0 acres (73,922,437.6 ft$^2$) | 16,427,208.4 cy | - | - | - | - | - | - | - | - | |

### 7.7.12 Summary of Proposed Environmental Protection Measures

The majority of potential effects to other marine uses, including military activities, are expected to be localized to specific areas of construction activity and structures. Atlantic Shores has incorporated design elements and taken precautionary steps and commitments to avoid, mitigate, and monitor the Project's effects on marine uses and military activities during construction, O&M, and decommissioning. Additional avoidance and mitigation measures and tools will be evaluated further as the Project progresses through development and permitting and in coordination with BOEM, DoD, DHS, state jurisdictional agencies and other stakeholders.

The following environmental protection measures are proposed to mitigate potential Project-related impacts to marine uses and military activities:

- Desktop assessments of military activities, sand resources, and offshore energy, cables, and pipelines have been conducted to characterize marine uses and military activities.
- Offshore Project infrastructure has been sited and designed to avoid or minimize impacts to sand resource areas, cables/pipelines, and known MEC (see Section 2.1 Geology) to the maximum extent practicable.
- Cable protection infrastructure will be employed where offshore cables are proposed to cross existing submarine cables and pipelines. Atlantic Shores is coordinating with cable owners that own assets within the Offshore Project Area regarding crossing methods and setbacks.
- Coordination will continue with military staff and DoD throughout the life of the Project.
- Consultation will continue with agencies and other research entities regarding scientific research and surveys in the Offshore Project Area. Atlantic Shores construction and O&M monitoring will provide additional contributions to scientific surveys and research.
- A Marine Coordinator will be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones.

## 7.8 Aviation and Radar

This section describes aviation and radar resources present in the Offshore Project Area, which for this analysis includes the Lease Area. This section also assesses the associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential impacts to these resources during construction, operation and maintenance (O&M), and decommissioning of the Project. Atlantic Shores is committed to minimizing and mitigating impacts to aviation and radar resources and will coordinate with the appropriate regulatory agencies to complete the appropriate consultations and obtain the required approvals.

For evaluations of airports and their associated procedures, the Lease Area and an approximate 30 nautical mile (nm; 56 km) buffer around the Lease Area was evaluated to be consistent with industry best practice.

Aviation resources include the navigable airspace in the vicinity of the Lease Area, defined as the airspace at or above the minimum altitudes of flight that include the airspace needed to ensure safety in the takeoff and landing of aircraft. The U.S. Congress has charged the Federal Aviation Administration (FAA) with administering airspace in the public interest as necessary to ensure the safety of aircraft and its efficient use.

Radar is a technology whereby radio waves are transmitted into the air and are then received when they have been reflected by an object in the path of the beam. Radar range is determined by measuring the time it takes (near the speed of light) for the radio wave to go out to the object and then return to the receiving antenna. The direction of a detected object from a radar site is determined by the position of the rotating antenna when the reflected portion of the radio wave is received. Radar is used to support navigation, military surveillance, weather monitoring, and coastal conditions.

The Project is subject to regulations under 49 U.S.C. § 44718 and 14 CFR Part 77, FAA Orders, and government-published Terminal Procedures and Aeronautical Data,[74] which provide the FAA with jurisdiction and a mandate to review all structures within U.S. territorial airspace (defined as 12 nm [22 km]) measured from the low-water line along the coast). The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not affect the safety of air navigation or the efficient utilization of navigable airspace by aircraft. The result of an aeronautical study is the issuance of a determination of 'hazard' or 'no hazard' that can be used by the proponent to obtain necessary local construction permits and Joint Order 7400.2N[75] instrument approach areas (see Appendix II-U1). The requirements for filing with the FAA for proposed structures vary based on a number of factors including height, proximity to an airport, location, and frequencies emitted from the structure (FAA 2021).

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[74] Joint Order 7400.2N – Procedures for Handling Airspace Matters; FAA Order 8260.3E – United States Standard for Terminal Instrument Procedures; FAA Order 8260-58B – United States Standard for Performance Based Navigational (PBN) Instrument Procedure Design; Technical Operations Evaluation Desk Guide for Obstruction Evaluation / Airport Analysis (1.6.1); United States Government Flight Information Publication, US Terminal Procedures; National Airspace System Resource Aeronautical Data.

[75] Joint Order 7400.2N – Procedures for Handling Airspace Matters.

Structures, vessels, and/or cranes that exceed 14 CFR §77.9 Notice Criteria and Joint Order 7400.2N instrument approach areas in height will require review and filing with the FAA per 14 CFR §77.7.

While the FAA is responsible for reviewing all structures within 12 nm (22 km), BOEM will consult with the FAA regarding airspace impacts beyond 12 nm (22 km) and is responsible for regulating renewable energy activities on the outer continental shelf in accordance with 30 CFR Part 585. Structures that fall under FAA and/or BOEM jurisdiction must also be reviewed by the Department of Defense (DoD) and the U.S. Department of Homeland Security (DHS) to ensure no interference with testing and training operations and/or radar systems. Beyond the FAA jurisdictional boundary, BOEM is anticipated to work with the FAA to promote a cohesive hazard assessment and lighting/marking scheme using the BOEM-adopted FAA Marking and Lighting Guidance (BOEM 2019; FAA Marking and Lighting Advisory Circular 70/7460/1M, 11/16/2020). Atlantic Shores plans to request approval from the FAA to install an Aircraft Detection Lighting System (ADLS) which will provide visual and environmental benefits due to reduction in the operation time of required lighting (see Sections 4.3 Birds, 4.4 Bats, 5.0 Visual Resources, and 6.1 Historic Properties). To support this request, an ADLS analysis was conducted for the Lease Area (see Appendix II-M2).

The assessment of aviation and radar resources included evaluation of the Lease Area and an approximate 30 nm (56 km) buffer around the Lease Area, consistent with industry best practice. The focus of the assessment was on structures that would meet or exceed the FAA's threshold for review of 200 ft (61 m) in height for WTGs.

### 7.8.1 Affected Environment

The information presented in this section is based on FAA requirements and an Obstruction Evaluation/Airspace Analysis (OE/AA) Report that was completed to characterize the existing airspace surrounding the Lease Area and support the preliminary assessment of the WTGs potential effects on airspace. The OE/AA Report has been included as Appendix II-U1.

In addition to the aforementioned study, Atlantic Shores has completed a preliminary navigation and radar screening study (see Appendix II-U2) to assess the potential for Project WTGs to be within the line of sight of radars serving as military or civilian surveillance and air traffic control, weather radar, coastal high frequency (HF) radar and impacts to navigational aids.

The following subsections provide a description of existing aviation and radar resources based on Atlantic Shores' site-specific studies as well as the requirements of 14 CFR Part 77, FAA Orders, and government-published Terminal Procedures and Aeronautical Data.

### 7.8.2 Aviation

Aviation activity or air traffic volume within the Lease Area is varied and consists of flights to and from public, private-use, and military airports in proximity to the Lease Area as summarized in Table 7.8-1. The locations of these airports are presented in Appendix II-U1 (Figure 1). The largest and most active of these locations is the Atlantic City International Airport, located approximately 23 mi (37.5 km) west of the Lease Area.

## Table 7.8-1. Airports within Proximity to the Lease Area

| Airport Name or Designation | Municipality Name |
|---|---|
| **Public** | |
| Atlantic City Intl. (ACY) | Egg Harbor Township |
| Camden County (19N) | Berlin |
| Cross Keys (17N) | Williamstown |
| Eagles Nest (31E) | West Creek |
| Flying W (N14) | Lumberton |
| Hammonton Muni (N81) | Hammonton |
| Kroelinger (29N) | Vineland |
| Millville Muni (MIV) | Millville |
| Ocean City Muni (26N) | Ocean City |
| Ocean County (MJX) | Berkeley |
| Penn's Landing (P72) | Philadelphia |
| Redwing (2N6) | Springfield |
| South Jersey Regional (VAY) | Lumberton |
| Southern Cross (CO1) | Williamstown |
| Vineland-Downstown (28N) | Vineland |
| Woodbine Muni (OBI) | Woodbine |
| **Private-Use** | |
| Alliance Airport (23NJ) | Pittsgrove |
| Albert Einstein Medical Center Heliport (2PS9) | Philadelphia |
| AT&T Cedarbrook Heliport (NJ04) | Atco |
| Allen Airstrip (3NJ9) | Southampton |
| Allen's Seaplane Base (JY35) | Brick |
| Atlantic City Medical Center (JY28) | Pamona |
| Atlantic City Medical Center Heliport (0NJ0) | Atlantic City |
| Atlantic County Helistop (99NJ) | Northfield |
| Atsion Helistop (5NJ5) | Trenton |
| Bayside State Prison (JY32) | Leesburg |
| Bertino Heliport (49NJ) | Hammonton |
| Berkeley Township Police Heliport (0NJ1) | Bayville |
| Binder Winslow Airport (26JY) | Winslow |
| Blue Jay Heliport (56NJ) | Mt. Holly |

| Airport Name or Designation | Municipality Name |
|---|---|
| Breezey Acres Farm Heliport (JY30) | Waterford |
| C and T Helistop (NJ94) | Merchantville |
| Camden Tower Heliport (NJ02) | Alloway |
| Campbell Soup Heliport (NJ01) | Camden |
| Colgate Palmolive Heliport (NJ23) | Burlington |
| Community Medical Center Heliport (44NJ) | Toms River |
| Coyle Field Airport (NJ20) | Chatsworth |
| CS Lake Center Heliport (80NJ) | Evesham |
| Daiagi Heliport (72NJ) | Pennsauken |
| Dix Field Airport (0NJ6) | Linwood |
| Elizabeth Grogan Memorial Heliport (3NJ5) | Toms River |
| Express Marine Heliport (50NJ) | Camden |
| Forked River Heliport (66NJ) | Forked River |
| Germania Heliport (51NJ) | Cologne |
| Golden Nugget Atlantic City Heliport (NJ48) | Atlantic City |
| Harrah's Landing Seaplane Based (58NJ) | Atlantic City |
| Hummel Seaplane Base (16NJ) | Island Heights |
| Indian Mills Heliport (7NJ0) | Medford |
| Inductotherm Airport (3NJ6) | Rancocas |
| J L Gentile Heliport (29NJ) | Buena |
| Jefferson Cherry Hill Hospital (31NJ) | Galloway |
| Jet Line South Heliport (2JY5) | Cinnaminson |
| Kennedy Health System Heliport (9NJ9) | Washington Township |
| Kennedy Memorial Hospital Heliport (JY11) | Stratford |
| Lourdes Medical Center of Burlington City (96NJ) | Willingboro |
| LZ 1 NLDC Heliport (NJ62) | New Lisbon |
| Michaels Organization Heliport (19NJ) | Marlton |
| Middle Sedge Island Heliport (95NJ) | Toms River |
| Mount Holly Heliport (0NJ3) | Mount Holly |
| My Girls Helistop (JY15) | Medford |
| New Jersey Turnpike Authority Heliport (NJ97) | Mount Laurel |
| New Freedom Switching Station Heliport (7NJ1) | Winslow |
| Penn DDA Inc. Heliport (PS28) | Philadelphia |

| Airport Name or Designation | Municipality Name |
|---|---|
| Red Lion Airport (JY73) | Vincentown |
| Saint Christopher's Hospital for Children Heliport (1PA2) | Philadelphia |
| Shore Medical Center (87NJ) | Somers Point |
| Soaring Sun Seaplane Base (21JY) | Harvey Cedars |
| Sony Music Heliport (27NJ) | Pitman |
| Southern Ocean Medical Center (NJ89) | Manahawkin |
| Steel Pier Taj Mahal Heliport (28NJ) | Atlantic City |
| Steeplechase Pier Heliport (NJ57) | Atlantic City |
| Stone Harbor Golf Club Heliport (NJ08) | Cape May Court House |
| Strawberry Fields Airport (89NJ) | Mays Landing |
| Thomas Browne Airpark (61NJ) | Glassboro |
| Two Can Sam Heliport (86NJ) | Vineland |
| Vineland Veterans Home Heliport (4NJ6) | Vineland |
| Virtua-Voorhees Hospital Heliport (85NJ) | Voorhees |
| Warren Hopely Heliport (JY18) | Vincentown |
| West Jersey Hospital Heliport (5NJ9) | Voorhees |
| William B. Kessler Memorial Hospital Heliport (2JY3) | Hammonton |
| WJRZ Radio Heliport (38NJ) | Manahawkin |
| **Military** | |
| McGuire Joint Base McGuire-Dix-Lakehurst (WRI) | Trenton |
| Lakehurst Maxfield Field (NEL) | Lakehurst |
| Warren Grove Range (NJ24) | Chatsworth |

As the WTGs defined by the maximum Project Design Envelope (PDE) with a tip height of 1,047 ft (319 m) above mean sea level (AMSL) will exceed 200 ft (61 m), each WTG located within 12 nm (22 km) will require review by the FAA in accordance with 14 CFR Part 77.9. Of the 157 WTGs in the Lease Area, up to 83 will require filing with the FAA (U.S. Territorial Airspace).

Aviation activities are managed by the FAA using a variety of flight rules to establish safe altitudes, flight paths, and obstruction (e.g., natural terrain and or structure) clearances for aircraft using the airspace. The Lease Area will overlap with one or more FAA flight paths associated with the Atlantic City International Airport (ACY) that require obstacle clearances of 1,000 ft (304.8 m) above the tip height of the WTGs. Atlantic Shores will coordinate with the FAA through the FAA filing process for potential mitigations and changes to airspace, if required.

Based on the OE/AA Report (see Appendix II-U1), portions of the Lease Area also overlap with various FAA terminal radar control facilities (TRACONs) and Air Route Traffic Control Centers (ARTCCs) that provide approach control services to aircraft arriving, departing, or transiting regional airspace (see also Section 7.8.1.2). These specifically include TRACON minimum vectoring altitude sectors for Atlantic City (ACY), and Philadelphia (PHL). Some of these sectors have existing obstacle clearances of 649 ft (197.8 m) AMSL. Atlantic Shores will coordinate with the FAA through the FAA filing process for potential mitigations and changes to airspace, if required.

An Air Traffic Flow Analysis of current and historic flights within FAA managed airspace is currently underway to assess potential requirements for mitigation prior to formal filing and review under 14 CFR Part 77 and FAA Order 7400.2M. The findings in the Air Traffic Flow Analysis are presented in Appendix II-U3. Further consultation with FAA may be required to determine potential effects and mitigating measures. As with other stakeholder groups, Atlantic Shores is committed to this collaboration.

**Military Airspace**

Atlantic Shores also reviewed military airspace, training routes, special use airspace, warning areas, and search and rescue (SAR) activities that overlap with the Lease Area.

The New Jersey and Delaware Air National Guard and the U.S. Navy use portions of the Lease Area for flight training. These training routes are discussed in Appendix II-U1 OE/AA Report. Warning Areas W-107A and W-107C as well as VR-1709 (managed by the 177$^{th}$ Fighter Wing of the New Jersey Air National Guard) and SR-846 (managed by the 166th Airlift Wing of the DE Air National Guard) also overlay the Lease Area (see Figure 14 in Appendix II-U1).

In addition to the designated military airspace within the offshore Lease Area, the USCG will conduct flights over the water associated with the Offshore Lease Area to support SAR missions using both vessel and helicopter assets. The USCG conducts SAR missions for offshore incidents including, but not limited to vessels capsizing, disabled vessels, vessels taking on water, and persons in the water. A review of 10 years (2011 to 2020) of historical USCG SAR data for the coastline of New Jersey documented that there were five SAR missions within the Lease Area during this 10-year period. This is an average frequency of 0.5 missions per year. One of the missions involved an aerial sortie, two involved marine rescues, and the remaining two did not require a response from USCG resources. A detailed risk assessment workshop covering USCG SAR operations in the Lease Area was conducted. The results of the risk assessment workshop are provided in the Search and Rescue Risk Assessment Workshop Summary Report included as Appendix II-U4. During this workshop, potential scenarios which could occur as a result of the installation of WTGs within the Lease Area were assessed using a qualitative framework. For each identified scenario, potential mitigations were identified which could be used to reduce the risk associated with the scenario. For the initial assessment, only safeguards that are already planned by Atlantic Shores were considered and a risk ranking was assigned. A second assessment was performed which included the additional identified mitigations and a second risk ranking was assigned in order to gauge the effectiveness of the proposed mitigations. Atlantic Shores is using the results of this workshop to further investigate proposed mitigations that were shown to materially reduce risk and is evaluating the feasibility and suitability of their use.

Atlantic Shores has participated in several meetings with military staff in 2019-2022 (e.g., Air Force, Navy, Marine Corps) and the Military Aviation and Installation Assurance Siting Clearinghouse (Clearinghouse) to present Project information, discuss interactions with military airspace, training routes and assets; explore minimization and mitigations measures; and establish a process for information sharing and engagement. During consultations with the Marine Corps, it was confirmed that operations that overlap within the identified warning areas primarily support transit and not training activities (G. Simon, pers. comm., May 7, 2019). During discussion with the Clearinghouse, staff indicated that much of their concerns regarding military airspace had been addressed during the New Jersey Wind Energy Area siting and Leasing process with BOEM (S. Sample, pers. comm. October 16, 2020). However, DoD requested that Atlantic Shores maintain communications with the Clearinghouse and military staff as Project development advances to ensure any items of potential concern could be proactively addressed. As with other stakeholder groups, Atlantic Shores is committed to this request.

### 7.8.3 Radar

Radar facilities that overlap with the Offshore Lease Area include those that support air traffic control, military surveillance, high frequency (HF) coastal radars, and weather monitoring.

To support the understanding of radar facilities operating in the Offshore Project Area, Atlantic Shores conducted an initial analysis for Long Range Radar (LRR) and NEXRAD using the DoD Preliminary Screening Tool (PST) on the FAA Obstruction Evaluation/Airport Airspace Analysis website. This analysis provides a cursory indication of whether wind turbines may be within line-of-sight of one or more radar sites, and likely to affect radar performance. The PST LRR analysis accounts for air route and airport surveillance radar associated with the FAA, DoD and DHS. The PST NEXRAD analysis accounts for DoD, FAA, and National Oceanic and Atmospheric Administration (NOAA) Weather Surveillance Radar. The preliminary results indicate that the Project will overlap with LRR and will potentially influence NEXRAD Radar which will require further consultation with FAA, DoD, and DHS to determine potential effects and potential mitigating measures, if required (see Section 7.8.2.2).

Preliminary screening, and results from the Radar and Navigational Aid Screening Study (see Appendix II- U2) also revealed that the Lease Area will overlap with various NOAA high-frequency coastal radar sites used to support ocean observations. Further consultation with NOAA will be required to determine potential effects (see Section 7.8.2.2) and potential mitigating measures, if required. As with other stakeholder groups, Atlantic Shores is committed to this collaboration.

### 7.8.4 Potential Impact Producing Factors and Proposed Environmental Protection Measures

The following subsections summarize the potential effects to aviation, radar, and military operations during construction, O&M and decommissioning along with proposed avoidance and mitigation measures. The potential IPFs which may affect aviation and radar resources during construction, O&M, or decommissioning are presented in Table 7.8-2.

### Table 7.8-2. Impact Producing Factors for Aviation and Radar Resources

| Impact Producing Factors | Construction and Installation | Operations and Maintenance | Decommissioning |
|---|---|---|---|
| Installation and Maintenance of New Structures | ● | ● | ● |
| Presence of Structures | ● | ● | |

The WTGs and construction equipment (e.g., cranes) are Project elements that will have the potential to affect aviation and radar resources during the Project's lifecycle given their height above 200 ft (61 m). At the end of the Project's useful life, the WTGs will be decommissioned and removed resulting in no further impacts. The offshore substations (OSS), onshore substations, port areas will be evaluated for 14 CFR Part 77.9 Notice Criteria and FAA filing requirements based on final engineering design and final requirements for construction, O&M, and decommissioning.

Impacts to aviation, SAR, military airspace, and radar are based on the Project Design Envelope (PDE) for the maximum potential offshore Project build-out of WTGs in a uniform grid pattern with 1.0 nm) (1.9 km) by 0.6 nm (1.1 km) spacing and 1,047 ft (319 m) AMSL WTGs as detailed in Section 1.1 and Table 4.3-1 of Volume I.

## 7.8.5 Installation and Maintenance of New Structures

Aviation and/or radar facilities could be affected by the use of vessels and equipment (e.g., cranes) during construction, O&M and decommissioning of new offshore structures. The effects would result from the potential that tall structures could interfere with air traffic and/or radar transmission within the Lease Area. If vessels, and/or cranes required to support construction, O&M or decommissioning exceed 14 CFR Part 77.9 Notice Criteria and JO 7400.2N Instrument Approach Areas, Atlantic Shores will file accordingly with the FAA.

## 7.8.6 Presence of Structures

The WTGs within the Lease Area will overlap with FAA flight procedures and flight paths, military airspace and various FAA, NOAA and DoD/DHS radar systems. The following subsections summarize the potential effects on these resources including next steps and proposed mitigations.

**Aviation**

As previously stated, all structures exceeding 14 CFR Part 77.9 Notice Criteria located within territorial airspace must be submitted to the FAA for evaluation. Given the maximum tip height of the WTGs exceeds 499 ft (152 m), the proposed WTGs within U.S. Territorial Airspace will be considered obstructions under 14 CFR Part 77.17(a)(1); therefore, the FAA will require further study and a public comment period. However, structures in excess of 499 ft (152 m), are potentially feasible provided the proposed procedural changes to FAA operations do not affect a significant volume of operations. Atlantic Shores is currently conducting an Air Traffic Flow Analysis to determine if there is evidence of historic flights within FAA managed airspace to determine the potential to modify FAA operational procedures and/or adjust airspace and/or other mitigation requirements through formal filing and review under Federal Regulations, FAA Orders, and Flight Information Publications. The Air Traffic Flow Analysis will be provided in a future Construction and Operations Plan (COP) Supplement.

Consultation with military staff, the Clearinghouse, and the USCG indicate that airspace overlapping the Offshore Project Area supports both military transit and aerial SAR operations. Although the FAA does not consider impact on military airspace or training routes, the FAA will notify DoD of proposed structures within these segments of airspace to support evaluation and review. As previously stated, Atlantic Shores is committed to coordinating through the Clearinghouse and the USCG to assess and mitigate possible effects of Project activities throughout all phases of development and operations.

Atlantic Shores is committed to maintaining maritime safety and has specifically designed the Lease Area layout to accommodate predominant vessel traffic that minimizes effects to existing maritime activities (see Section 7.4 Navigation and Vessel Traffic). Atlantic Shores will mark and light all structures in accordance with FAA, BOEM, and USCG guidelines.

Atlantic Shores has also committed to implementing a comprehensive set of measures to avoid, minimize, or mitigate effects to SAR and improve search efforts overall. The measures include, but are not limited to, installing a direction finder system, high-resolution infrared cameras, and weather monitoring devices; employing a Marine Coordinator to liaise with the USCG; and developing an Emergency Response Plan (ERP).

Additionally, Atlantic Shores prepared a comprehensive risk assessment of aerial SAR (see Appendix II-U4 to further evaluate effects of the Project on USCG SAR missions and identify additional risk mitigation strategies.

Based upon the layout of the Lease Area in combination with the planned risk assessment and associated mitigation and monitoring, it is expected the successful implementation of USCG aerial SAR missions will not be negatively affected.

**Radar**

As discussed in Section 7.8.1.2, the Lease Area overlap with radar facilities that support air traffic control, military surveillance, and weather monitoring. Based on the preliminary screening analysis supported by the Clearinghouse PST and the Radar and Navigational Aid Screening Study (see Appendix II-U2), WTGs may affect radar by causing unwanted radar returns (i.e., clutter) resulting in a partial loss of target detection or false targets within and in proximity to the Lease Area. Other radar effects could include a partial loss of weather detection and false weather indications. Atlantic Shores is committed to continue working to further evaluate potential effects to these radar facilities in coordination with the FAA, DoD, DHS, and NOAA and identify potential mitigating measures, if required.

### 7.8.7 Summary of Proposed Environmental Protection Measures

Several environmental protection measures will be implemented to avoid and minimize potential impacts from the Project on aviation and radar resources, including but not limited to the following:

- Site-specific studies for the WTGs were conducted including an OE/AA analysis (Appendix II-U1) and radar screening (Appendix II-U2) studies to determine impacts to aviation and radar resources, respectively.
- An aerial SAR risk assessment (Appendix II-U4, including associated mitigation measures, has been prepared in coordination with USCG (Appendix II-U4) supplement to mitigate risk to SAR operations within the Lease Area.
- To aid mariners in distress and support the USCG SAR operations, Atlantic Shores has committed to implementing the following approaches and innovative technologies within the wind farm:
    - Coordinated with USCG to design a Project that provides sufficient WTG spacing to allow for safe aerial SAR.
    - Install a direction finder system to assist with the location of vessels in distress and persons overboard with a transponder.
    - Install high-resolution infrared cameras to detect, day or night and in all weather conditions, thermal images (e.g., vessels or a person in the water) across the entire Lease Area.
    - Install weather monitoring devices.
    - Hire a Marine Coordinator to liaise with the USCG as required during SAR activity within Lease Area, particularly with emergency braking of selected WTG rotors.
    - Develop an ERP to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.
    - Atlantic Shores will mark and light all structures in accordance with FAA, BOEM and USCG guidelines.
    - Continue ongoing Project coordination with FAA, BOEM, the DoD through the Clearinghouse, and the USCG.

# 7.9 Onshore Transportation and Traffic

This section describes onshore transportation systems and traffic patterns in the Onshore Project Area, associated impact producing factors (IPFs), and measures to avoid, minimize, or mitigate potential effects to these resources during construction, operations, and maintenance (O&M), and decommissioning.

Atlantic Shores has conducted a desktop assessment of onshore transportation and traffic to inform Project design decisions. Project construction, O&M, and decommissioning activities are designed to minimize effects to onshore transportation and traffic. Where the proposed onshore interconnection cable routes pass through or near transportation corridors, specialty installation techniques including horizontal directional drilling (HDD), pipe jacking, and jack-and-bore will be used to avoid and minimize traffic effects. Atlantic Shores will also adhere to voluntary seasonal construction restrictions and local ordinances that restrict hours of construction to avoid peak traffic usage.

## 7.9.1 Affected Environment

Installation of onshore Project facilities will occur in Monmouth and/or Ocean Counties in New Jersey and Richmond and/or Kings Counties New York. Atlantic Shores has also identified potential port facilities that may be used for activities, including but not limited to staging activities, crew transfers, and loading. This section describes the affected environment within those portions of New Jersey and New York where onshore Project components may be located.

## 7.9.2 Monmouth and Ocean Counties, New Jersey

Onshore Project components in Monmouth and Ocean Counties include the landfall site and onshore interconnection cable route options, a new onshore substation and/or converter station, and potential upgrades to the existing Larrabee or Atlantic points of interconnection (POI). These onshore facilities are described in detail in Sections 4.8 and 4.9 of Volume I.

The landfall sites will be located in an area generally situated within Sea Girt Borough, and/or City of Asbury Park. Atlantic Shores has currently identified five potential landfall options (see Figure 7.9-1) for interconnection into New Jersey.

The onshore interconnection cable route options exclusively use existing linear infrastructure corridors (including roadway rights-of-way [ROWs] and utility ROWs) (see Figure 7.9-1). Potential route options are collocated within or intersect various State and County Routes as well as municipal roadways. Depending on the onshore interconnection cable route option selected, State Routes 18, 33, 34, 35, 71, Interstate 195, the Garden State Parkway and the New Jersey Transit North Jersey Coast Line could be crossed or collocated (see Figure 7.9-1). Several of these routes serve as coastal evacuation routes such as State Routes 18, 34, 35, 71 the Garden State Parkway, and I-195. Additionally, there are numerous bus routes located along most of the State Routes proximate to the onshore interconnection cable route options.

Before connecting to the existing Larrabee and/or Atlantic POI Substations, the onshore interconnection cables will connect to a substation and/or converter station. Atlantic Shores is in the process of vetting potential substations and/or converter site locations in proximity to the proposed New Jersey POIs. The minimum siting criteria necessary to support the proposed substation and/or converter station is described in Volume I Section 3.2. The site(s) selected as a result of this due diligence exercise will be presented in a future Construction and Operations Plan (COP) Supplement. The onshore interconnection cable route options are described in detail in Section 4.8.1 of Volume I.


**Figure 7.9-1**

*Sheet 1 of 2*

*Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County NJ*

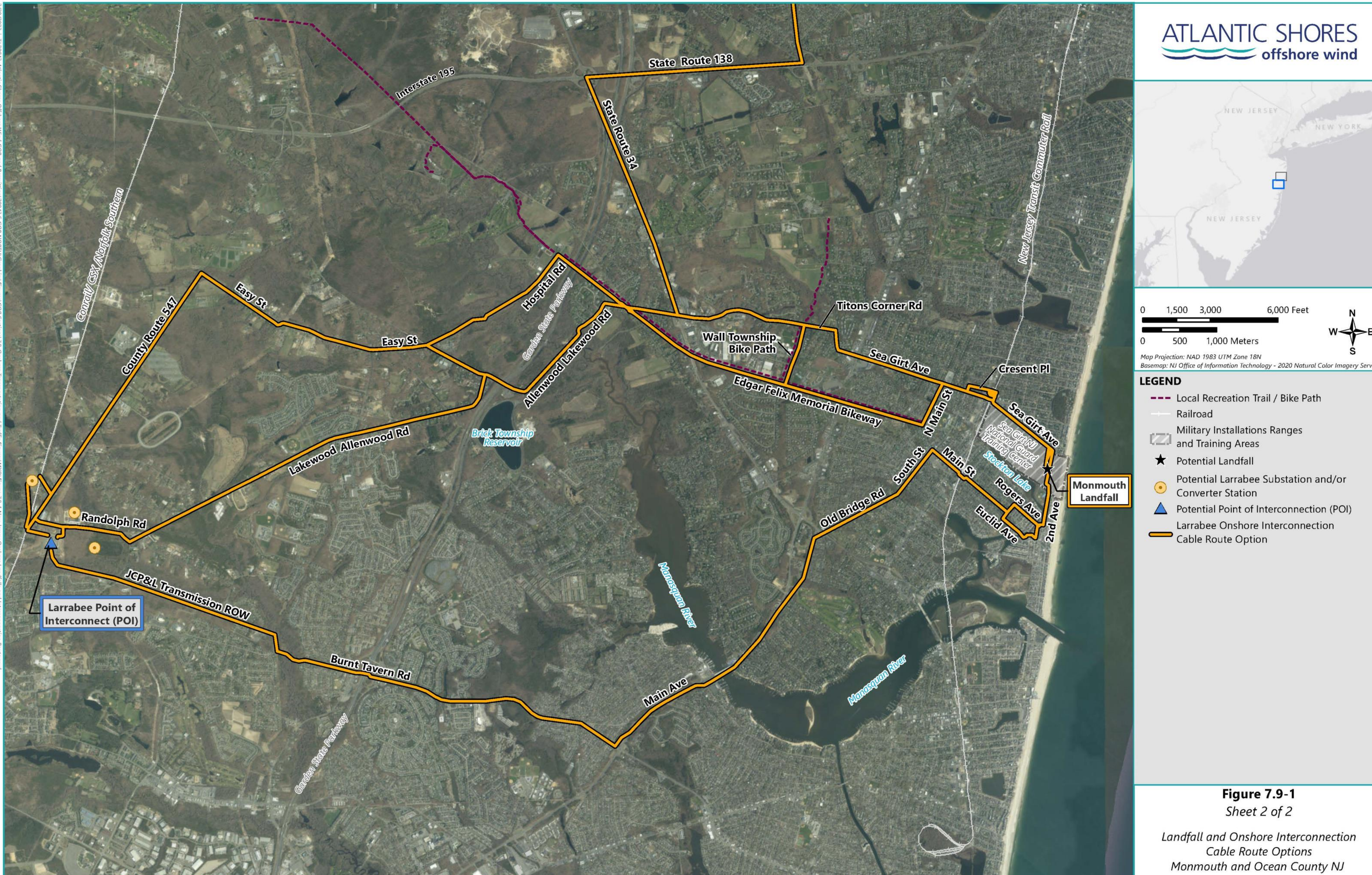


**Figure 7.9-1**

*Sheet 2 of 2*

*Landfall and Onshore Interconnection Cable Route Options Monmouth and Ocean County NJ*

#### 7.9.2.1 Kings and Richmond Counties, New York

Onshore Project components in Kings and Richmond Counties, New York include the proposed landfall sites, and onshore interconnection cable route options, a new onshore substation and/or converter station, and potential upgrades to the existing Fresh Kills, Goethals, and/or Gowanus POIs. These onshore facilities are described in detail in Sections 4.8 and 4.9 of Volume I.

Atlantic Shores has identified three potential landfall options for interconnection into New York. Potential landfall options are proposed on the southeastern shore of Staten Island and southern Kings County (see Figure 7.9-2).

The onshore interconnection cable route options exclusively use existing linear infrastructure corridors (i.e., roadway ROW) with the exception of crossing waterways, the State Island Railway, and the undeveloped lands to the north and south of the Staten Island Railway (see Figure 7.9-2). The onshore interconnection cable route options in New York are collocated within or cross numerous thoroughfares including State Routes 440, Korean War Veterans Parkway, as well as city streets. The route options also cross under the Staten Island Railway. I-278, and the Belt Parkway corridors. Additionally, there are numerous bus routes utilizing the city streets along and proximate to the proposed onshore interconnection cable route options.

Before connecting to the existing Fresh Kills, Goethals, and/or Gowanus POI Substations, the onshore interconnection cables will connect to a substation and/or converter station. Atlantic Shores is in the process of vetting potential substations and/or converter site locations in proximity to the proposed New Jersey POIs. The minimum siting criteria necessary to support the proposed substation and/or converter station is described in Volume I Section 3.2. The site(s) selected as a result of this due diligence exercise will be presented in a supplement to this COP. The onshore interconnection cable route options are described in detail in Section 4.8.1 of Volume I.

#### 7.9.2.2 Port Utilization

Atlantic Shores has identified several port facilities in New Jersey, New York, the Mid-Atlantic, and New England that may be used for major construction staging activities for the Project. In addition, some components, materials, and vessels could come from U.S. Gulf Coast or international ports.

Potential construction ports are discussed in Section 4.10 of Volume I. All ports that may be used are either existing facilities or planned facilities that are expected to be developed by others to support the offshore wind industry. Atlantic Shores does not propose developing any construction or staging port facilities. Activities such as refueling, restocking supplies, sourcing parts for repairs, and potentially some crew transfer, may occur out of ports other than those identified.

Potential O&M ports are described in Section 5.5 of Volume I and include Atlantic City, Lower Alloways Creek Township, and within the Port of New Jersey/New York.

9/7/2023 | T:\20043 Atlantic Shores Offshore Wind COP and Permitting\20043.6 COP NORTH\Graphics\Figures\COP Sections\7.9 Onshore Transportation and Traffic Figures\MXD\Figure 7.9-2 New York Onshore Landfalls and Interconnection Route_NEW.mxd

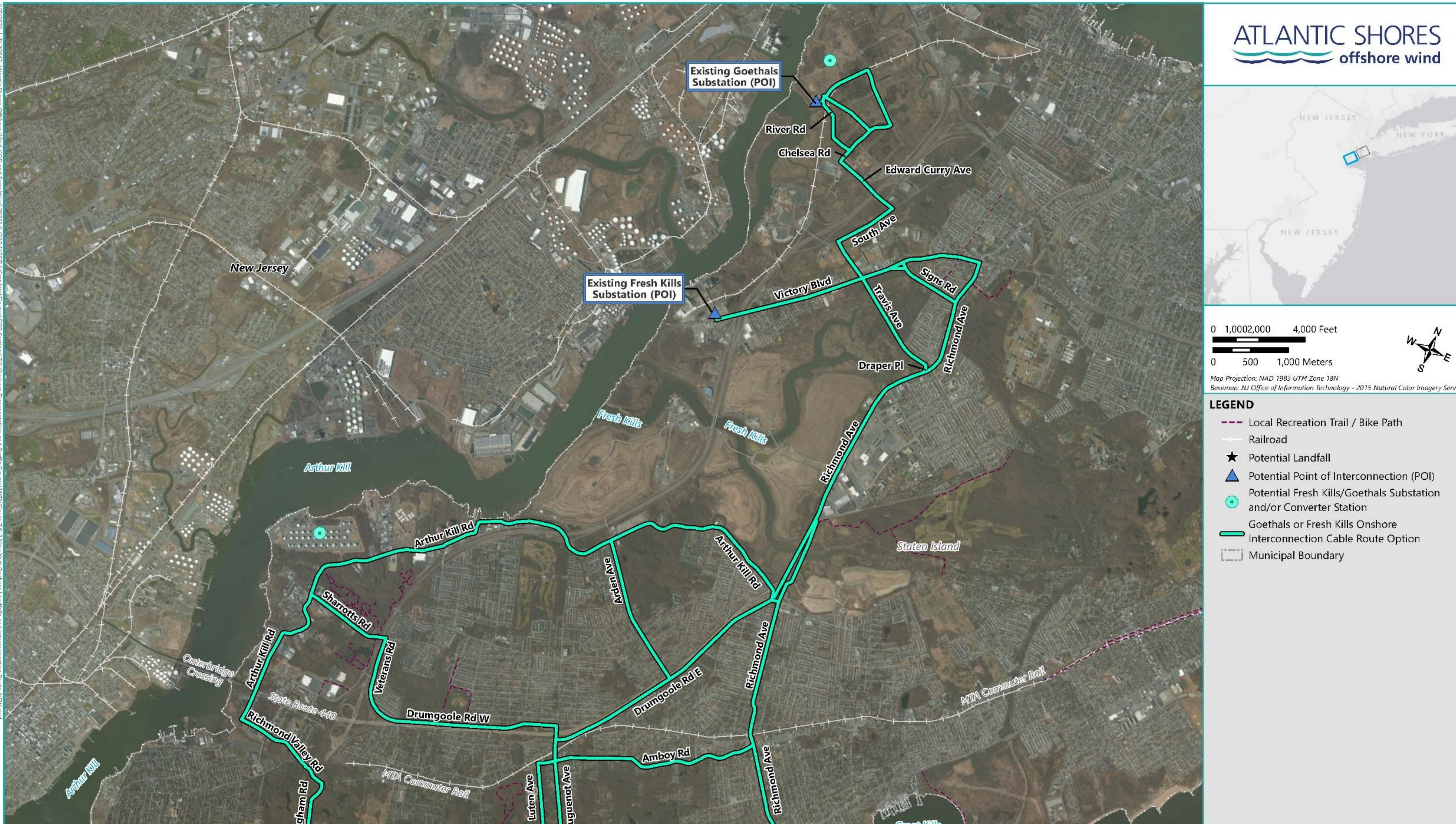


**Figure 7.9-2**

*Sheet 1 of 2*

*Landfall and Onshore Interconnection Cable Route Options*
*Richmond County, NY*

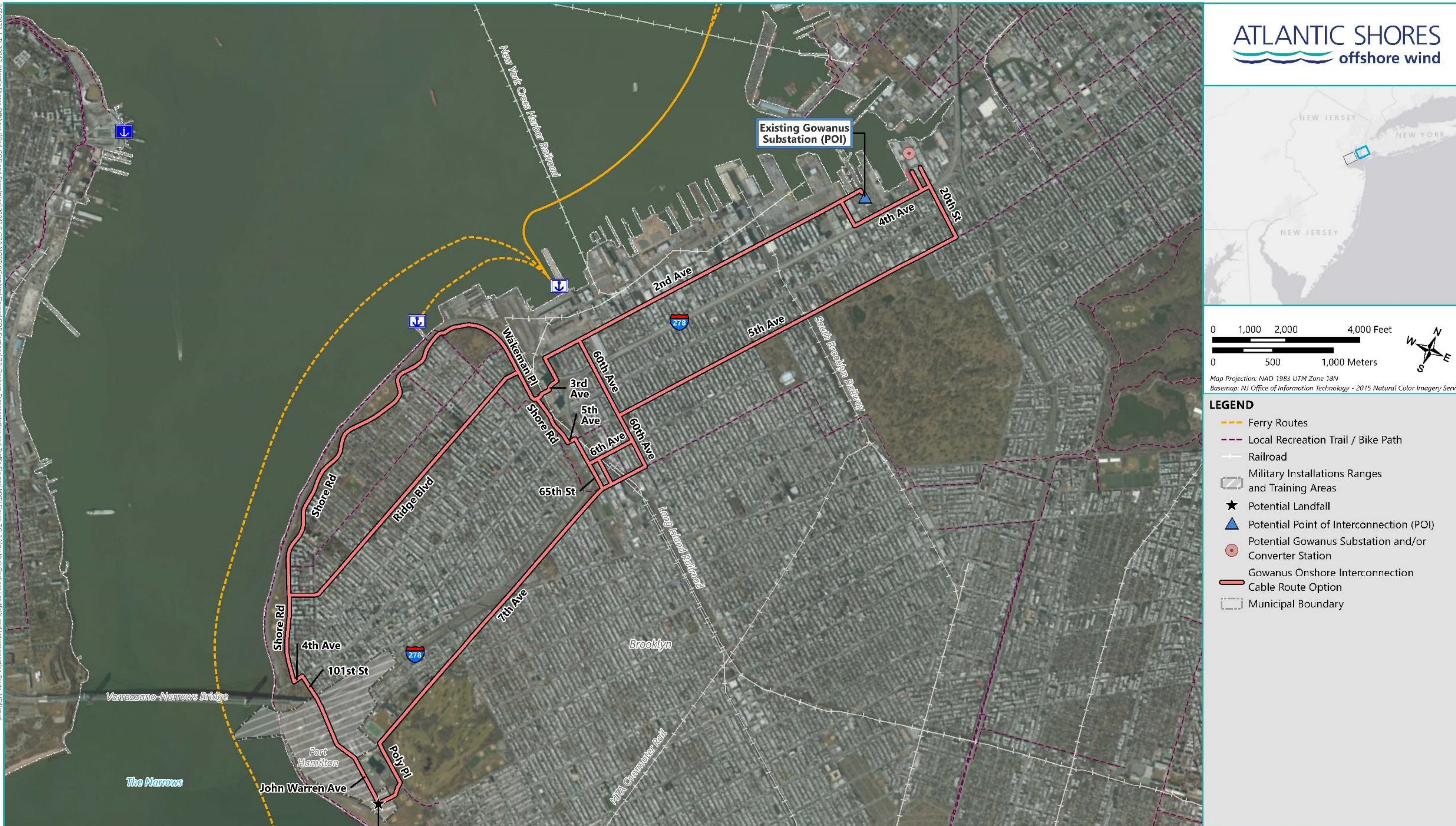


**Figure 7.9-2**

*Sheet 2 of 2*

*Landfall and Onshore Interconnection Cable Route Options Richmond and Kings County, NY*

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### 7.9.3 Potential Impacts and Proposed Environmental Protection Measures

The IPFs which may affect onshore transportation and traffic during Project construction, O&M, or decommissioning are presented in Table 7.9-1.

**Table 7.9-1. Impact Producing Factors for Onshore Transportation and Traffic**

| Impact Producing Factors | Construction & Installation | Operations & Maintenance | Decommissioning |
|---|---|---|---|
| Onshore Transportation and Traffic | ● | | ● |
| Port Utilization | ● | | ● |

The maximum Project Design Envelope (PDE) analyzed is the maximum onshore build-out of the Project for onshore transportation and traffic, and the maximum offshore build-out of the Project for port utilization (see Section 4.1.1 of Volume I).

#### 7.9.3.1 Onshore Transportation and Traffic

The onshore interconnection cable route options were selected primarily to make use of existing roadway ROWs. Given the dense, urban nature of much of the Onshore Project Area in New Jersey and New York, Atlantic Shores has evaluated measures to minimize effects.

The onshore interconnection cable routes options in New Jersey and New York were developed specifically to collocate within existing infrastructure including roadways. To minimize impacts to traffic Atlantic Shores will use trenchless crossing methods and develop a traffic control plan in collaboration with state, county, and location officials (see Section 4.8 of Volume I).

Construction and the associated land disturbance will be phased to limit impacts to discrete areas and therefore, will impact only a specific area for a short period of time. Atlantic Shores will adhere to seasonal construction restrictions in coordination with local authorities for certain portions of the onshore interconnection cable routes to avoid impacts during peak usage periods (e.g., summer shore season which is generally from Memorial Day to Labor Day). Aside from peak summer traffic, many of these roads also function as coastal evacuation routes. To minimize potential impact to these coastal evacuation routes, Atlantic Shores will develop a traffic control plan in coordination with municipal, county, and state officials to address these routes during construction and the coordination with emergency personnel.

Atlantic Shores will work with police, fire departments, state, county, and local municipalities as appropriate to develop a Traffic Management Plan (TMP) prior to construction to avoid and minimize traffic- and transportation-related effects. The TMP will be reviewed and approved by either NJDOT or NYDOT for those portions of the route that cross or occupy state highway ROW and will also pertain to county and local roads. Best management practices (BMPs) for the TMP are expected to include traffic control measures such as signage, police details, lane closures, and detours, among others. Additional specific traffic management strategies implemented by the Project may include, but will not be limited to, alternate traffic routes, reduced speeds, signal adjustments, physical barriers and channeling devices, alternate truck routes, and others.

Atlantic Shores will inform the public regarding onshore construction locations and schedules. Information regarding the construction of the Project may be made available via the Atlantic Shores website, news releases, community meetings, or other means. No meaningful effects or interruptions in service are expected for any bus routes operating along the onshore interconnection cable routes.

Construction hours will be developed in accordance with local noise ordinances. While Atlantic Shores is not anticipating significant nighttime work, any nighttime work deemed necessary will be coordinated with the local authorities.

Periodic maintenance of the onshore facilities may be required during the O&M phase of the Project. Access for maintenance is expected to take place through manholes, thereby avoiding or minimizing land disturbance and impacts to transportation and traffic. Decommissioning effects are expected to be similar to construction.

#### 7.9.3.2 Port Utilization

Project construction, O&M, and decommissioning will be supported by using existing ports, which may cause a temporary, minor increase in traffic during construction and decommissioning. As described in Section 7.9.1.3, Atlantic Shores will utilize existing or planned ports that can support offshore wind, including the required workforce. During construction and decommissioning, it is expected that dozens of workers will be required at the port(s) used by the Project. Although public transit may be available, most workers are expected to commute in their private vehicles. It is expected that parking for commuting workers will be provided onsite. Truck deliveries are not anticipated to be significantly different compared to normal port operations. During O&M, fewer personnel are expected at each port to support the Project than during the construction and decommissioning periods. Accordingly, Project-related transportation and traffic are not expected to result in any incremental increase in the scope and nature of transportation and traffic associated with existing port activities.

### 7.9.4 Summary of Proposed Environmental Protection Measures

Project construction, O&M, and decommissioning activities are designed to minimize effects to onshore transportation and traffic:

- A desktop assessment has been conducted of onshore transportation and traffic to inform Project design decisions.
- Seasonal construction restrictions will be implemented and compliance with local construction hour ordinances will be coordinated and observed with local municipal officials to avoid peak traffic usage.

- A TMP that includes traffic control measures (e.g., signage, police details, lane closures, and detours, and implementation of BMPs) will be developed and implemented.
- The public will be informed of construction locations and schedules using a variety of communication tools (e.g., via the Atlantic Shores website, news releases, community meetings, or other means).

# 8.0 In-Air Noise and Hydroacoustics

This section summarizes the in-air noise and underwater acoustic reports included as Appendices II-V and II-L, respectively.

- The Onshore Noise Report includes a baseline sound monitoring program that measured existing ambient sound levels near the proposed onshore substations and/or converter stations, modeling the predicted future sound levels when the onshore substations and/or converter stations are operational, computer modeling of onshore construction noise, and a comparison of predicted sound levels with applicable noise criteria. The purpose of this assessment is to demonstrate that construction and operations and maintenance (O&M) of the Project will meet all applicable onshore noise regulations.
- The Underwater Acoustic and Animal Exposure Modeling of Construction Sound Report includes acoustic modeling of construction activities and a predicted number of individual animals potentially exposed to sound levels above regulatory thresholds that may elicit a behavioral response or cause injury.

Section 8.1 summarizes the in-air noise assessment and Section 8.2 summarizes the underwater noise assessment.

## 8.1 In-Air Noise

An onshore noise assessment was conducted to analyze potential in-air sound level impacts from the construction and operation of the Project's onshore facilities. The comprehensive analysis focuses on potential impacts of the Project on people living and working in the communities proximal to the Project area in both New Jersey and New York (see Section 7.3 Recreation and Tourism of Volume II). The following subsections provide overviews of potentially applicable noise regulations, the baseline monitoring program, onshore operational noise, onshore construction noise, and proposed sound level protection measures. While Atlantic Shores recognizes that there may be some temporary minor effects on terrestrial wildlife, the focus of the in-air noise analysis is the human element.

Atlantic Shores will ensure the Project complies with applicable noise regulations and does not have a negative effect on surrounding communities. Localized and short-term generation of in-air noise may occur during construction. Operations and maintenance of the onshore substations and/or converter stations may result in minor and localized noise generation. Operational noise will emanate from the onshore substation and/or converter station components of the Project.

There are currently eight sites under consideration for the onshore substation and/or converter station. The sites are summarized in Table 8.1-1.

## Table 8.1-1. Summary of Potential Onshore Substations and/or Converter Stations

| Route | Label | Latitude | Longitude |
|---|---|---|---|
| Fresh Kills/Goethals | Arthur Kill Road Substation and/or Converter Station Site | 40.54552 | -74.2401 |
| Fresh Kills/Goethals | River Road Substation and/or Converter Station Site | 40.62216 | -74.1968 |
| Atlantic | Asbury Avenue Substation and/or Converter Station Site | 40.23601 | -74.0842 |
| Atlantic | Route 66 Substation and/or Converter Station Site | 40.22708 | -74.0770 |
| Larrabee | Lanes Pond Road Substation and/or Converter Station Site | 40.12143 | -74.1950 |
| Larrabee | Brook Road Substation and/or Converter Station Site (NJDPU SAA) | 40.11317 | -74.1852 |
| Gowanus | Sunset Industrial Park Substation and/or Converter Station Site | 40.6662 | -74.0004 |
| Larrabee | Randolph Road Substation and/or Converter Station Site | 40.11750 | -74.1884 |

## 8.1.1 Noise Regulations

### 8.1.1.1 State of New Jersey

Pursuant to the State of New Jersey's Noise Control Act of 1971, the New Jersey Department of Environmental Protection (NJDEP) promulgated noise regulations to control noise from stationary commercial and industrial sources in 1974 (see N.J.A.C. 7:29). The noise regulations establish broadband (A-weighted)[76] limits, as well as octave band level limits for daytime (7 am to 10 pm) and nighttime (10 pm to 7 am) continuous noise sources at industrial, commercial, or community service facilities.

The Project's onshore substations and/or converter stations are continuous noise sources[77] that fall under the category of "industrial facility." Thus, the most stringent broadband noise limits for these facilities would be 65 A-weighted decibels (dBA) during the day and 50 dBA at night. The sound level limits do not apply to construction noise which is regulated at the local level by allowing construction activity during specific hours and days of the week.

### 8.1.1.2 State of New York

Historically, noise impacts of a project have been evaluated in the Article VII process by the NYS Department of Public Service (DPS). Based on recent certificates issued by DPS, the sound from a substation and/or converter station is expected to meet the following conditions.

[76] Environmental sound is typically composed of acoustic energy across a wide range of frequencies; however, the human ear does not interpret the sound level from each frequency as equally loud. To compensate for the physical response of the human ear, the A-weighting filter is commonly used for describing environmental sound levels. The A-weighting filters the frequency spectrum of sound levels to correspond to the frequency response of the human ear (attenuating low and high frequency energy similar to the way people hear sound).

[77] NJDEP also regulates noise from impulsive (very short duration) noise sources; impulsive noise sources occurring less than four times per hour must have sound levels less than 80 dBA. However, the impulsive noise limits do not apply to the onshore substation and/or converter station sites because these are continuous noise sources.

- Comply with a limit of 40 dBA $L_{eq}$ (1-hour) outside of any non-participating residence from the substation and/or converter station equipment, and subject to the tonal penalties described below.
- Not produce any audible prominent tones, as defined under ANSI S12.9-2013/Part 3 Annex B at any non-participating residences existing as of the date of this Certificate. Should a prominent tone occur, the broadband overall (dBA) noise level at the evaluated position shall be increased by 5 dBA for evaluation of compliance with the 40 dBA limit.

These conditions effectively create a 35 dBA limit at a non-participating residence since some larger electrical components at substations and/or converter stations often have tonal sound signatures.

#### 8.1.1.3 Local Regulations

Municipalities sometimes have noise ordinances that are more stringent than the State regulations. Relevant local noise regulations for each municipality are described in Section 4.3 of Appendix II-V for each of the four proposed onshore interconnection cable routes and their respective substation and/or converter stations.

### 8.1.2 Baseline Sound Level Monitoring Program

To characterize the existing soundscape of the Onshore Project Area, an ambient (baseline) sound level monitoring program was conducted in December 2022 and January 2023 around the Projects' eight potential sites for the onshore substations and/or converter stations. The Atlantic Onshore Interconnection Cable route will include a new substation and/or converter station at the Asbury Avenue Site or the Route 66 Site. The Larrabee Onshore Interconnection Cable route will include a new substation and/or converter station at the Lanes Pond Road Site or the Randolph Road Site or the Brook Road Site (as developed under the NJBPU's SAA). The Fresh Kills/Goethals Onshore Interconnection Cable route will include a new substation and/or converter station at the Arthur Kill Road Site and/or the River Road Site. The Gowanus Onshore Interconnection Cable route will include a new substation and/or converter station at the Sunset Industrial Park Site. At each onshore substation and/or converter station site, two to four sound monitoring locations were selected to represent nearby residences and commercial sites (i.e., noise sensitive receptors) in various directions from the onshore substation and/or converter station.

At each monitoring location, sound levels were monitored for 20 minutes during the day and for 20 minutes at night using a programmable, attended sound level meter. The sound level meter measured A-weighted broadband levels and one-third octave bands from 6.3 hertz (Hz) to 10,000 Hz. Meteorological observations (e.g., local wind speed, relative humidity, and temperature) were also made at each monitoring location using handheld instrumentation.

A high-frequency natural sound (HFNS) filter was applied to all ambient measurements using methods identified by the American National Standards Institute (ANSI) for consistency with prior submittals. The baseline sound level monitoring results are presented in Section 6 of Appendix II-V.

### 8.1.3 Onshore Operational Noise

The analysis of onshore in-air operational noise examines expected sound levels from the Projects' onshore site equipment in Section 7 of Appendix II-V. The proposed onshore substation and/or converter station site design and specific equipment will depend on whether the onshore interconnection cables are high voltage alternating current (HVAC) or high voltage direct current (HVDC). Because HVDC equipment is expected to be primarily indoors, it is anticipated that the HVDC design would have generally lesser sound impacts on the surrounding community than the HVAC design. However, given that there is a possibility that the proposed onshore substations and/or converter stations may consist of a combined HVAC/HVDC configuration, sound level modeling has been conservatively performed to include the equipment from both designs to represent the reasonable worst-case scenario under a Project Design Envelope (PDE) approach.

A complete modeling analysis and evaluation is presented for one of the eight proposed onshore substation and/or converter station sites (Lanes Pond Road) in this submittal. The sound level modeling analyses are still in progress for the other seven sites, and these will be included in a later submittal. Project-only sound levels were modeled at nearby commercial and residential receptors using Cadna/A noise calculation software. All modeled onshore site noise sources (e.g., transformers, shunt reactors, and harmonic filters) were assumed to be operating simultaneously. Noise control features were incorporated into the modeling to limit sound level impacts in neighboring communities. The ultimate noise control solution will be decided in final design and will consider quieter equipment, noise barrier walls, site layout, or some combination of these elements to ensure compliance with the applicable noise regulations at the time of construction.

### 8.1.4 Onshore Construction Noise

There will be temporary noise during construction of the Project's onshore substation and/or converter station, installation of the onshore interconnection cables, and horizontal directional drilling (HDD) at the landfall sites where the export cables transition from offshore to onshore. Construction hours will adhere to local ordinances, and Atlantic Shores anticipates that typical construction hours will extend between 7 am and 6 pm (weekdays), depending on local noise ordinances. Planned construction activities, onshore and offshore, may temporarily disrupt or limit people from accessing work areas for public health and safety reasons where heavy equipment or vessels are maneuvering. Construction activities in coastal regions will be conducted outside of the peak tourism season (generally Memorial Day to Labor Day). While Atlantic Shores is not anticipating significant nighttime work, any nighttime work deemed necessary will be coordinated with the local authority.

Onshore site construction will resemble typical construction at an electric transmission substation. Construction equipment may include excavators, concrete trucks, backhoes, cranes, typical grading equipment, and other support vehicles. Based on maximum sound levels provided by the U.S. Environmental Protection Agency (EPA) (1971) for five major phases of construction (i.e., ground clearing, excavation, foundations, erection, and finishing), sound levels from onshore site construction will be estimated at nearby receptors using modeling when the final site locations have been selected.

Installation of the onshore interconnection cables and concrete duct bank will require typical construction equipment such as dump trucks, front-end loaders, concrete trucks, and excavators. Onshore interconnection cable installation will also require specialized construction vehicles such as winches and cable reel trucks. Onshore interconnection cable installation will generate noise levels that are periodically audible along the cable route. Noise and construction equipment will be similar to that for typical public works projects (e.g., road resurfacing, storm sewer installation, etc.).

The offshore-to-onshore export cable transition will be accomplished using HDD at the landfall sites. Maximum sound levels expected at the nearest residential receptors to the HDD at each landfall site will be predicted, assuming the loudest portion of HDD activity is onshore. Atlantic Shores may develop and implement construction noise mitigation measures as the Project design advances. Such mitigation measures may include use of a low noise/muffled generator, portable sound walls (temporary noise barriers) as needed to block the path of sound from equipment and working with municipalities to coordinate work schedules.

### 8.1.5 Summary of Potential Effects and Proposed Environmental Protection Measures

Results of the onshore noise assessment are used to understand potential effects to members of the public (see Section 7.3 Recreation and Tourism), although Atlantic Shores recognizes that noise may also have a limited effect on terrestrial wildlife. These types of effects to wildlife are addressed in Sections 4.2 Coastal and Terrestrial Habitat and Fauna, 4.3 Birds, and 4.4 Bats.

Operation of the onshore substation and/or converter station will be designed to comply with the applicable sound level limits and will include sound level mitigation as needed. Onshore, the presence and movement of Project personnel, equipment, and vehicles during construction could generate short periods of activity resulting in traffic and noise in isolated locations near the work activity. While intermittent increases in noise levels are expected during onshore construction, Atlantic Shores will make every reasonable effort to minimize noise impacts. Onshore equipment that produces noise will be located to avoid areas where recreational and tourism activities take place, so adverse effects of Project-related noise and vibration are greatly minimized.

Construction-period mitigation measures may include using quieter equipment, assuring the functionality of equipment, and adding mufflers or noise-reducing features, using portable sound walls (i.e., temporary noise barriers), and replacing back-up alarms on trucks and equipment with strobes, as allowed within Occupational Safety and Health Administration (OSHA) regulations.

The Onshore Project Area is characterized by existing development, vehicle traffic, and commercial activity. Noise and vibration from the Project are expected to be limited in the context of the surrounding land uses, localized and short-term. Atlantic Shores is proposing to adhere to seasonal construction restrictions in coastal regions during the peak tourist season to minimize effects associated with temporary noise. To the extent practicable, onshore construction in areas near the coast, including HDD at the landfall sites, will not occur during the summer (generally from Memorial Day to Labor Day), subject to ongoing coordination with local authorities. Additionally, the daily hours of operation for onshore construction activities, including HDD, will be developed in accordance with municipal noise ordinances. Any work that needs to extend outside allowed construction hours will be discussed with local officials and waivers will be obtained, if necessary. To further minimize the effects of construction noise, Atlantic Shores will maintain strong communication and public outreach with adjacent stakeholders about the time and nature of construction activities.

## 8.2 Underwater Noise

Construction activities will result in the short-term generation of underwater noise from pile driving and other Project activities such as high resolution geophysical (HRG) surveys, coffer dam installation, conductor barrel and goal post installation (a temporary structure installed to support the installation of the conductor barrels), and vessel engines, thrusters, and propellers. Atlantic Shores has conducted underwater acoustic and animal exposure modeling within the Lease Area and is provided herein as the Underwater Acoustic Assessment of Pile Driving and Related Sound-Producing Construction Activities at the Atlantic Shores Offshore Wind North Project Report (see Appendix II-L). This report provides acoustic modeling of pile driving and cofferdam, conductor barrel, and goal post installation activities, including a predicted number of individual animals potentially exposed to sound levels that may elicit a behavioral response or cause injury, as well as a qualitative assessment of other anthropogenic noise sources. This modeling, based on the specific Project design, supports the Project's understanding of the potential effects of construction noise on marine wildlife, namely marine mammals, sea turtles, and fish, along with the associated options for mitigation. The following subsections describe the model inputs and the modeling steps. Detailed results of the hydroacoustic modeling, potential effects to marine organisms, and mitigation measures are presented in Sections 4.5 Benthic Resources, 4.6 Finfish, Invertebrates, and Essential Fish Habitat, 4.7 Marine Mammals, and 4.8 Sea Turtles.

### 8.2.1 Model Inputs

The hydroacoustic modeling considers the proposed development of the Lease Area and is based on parameters included in the PDE detailed in Section 4.0 of Volume I. Atlantic Shores is proposing to install up to 157 wind turbine generators (WTGs), up to 8 offshore substations (OSSs), and one permanent meteorological (met) tower in the Lease Area over a 2-year offshore construction period. The PDE includes two piled foundation types that are the focus of the hydroacoustic modeling: monopiles and jackets. The jacket foundations may be "pre-piled" (where piles are driven, and the jacket is subsequently set onto the piles) or "post-piled" (where the piles are driven through guides mounted to the base of each jacket leg after the jacket is set on the seafloor).

The hydroacoustic modeling includes the following key inputs:

- Foundation types:
    - WTG and met tower foundations may include monopiles or jackets. If jackets, foundations are pre-piled and may include up to four piles.
    - OSS foundations are post-piled jackets and may include up to 24 piles for the largest OSS size.
- Pile diameters:

  - Under the maximum design scenario in the Project's PDE, monopile foundations have a bottom diameter of up to 49.2 feet (ft) (15.0 meters [m]).
  - Under the more realistic "base-case" scenario, monopile foundations have a bottom diameter of up to 32.8 ft (10.0 m).
  - Jacket piles have a diameter of up to 16.4 ft (5.0 m).
- Hammer energy, model, and number of strikes:
  - The maximum expected hammer size for installation of monopiles is up to 4,400 kilojoules (kJ) whereas the maximum expected hammer size for jacket pin piles is 2,500 kJ.
  - The representative makes and model of impact hammers and the hammer energy schedule used in the acoustic modeling are presented in Table 5 of Appendix II-L.
- Site-specific conditions including bathymetry, sound speed in the water column, and seabed geoacoustics:
  - Modeling was conducted at two sites representing the range of water depths within the Lease Area: Location 1 (shallow) has a water depth of 67.9 ft (20.7 m), and Location 2 (deep) has a water depth of 90.2 feet (27.5 m) (see Figure 1 and Table 3 in Appendix II-L).
- Installation schedule:
  - Pile driving occurs in the months of May to December.
  - Up to two monopile or four jacket piles are installed per day, with no concurrent pile driving.

The expected number of days of piling each month over a combined 2-year period are provided in Table 8.2-1 (see also Table 1 of Appendix II-L). Construction Schedule 1 assumes all WTGs and the met tower will be supported by 49.2 ft (15.0 m) monopile foundations. Construction Schedule 2 assumes all WTGs and the met tower will be supported by pre-piled jacket foundations. In both Schedules 1 and 2, the OSS jacket foundations were modeled assuming post-piled installation.

### Table 8.2-1. Modeled Foundation Installation Schedules for Monopile and Jacket Foundation Approaches, Atlantic Shores Offshore Wind Project

| Constr. Month | Construction Schedule 1 (WTG Monopile) | | | Construction Schedule 2 (WTG Jacket) | | |
|---|---|---|---|---|---|---|
| | WTG Monopile Foundation Piling Days | OSS Jacket Foundation Piling Days | Total # Piling Days | WTG Jacket Foundation Piling Days | OSS Jacket Foundation Piling Days | Total # Piling Days |
| | 49.2 ft (15 m) | 16.4 ft (5 m) | | 16.4 ft (5 m) | 16.4 ft (5 m) | |
| May | 36 | 0 | 36 | 36 | 0 | 36 |
| June | 20 | 12 | 32 | 20 | 12 | 32 |
| July | 34 | 0 | 34 | 34 | 0 | 34 |
| August | 22 | 6 | 28 | 22 | 6 | 28 |
| September | 12 | 0 | 12 | 12 | 0 | 12 |
| October | 14 | 0 | 14 | 14 | 0 | 14 |
| November | 13 | 0 | 13 | 13 | 0 | 13 |
| December | 7 | 0 | 7 | 7 | 0 | 7 |
| **Total** | **158** | **18** | **176** | **158** | **18** | **176** |

1 Construction schedules are based on a combined 2-year period.
2 One, 4-legged jacket foundation installation is assumed per day.
3 Installation of up to two monopile foundations per day is assumed with no concurrent pile driving.
4 The WTG jacket foundation is pre-piled, and the OSS jacket foundation is post-piled.5 Total under WTG monopile foundation includes one met tower monopile foundation.

## 8.2.2 Modeling Process

The hydroacoustic modeling and assessment process involves five primary steps to evaluate the potential risk from acoustic exposure for marine mammals, sea turtles, and fish.

- Source modeling was conducted to determine sound transmission from impact pile driving. Sound transmission to marine organisms can occur directly through the water, as a result of reflection from the water's surface or seabed, or as a result of sound being re-radiated from the seabed into the water. The sound source modeling and the accompanying forcing functions for impact pile driving were computed for each pile type using GRLWEAP 2010 (GRLWEAP, Pile Dynamics 2010) as well as the Pile Driving Source Model developed by JASCO Applied Sciences, Inc. and used in the hydroacoustic analysis conducted for adjacent Lease Area OCS-A 0499 (Weirathmueller et al. 2022).
- Sound propagation modeling was used to estimate the three-dimensional sound fields generated from pile driving activities. Specifically, the propagation modeling results are used to determine distances to regulatory-defined acoustic thresholds that may elicit a behavioral response or cause

injury to marine species; these distances to acoustic thresholds are referred to as "acoustic ranges." Behavioral thresholds are provided relative to sound pressure levels (SPL or Lp) and injurious thresholds are provided relative to sound exposure levels (SEL or LE) and peak pressure levels (PK or LPK).78 The propagation modeling approach used for the Project is fully described in Section 2.4 of Appendix II-L.

- The use of noise abatement systems (NAS) such as bubble curtains was incorporated into the modeling. To account for the likely minimum sound reduction resulting from NAS, hypothetical broadband noise attenuation levels of 6 decibels (dB), 10 dB, and 15 dB were incorporated into the model results for acoustic and exposure ranges (described in Steps 2 and 4, respectively) and exposure estimates (described in Step 5).
- As described in Sections 4.7 Marine Mammals and 4.8 Sea Turtles, animal movement modeling was conducted to account for the fact that an animal will not remain in a static position for the duration of pile driving. The animal movement modeling incorporated realistic behaviors (e.g., diving, foraging, surface times) for the simulated animals (animats) used in the modeling. The results of the animal movement modeling were used to estimate the received sound levels for animals near to the construction activity. The results were also used to calculate the radial distances from the pile (referred to as "exposure ranges") within which 95% of animats may be exposed above the relevant thresholds for behavioral response or injury for marine species. The animal movement modeling approach used for the Project is fully described in Section 2.8 of Appendix II-L.
- Following the completion of the preceding modeling steps, the number of animals exposed to sound levels above threshold values was estimated using the local animal densities to scale the number of animats exposed above threshold criteria in the model. While exposure estimates were calculated for a range of hypothetical noise attenuation levels as described in Step 3, the exposure estimates used to assess potential effects to marine mammals and sea turtles (described in Sections 4.7 Marine Mammals and 4.8 Sea Turtles, respectively) conservatively included 10 dB as an achievable sound reduction level when NAS are in use during pile driving, based on a recent analysis of NAS (Bellmann et al. 2020). The assumption represents the minimum sound reduction expected from NAS, such as bubble curtains.

### 8.2.3 Summary of Potential Effects and Proposed Environmental Protection Measures

The hydroacoustic analysis predicted the sound fields generated by the Project and potential effects to marine species. To reduce the effects of underwater noise on marine wildlife, Atlantic Shores will implement reasonable NAS (e.g., bubble curtains, sleeves, and hydro-sound dampers) to achieve a minimum of 10 dB of attenuation. The model results include conservative assumptions and do not consider the mitigation measures that Atlantic Shores is proposing in addition to use of NAS, which are expected to substantially reduce risk. Detailed results of the hydroacoustic modeling, potential effects to marine wildlife, and environmental protection measures are presented in Sections 4.5 Benthic Resources, 4.6 Finfish, Invertebrates, and Essential Fish Habitat, 4.7 Marine Mammals, and 4.8 Sea

[78] See Section 4.1 of Appendix II-L for a description of injurious and behavioral acoustic thresholds used to evaluate potential effects to marine mammals. Acoustic thresholds used to evaluate potential effects to fish and sea turtles are discussed in Sections 4.2 and 4.3 of Appendix II-L, respectively.

Turtles. As described further in those sections, environmental protection measures to be implemented during impact pile-driving activities include, but are not limited to, the following:

- Seasonal restrictions on construction activity to avoid months (January to April) when North Atlantic right whale densities are higher;
- Equipment operating procedures (e.g., soft starts, ramp-ups, and shutdowns);
- Daytime visual monitoring by NOAA Fisheries-approved Protected Species Observers (PSOs);
- Use of Passive Acoustic Monitoring (PAM);
- Evaluation of innovative monitoring technologies such as, autonomous underwater vehicles and unmanned aerial systems; and
- Designation and maintenance of species-specific protection, clearance, shutdown, and monitoring zones.

# 9.0 Public Health and Safety

The Project will produce clean, renewable energy from offshore wind. While construction, operations and maintenance (O&M), and decommissioning activities associated with the Project will generate some air pollutant emissions (see Section 3.1 Air Quality) and wastes (see Section 7.0 of Volume I), the generation of energy from offshore wind itself is emission-free and waste-free, and thus poses minimal risks to public health and safety. In fact, as described in Section 2.2 of Volume I, the Project will have significant environmental and public health benefits. By displacing electricity from pollution-emitting fossil fuel power plants that otherwise would be required to serve the projected increase in electric demand within regional electric markets over the life of the Project, the Project will result in a region-wide net decrease in harmful air pollutant emissions. Such emissions damage sensitive ecosystems (by contributing to acid rain, ocean acidification, and ground level ozone/smog) and are linked to increased rates of public health issues (e.g., early death, stroke, heart attacks, and respiratory disorders). The Project will also result in a net decrease in greenhouse gas (GHG) emissions that contribute to climate change.

This section discusses potential public health and safety concerns and issues that may arise during the life of the Project, including public access and security, electromagnetic fields (EMF), and non-routine and low probability events such as vessel allisions and collisions, accidental spills, and significant infrastructure failure.

Health, safety, security, and environmental (HSSE) protection are critical components of all Atlantic Shores planning and activities. Atlantic Shores is committed to full compliance with applicable HSSE regulations and codes throughout the pre-construction, construction, O&M, and decommissioning phases of the Project. As described in Section 1.5.3 of Volume I, Atlantic Shores will implement the following HSSE plans: Safety Management System (SMS), Oil Spill Response Plan (OSRP), and Spill Prevention, Control, and Countermeasure (SPCC) Plan. Many of the events described in this section are unlikely to occur. The Atlantic Shores HSSE plans and systems further reduce the risk that such events may arise and prescribe the response actions needed to address any incidents that do manifest.

## 9.1 Public Access and Security

Atlantic Shores will employ numerous strategies to ensure that the Project facilities are secure and to keep the public safe during offshore and onshore construction, O&M, and decommissioning. As described in Section 1.4.2 of Volume I, Atlantic Shores will keep stakeholders informed about the Project through several stakeholder engagement tools including, but not limited to, employing a Community Liaison Officer, maintaining an up-to-date and interactive Project website, and providing Project updates via various social media platforms.

## Offshore

As described in the draft SMS (Appendix I-D), access to the offshore facilities will be controlled by the Site Manager (or designated subordinate), and personnel intending to transfer to the offshore facilities must have the necessary training and certificates (e.g., sea survival training), medical fitness for duty verification, and site-specific induction training. The wind turbine generator (WTG), offshore substation (OSS), and meteorological (met) tower foundations will include signage in multiple locations (e.g., near the boat landing) restricting access to authorized individuals. However, the access ladders on the WTG and OSS foundations will be designed to allow distressed mariners access to an open refuge area above the splash zone. Beyond the refuge area, a locked door will prevent access to the OSS or WTG work platform or interior. The presence of a person on the offshore structure will be detected, for example, by cameras or intrusion detectors.

The offshore cables will be buried beneath the seabed to sufficient depths or protected with cable protection (in limited areas) to prevent damage from marine activities.

During offshore construction or O&M activities, Atlantic Shores anticipates that temporary safety buffer zones will be established around the working areas to reduce hazards. These safety buffer zones will only cover a small portion of the Lease Area or Export Cable Corridors (ECCs) and will be limited to the duration of the work being conducted.

## Onshore

During onshore interconnection cable installation, active worksites will be secured. When no work is being performed, trenches or holes will either be temporarily secured and covered, or barricades will be used in compliance with local construction permit requirements. As part of the onshore cable route in the state permitting process, Atlantic Shores will develop a Traffic Management Plan (TMP) to avoid and/or minimize traffic- and transportation-related effects during onshore construction (see Section 7.9.2.1). Best management practices (BMPs) for the TMP are expected to include traffic control measures such as signage, police details, lane closures, and detours, among others. The TMP will be reviewed with police, fire departments and local authorities to address emergency vehicle access. Once the onshore interconnection cables are installed, access to the cables will be restricted via manhole covers.

For the construction of the onshore substation and/or converter station, temporary fencing and signage will be installed to prevent public access to the construction site. Site access will be fenced and gated, and security personnel will be located at the gate during construction work hours. Once the onshore substation and/or converter station is operational, a security plan will control site access by employing permanent fencing (with earth grounding), screening barriers, camera systems, signage, and physical barriers. Access to the onshore facilities will be controlled by the Site Manager (or designated subordinate), and personnel intending to work within or access the facilities must have the necessary training and certificates and site-specific safety training.

Before starting any onshore work, Atlantic Shores will coordinate as appropriate with municipalities and work to inform members of the public regarding onshore construction locations and schedules (see Section 1.4). Prior to performing any offshore work, Atlantic Shores will adhere to its Fisheries Communication Plan (FCP) (see Appendix II-S) and will communicate directly with its fishing industry contacts to avoid and minimize interactions with fishing vessels and fishing gear. Atlantic Shores will coordinate with the U.S. Coast Guard (USCG) to issue Notices to Mariners to inform fishermen and other mariners of the Project's activities.

## 9.2 Non-Routine and Low Probability Events

Non-routine and low probability events are defined as incidents of high potential consequence that are not likely to occur. The types of non-routine and low probability events that could occur during construction, O&M, and/or decommissioning of the Project include:

- vessel allisions (a vessel striking a stationary object such as a WTG or OSS), collisions between vessels, and accidental vessel grounding
- severe weather and natural events
- offshore, coastal, and onshore spills and other accidental releases
- significant infrastructure failure, including cable damage or displacement
- terrorist attacks.

The following subsections provide information regarding these types of non-routine and low probability events and the measures Atlantic Shores has taken to ensure that the potential risks associated with these events (should they occur) have been minimized to the maximum extent practicable.

### 9.2.1 Vessel Allisions, Collisions, and Grounding

Allisions occur when a vessel strikes a stationary object, such as a WTG or OSS. Collisions occur when a vessel strikes another moving object, such as another vessel. Grounding occurs when a vessel strikes the seabed in shallow waters.

The Project Navigation Safety Risk Assessment (NSRA) analyzes the risk of two types of allisions: drifting allisions and powered allisions (See Appendix II-T). Drifting allisions occur when a vessel loses propulsion and/or the ability to steer and is transported by currents and wind into a structure. Powered allisions occur when a vessel strikes a structure while moving under power as the result of human error. The NSRA also analyzes three types of collisions between vessels (head-on, overtaking, and crossing). Given the bathymetric conditions of the Lease Area, accidental vessel grounding was not considered a significant source of risk, although shallower water is present in each ECC near the landfall sites.

The application of a quantitative navigational risk model indicated that the presence of structures and increase in vessel traffic due to the Project may cause a small potential increase in accident frequencies. The frequency of accidents changed from 0.090 accidents per year under existing conditions (an 11-year return period) to 0.10 to 0.11 accidents per year post-construction (a 9.0- to 10-year return period, respectively). This risk of accidents includes both risk to existing traffic and risk to Atlantic Shores' O&M vessels. Considering only the risk to existing vessel traffic (i.e., excluding collisions between O&M vessels themselves or allisions by O&M vessels), the overall post-construction accident frequency drops to 0.098 to 0.107 accidents per year (a 10.2 to 9.4-year return period, respectively). This change from existing conditions represents one additional accident every 50 to 103 years, depending on the foundation type, which is greater than the 30-year operational life of the project. Although large commercial vessels (e.g., cargo, tug-barge, passenger, etc.) are anticipated to route around the Lease Area once the WTGs and OSSs are installed, the number of encounters (and hence the risk of collision) with smaller craft (fishing and recreational vessels) is expected to remain about the same. The presence of the WTG/OSS structures does cause a small allision risk, but the routing of the fishing and recreational craft down defined corridors tends to offset this risk.

As described in Section 7.6.2.3, the WTG layout will create 1.0 nautical mile (nm) (1.9 kilometer [km]) wide corridors in an east-northeast to west-southwest direction); 0.6 nm (1.1 km) wide corridors in an approximately north to south direction; 0.54 nm (1.0 km) diagonal corridors running approximately northwest to southeast; and 0.49 nm (0.9 km) diagonal corridors running approximately north-northeast to south-southwest (see Figure 7.6-11). Given the relatively low level of vessel traffic density in the Lease Area, these corridors are expected to organize vessel traffic through the Lease Area and limit vessel interactions that may have otherwise occurred in open water conditions. However, this slight reduction in collision risk is counteracted by the small allision risk created by the presence of the WTGs and OSSs. See Section 7.6.2.4 for additional discussion of the changes in collision and allision risk due to the Project.

In addition to the Project uniform grid layout, other mitigating factors that reduce the risk of vessel allisions and collisions include:

- **Location of the Lease Area:** The Lease Area is within the New Jersey Wind Energy Area (NJWEA), which was sited by the Bureau of Ocean Energy Management (BOEM) to avoid shipping lanes, traffic separation schemes, and fishing hotspots (see Section 1.3.1 of Volume I). The traffic density for all vessels is concentrated in the nearshore areas west of the Lease Area. At its closest point, the Lease Area is approximately 8.4 miles (mi) (13.5 kilometers [km]) from the New Jersey shoreline and approximately 60 mi (96.6 km) from the New York State shoreline.

- **Marine Navigation Lighting and Marking:** To enhance navigation safety, the Project WTGs, OSSs, and met tower will be equipped with marine navigation lighting and marking in accordance with U.S. Coast Guard (USCG) and BOEM guidance. Based on USCG District 5 Local Notice to Mariner (LNM) 45/20, Atlantic Shores expects to include unique alphanumeric identification on each WTG and/or foundation, yellow flashing lights on each foundation that are visible in all directions, and Mariner Radio Activated Sound Signals (MRASS) on select foundations. Automatic Identification System (AIS) will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). See Section 5.3 of Volume I and Section 7.6.2 of Volume II for additional discussion of lighting and marking. The location of the Project offshore facilities will also be provided to USCG and the National Oceanic and Atmospheric Administration (NOAA) for inclusion on nautical charts.

- **Adherence to USCG and International Maritime Regulations:** The use of USCG lighting on vessels and mariners' adherence to Federal and international regulations, such as the International Regulations for Preventing Collisions (COLREGs), will reduce the risk of vessel collisions and allisions.

While vessel collisions and allisions are unlikely due to these mitigating factors, Atlantic Shores will develop an Emergency Response Plan (ERP) for a range of emergency situations, including allisions between vessels and structures, vessels in distress, man overboard, and search and rescue (SAR) (see Section 13.0 of the draft SMS provided as Appendix I-D). The potential effects from the Project on USCG SAR activities within and near the Lease Area, should a collision or allision occur, are discussed in Section 7.6.2.3. Atlantic Shores is proposing a variety of mitigation measures to assist with USCG SAR activities, including implementation of WTG rotor emergency braking systems to set and maintain the position of WTG moving parts during a SAR event, measures to assist in search detection (e.g., installation of very high frequency [VHF] direction finding equipment and high-resolution infrared detection systems) and access ladders on the WTG and OSS foundations to allow distressed mariners access to an open refuge area (see Section 7.6.2.3).

Should a collision or allision result in a spill, Atlantic Shores will adhere to the protocols outlined in the OSRP (see Section 9.2.3 and Appendix I-C).

### 9.2.2 Severe Weather and Natural Events

Severe weather events such as hurricanes, extratropical cyclones (e.g., nor'easters), and tropical storms have been recorded within or in the vicinity of the Lease Area and ECCs (see Section 2.2 Physical Oceanography and Meteorology). These weather events have the potential to injure personnel and cause structural damage to the Project offshore facilities (BOEM 2012). Although extremely unlikely, severe flooding and/or coastal erosion from a major storm could cause damage to the Project onshore facilities. The Project is not located in a region considered to be seismically active (see Section 2.1 Geology), and the Project facilities will be designed to meet relevant seismic stability criteria; therefore, the potential for catastrophic damage to the Project facilities from an earthquake is extremely low. Significant infrastructure failure/damage, which may result from severe weather, earthquakes, and other natural events, is discussed further in Section 9.2.5.

The Project facilities are designed to withstand severe weather events based on site-specific meteorological, oceanographic, and geological conditions and will conform to all applicable standards (e.g., American Clean Power Association [ACP], International Electrotechnical Commission [IEC], American Petroleum Institute [API], and International Organization for Standardization [ISO] standards). The maximum scenario meteorological, oceanographic, and geological conditions on which the Project design will be based will be detailed in the design basis and verified by the independent Certified Verification Agent (CVA) as part of the Facilities Design Report (FDR) and Fabrication and Installation Report (FIR). In particular, the WTGs are designed to reference wind speeds for type certification[79] (see Section 4.3.1 of Volume I), although a site-specific assessment of the WTGs will be performed for the Project. The WTGs will continuously adjust the angle of the blades and the direction of the rotor nacelle assembly based on wind speed and direction to maintain safe operating limits. During a high wind event, the WTGs will automatically shut down when wind speeds exceed the WTGs' maximum operational limit (see Section 4.3.1 of Volume I).

As described in Section 1.5.2 of Volume I and Appendix I-E, Atlantic Shores will employ a third-party CVA to conduct an independent assessment of the design of the Project facilities and the planned fabrication and installation activities. The CVA will certify to BOEM that the Project is designed to withstand the site-specific environmental and functional load conditions appropriate for its intended service life.

### 9.2.3 Offshore Spills, Discharges and Accidental Releases

Offshore spills, discharges or inadvertent releases may result from accidents during vessel refueling, equipment malfunction or breakage, vessel collisions/allisions/grounding, or inadvertent releases of grout during foundation installation. As described in Section 7.0 of Volume I, the solid and liquid wastes generated by the Project will be treated, released, stored, and/or disposed of in accordance with applicable Federal, State, and local regulations to reduce the risk of spills, discharges, and accidental releases.

While spills during vessel refueling are not expected, if a spill occurs, it is likely to be small in volume and areal extent. The USCG reports that over the last two decades (2000-2019), the average petroleum oil spill size in U.S. waters for vessels other than tank ships and tank barges was 117 gallons (443 liters) (Bureau of Transportation Statistics 2020). A petroleum oil spill of this size is expected to dissipate rapidly and evaporate within days; thus, any effects would be temporary and localized. The risk of spills from Project vessels will be minimized through compliance with USCG regulations for the prevention and control of oil spills found at 33 CFR Part 155. Project vessels will also comply with USCG waste and ballast water management regulations and vessels covered under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) are also subject to the effluent limits contained in the VGP (see Section 7.0 of Volume I).

The OSSs and WTGs will include secondary containment for oil-filled equipment to prevent discharges or inadvertent releases due to equipment malfunction or breakage. Grout may be used to stabilize foundation joints. To minimize any inadvertent release of grout, proper grouting procedures will be utilized to minimize any overflow.

In the event of a spill, Atlantic Shores and its contractors will follow the procedures outlined in the Project OSRP, which defines spill prevention measures as well as provisions for communication, coordination, containment, removal, and mitigation of a spill (see Appendix I-C). As described in Section 1.5.3.2 of Volume I, Project personnel will undergo routine training on the content of the OSRP to ensure they are familiar with the OSRP's requirements and are prepared to respond to emergencies.

[79] Type certificates are issued by an accredited certification body to independently verify that a WTG (or other renewable energy equipment) is designed and manufactured in accordance with all applicable requirements/standards.

In addition to the overarching OSRP, contractors will also have plans to immediately contain and stop a spill in accordance with applicable regulations.

### 9.2.4 Coastal and Onshore Spills, Discharges, and Accidental Releases

Coastal and onshore spills or accidental releases may include trash and debris, spills during refueling, accidental release of lubricating or hydraulic oils from onshore construction equipment, spills of waste and chemicals stored onshore, or releases associated with horizontal directional drilling (HDD) activities at the landfall sites.

Solid waste, trash, and debris generated by the Project will be disposed of in accordance with applicable Federal, State, and local regulations. Waste will be stored and properly disposed of onshore or incinerated offshore and project vessels must meet the USCG's waste management regulations. Atlantic Shores will also require offshore contractors to participate in a marine trash and debris prevention training program.

Refueling and service of construction vehicles and equipment will be conducted in a manner that protects coastal habitats, wetlands, and drinking water supplies from spills and accidental releases. Refueling and major equipment maintenance will be performed offsite (e.g., at commercial service stations or a contractor's yard) to the maximum extent practicable. Any refueling will be performed by well-trained and knowledgeable personnel. To minimize the potential effect of a fuel or oil spill (should one occur), proper spill containment gear and absorption materials will be maintained onsite to enable immediate response.

As described in Section 7.0 of Volume I, all onshore waste likely to cause environmental harm will be stored in designated, secure, and bermed locations away from depressions and drainage lines that carry surface water until collected by the selected waste contractor. To minimize and control spills, spill kits will be provided at all locations where hazardous materials are stored.

To prevent accidental releases at the onshore substation and/or converter station sites, full-volume containment will be provided for major oil-containing equipment (e.g., oil-filled transformers and reactors), which could be comprised of individual containment systems (pits) or a central collection system with a pump (see Section 4.9.2 of Volume I). Any oil containment system will be sized to contain the oil in a single piece of equipment plus rainwater, melted snow, or washdown sized in accordance with applicable industry standards. Any indoor lead-acid batteries that are used will also be outfitted with spill containment and absorbent mats.

Atlantic Shores will develop and maintain an SPCC Plan per 40 CFR Part 112, which will identify what oil materials are stored at the onshore facilities, how oil is delivered and transferred, facility spill prevention and control procedures, spill response and notification procedures, inspections, recordkeeping, and reporting requirements. Atlantic Shores will also submit Discharge Prevention, Containment, and Countermeasure (DPCC) and Discharge Cleanup and Removal (DCR) plans per N.J.A.C. 7:1E to the New Jersey Department of Environmental Protection and Spill Prevention Control and Countermeasure Plans per 6 NYCRR Part 613 to the New York Department of Environmental

Conservation. Counties in New York may also have local regulations governing the handling and disposal of petroleum-based products.

HDD at the landfall sites will use a drilling fluid comprised of bentonite (an inert, non-toxic clay) and water to lubricate the drill head and extract excavated material from the bore hole (see Section 4.7.1 of Volume I). Drilling fluids likely will be managed within a contained system and will be collected for reuse or proper disposal. Although unlikely, an inadvertent release of pressurized drilling fluid (i.e., drilling fluid seepage or "frac-out") could occur during HDD. Since the drilling fluid is an inert, non-toxic clay and, if released, would likely occur in small amounts, the released HDD material would be expected to cause only minor and temporary turbidity effects. Preconstruction planning, engineering, and design practices can greatly mitigate the chance of an inadvertent release. To further reduce the risk of drilling fluid seepage during HDD, the position of the drill head and drilling fluid pressure will be closely monitored. Atlantic Shores will develop an HDD Inadvertent Release Plan for activities at the landfall sites.

### 9.2.5 Significant Infrastructure Failure

While highly unlikely, it is possible that the Project could experience a significant structural, electrical, or hydraulic failure. To minimize the possibility of significant component failure, the Project will undergo a thorough and well-vetted structural design process in accordance with applicable standards (e.g., ACP, IEC, API, and ISO standards) and based on site-specific conditions. As discussed in Section 9.2.2, the Project design will be reviewed by a third-party CVA as well as BOEM and the Bureau of Safety and Environmental Enforcement (BSEE).

To further reduce the risk of significant damage, interruption of service, or other corrective maintenance, Atlantic Shores will adhere to a rigorous monitoring, inspection, and preventive maintenance program (see Section 5.4 of Volume I). All Project facilities, including the WTGs and OSSs, are designed to operate autonomously without on-site attendance by technicians. The Project will be equipped with a Supervisory Control and Data Acquisition (SCADA) system to interface between the WTG controllers, OSSs, onshore substations and/or converter stations, and all environmental and condition monitoring sensors, and to provide detailed performance and system information (see Section 5.1 of Volume I). The condition monitoring systems (CMS) of various subsystems are centralized into the SCADA system so that this data can be used to identify underperformance issues and major equipment failures before they occur. The SCADA system is configured to provide notifications of any alarms or warnings from Project components. Using the SCADA system, the Project operator will monitor the status, production, operation, and performance of the Project 24 hours per day.

Atlantic Shores will use an established O&M facility to provide preventative maintenance and repair services for the Project. Minor repairs can be performed via regular maintenance vessels, whereas larger, structural repairs may require support vessels and a larger team of technicians.

The target burial depth of the Project offshore cables is designed to substantially reduce the risk of cable damage or displacement caused by anchors, fishing gear, or erosion/scour due to major storms. Cable protection will be used (in limited areas) if sufficient cable burial is not achieved (see 4.5.7 of

Volume I). Therefore, the Project offshore cables are not expected to be damaged or displaced. Nevertheless, as described in Section 5.1 of Volume I, the export cables are expected to use technology such as a distributed temperature system (DTS) to constantly monitor cable temperature at points along their length to help identify anomalous conditions (i.e., potential changes in cable burial depth). The inter-array cables and inter-link cables (if used) may also use DTS, DAS, or OLPD. Cable surveys will be performed at regular intervals to identify any damage or issues associated with potential scour and depth of burial (see Section 5.4.4 of Volume I). In the unlikely event that cable damage or displacement occurs, the cables will be repaired as soon as possible. Cable repair activities will be similar to cable installation activities (although they would be isolated to a smaller area).

Catastrophic damage to Project onshore concrete duct bank and splice vaults, which are buried underground, is extremely unlikely but may occur due to severe weather or other natural events (see Section 9.2.2). There is also a remote possibility that the duct bank or splice vaults could be damaged by an unrelated construction project. If the duct bank or splice vaults are damaged, any overlying cover would be excavated, and the damaged section would be repaired. If needed, this repair work will be similar to the initial installation process, but the extent of the activities and associated temporary effects would be smaller.

### 9.2.6 Terrorist Attacks

Although extremely unlikely, the Project facilities could be targeted by terrorists. The effects of a terrorist attack would depend on the magnitude and location of the attack; given the dispersed nature of the Project offshore facilities, it is unlikely that an attack would affect all offshore structures. Terrorist attacks could cause spills/discharges or significant infrastructure damage to the WTGs, OSSs, offshore cables, onshore interconnection cables, onshore substations and/or converter stations, which are described in Sections 9.2.3, 9.2.4, and 9.2.5. The response to such incidents is covered in the Project Facility Security Plan and ERP.

## 9.3 Electromagnetic Fields and Human Health

This section describes EMFs and human health in relation to the Project onshore facilities. All onshore EMF levels are expected to be well below guidelines protective of public health. The potential effects of EMF from the Project offshore facilities on marine life are discussed in Sections 4.5 Benthic Resources, 4.6 Finfish, Invertebrates, and Essential Fish Habitat, 4.7 Marine Mammals, and 4.8 Sea Turtles.

EMFs consist of two component fields: electric fields and magnetic fields. These fields are created by positive and negative electric charges. EMFs are produced by electric power and by natural sources. People experience EMFs during daily living from sources such as household wiring, electric devices (e.g., hair dryers, vacuum cleaners), and appliances. All people experience the Earth's natural magnetic field as well. In the northern U.S., the Earth's steady direct current (DC) magnetic field is about 550 milligauss (mG).

Electric field strength is a function of voltage (the "pressure" that drives the flow of electricity) which is measured in kilovolts per meter (kV/m).

Electric fields are generated by the flow of current through transmission cables and decline rapidly with distance from the source. Atlantic Shores is proposing to install the Project onshore interconnection cables underground. Importantly, electric fields from underground cables are readily blocked by the cable sheath and intervening concrete, soil, and other materials.[80] Accordingly, underground transmission cables such as those proposed by Atlantic Shores do not create a risk of public exposure to *electric fields*. Therefore, this section is focused on the low-level *magnetic fields* that will be produced by the Project underground onshore interconnection cables and other onshore facilities.

Magnetic fields are produced by electric current, which is the flow of electric charges (normally measured in amperes [amps or A]). Magnetic fields are measured in mG and also decline rapidly with distance from a power source. Common household items have magnetic fields in the range of 10 to 600 mG, depending on the distance from the source. Individuals also occasionally experience much higher levels of magnetic fields from medical imaging devices (e.g., magnetic resonance imaging [MRI] uses a magnetic field of 30,000,000 mG).

The following subsections describe human health considerations associated with potential magnetic fields generated from the Project.

### 9.3.1 EMF Standards and Guidelines

The U.S. alternating current (AC) electrical power grid operates at 60 cycles per second (60 hertz [Hz]). There are no Federal standards or guidelines for 60 Hz EMF exposure from power lines and related facilities. A number of states have issued guidelines or standards for EMF levels, typically within and at the edge of utility transmission rights-of-way (ROWs). These State guidelines or standards generally are based on historically acceptable EMF levels within and at the boundaries of transmission ROWs. Typically, these EMF standards include limits for electric fields and limits for magnetic fields. The New Jersey Board of Public Utilities (NJBPU) has a State guideline for electric fields[81] but not for magnetic fields. The New York State Public Service Commission in Opinion No. 78-13 (1978) addressed health and safety issues and imposed interim operating standards. The subsequent Statement of Interim Policy on Magnetic Fields of Major Electric Transmission Facilities (1990) sets forth standards for Electric and Magnetic Fields associated with substation and/or converter stations and transmission lines.

The primary guidance with respect to EMF exposure from power lines and related facilities has been developed by national and world health organizations; these guidelines are designed to be protective against any adverse health effects. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has published guidelines on magnetic and electric field exposure which have been endorsed by the World Health Organization. For the general public, with the assumption of continuous exposure, ICNIRP recommends limiting one's exposure to magnetic fields to 2,000 mG for variable fields (i.e., AC). For steady magnetic fields (i.e., DC), ICNIRP (2010) recommends limiting magnetic fields to 5,000

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80 More precisely, as stated in the EMF assessment (see page three of Appendix II-I), "The electric field from the shielded power cables is blocked by the grounded cable armoring as well as the earth and therefore, the shielded cables will not be a direct source of any electric field outside the cables."

81 See for example NJBPU Docket No. E013111047 dated November 21, 2014; https://www.bpu.state.nj.us/bpu/pdf/boardorders/2014/20141121/11-21-14-2C.pdf.

mG (ICNIRP 2010). These guidelines, and similar guidelines established by other organizations, are widely considered to be highly conservative and adequately protective of health and safety.

Atlantic Shores conducted an extensive EMF assessment, including modeling of magnetic field levels in the immediate vicinity of the landfall sites, the underground onshore interconnection cables, and the onshore substations / converter stations (see Appendix II-I). The detailed EMF assessment also includes modeling for the offshore elements of the Project (i.e., export cables, inter-link cables, inter-array cables, and OSSs). As described in Section 4.5 of Volume I, Atlantic Shores is considering three transmission options, HVAC transmission, HVDC transmission, or a combined HVAC/HVDC transmission option.

The full range of cable options (230-275 kilovolts [kV] high voltage alternating current [HVAC] cables, 320-525 kV high voltage direct current [HVDC] cables, and/or combined HVAC and HVDC cables) as well as all representative arrangements (duct banks, onshore HDDs) were analyzed. This work provided the quantitative basis for the summaries of magnetic levels and comparisons to relevant health protective guidelines, which are described in Sections 9.3.2 through 9.3.4.

### 9.3.2 Landfall Sites (via Horizontal Directional Drilling)

As described in Section 4.7 of Volume I, the offshore-to-onshore transition between the submarine export cables and the underground onshore interconnection cables will occur at landfall sites in both New Jersey and New York. Based on the individual landfall site locations, the underground transition vaults will be located to the extent practicable within previously disturbed sites such as a parking area or roadway.

The offshore-to-onshore cable transition will be accomplished by HDD. At the landfall sites, HDD bores will be completed for each of the export cables coming ashore. The export cables will be pulled through HDD conduits inserted into the bore holes and jointed to the onshore interconnection cables in underground transition vaults (one per export cable) located near the onshore HDD entrance/exit point. The HDD trajectory for each bore is expected to range between approximately 1,640 and 3,281 ft (500-1000 meters [m]) dependent upon the specific landfall location. The trajectory of the bores will be a gently sloped arc which will pass beneath the intertidal zone, beach and/or other engineered coastal stabilization features such as seawalls and riprap revetments. The preliminary HDD designs for the landfall sites are currently underway in both New Jersey and New York and will be provided in a future COP supplement.

To assess EMF at the landfall sites, the Project cables were conservatively modeled using a full load current of 1,200 amps at 230 or 275 kV. The modeling results are provided in Appendix II-I as Cases 29 and 31, respectively (see Figures 4-76 and 4-80 of Appendix II-I). For ease of reference, the 230 kV case is provided as Figure 9.3-1. The maximum modeled magnetic field at the seabed at each landfall site is shown as approximately 1.02 amperes/meter (A/m) or approximately 12.8 mG. There are four peaks depicted in the magnetic field cross-section, corresponding to the four export cables being brought ashore via HDD at each landfall site. The peak values fall off very quickly with lateral distance from the cable centerlines. The modeled peak value of 12.8 mG is less than 1% of the ICNIRP health-protective magnetic field guidance of 2,000 mG, as are the results for the 275 kV case.

### 9.3.3 Onshore Interconnection Cables

Underground electric power cables have been used for many decades in urban environments and are the preferred means for onshore transmission in the offshore wind arena. The Project onshore interconnection cables will travel underground from the landfall sites primarily along existing roadways and utility ROWs to the new onshore substation and/or converter station sites. From the onshore substations / converter stations, the onshore interconnection cables will continue to the proposed points of interconnection (POIs). Atlantic Shores is currently evaluating Onshore Interconnection Cable Route options in both New Jersey and New York to connect the potential landfall sites to the POIs. Along each route, the onshore interconnection cables will be installed in buried concrete duct banks, with each cable housed in a high-density polyethylene (HDPE) or Polyvinyl Chloride (PVC) conduit. Typical cover over the buried duct bank (e.g., along roadway ROWs) will range from approximately 3 ft to 6 ft (0.9 m to 1.8 m).[82] The onshore interconnection cables will employ HVAC technology (up to four circuits for the Project consisting of up to twelve 230 kV to 275 kV cables), HVDC technology (up to two circuits consisting of four 320 kV to 525 kV cables), and/or a combined HVAC/HVDC arrangement.

As detailed in Appendix II-I, the HVAC underground onshore interconnection cables were modeled using a current of 1,200 amps at 230 or 275 kV for several different ROW configurations (e.g., roadway, bike path, existing ROW, etc.). For the 230 kV four-circuit, narrow ROW case (Case 42), the maximum modeled magnetic field was approximately 17 A/m (212.5 mG). The modeled levels fall to approximately 3 A/m (37.5 mG) at a distance of 16.4 ft (5 m) on either side of the duct bank centerline. For ease of reference, the graphical results from Appendix II-I (Figure 4-102) are provided as Figure 9.3-2. The levels for the 275 kV case are slightly higher (19 A/m). In all cases, the modeled magnetic fields are well below the health-protective magnetic field guidance per ICNIRP of 160 A/m or 2,000 mG.

The HVDC underground onshore interconnection cables were modeled using a current of 2,000 amps at 320 or 525 kV. For the 320 kV HVDC cable circuit, a maximum magnetic field of 47 A/m (587 mG) was modeled (Case 48). For the 525 kV HVDC cable circuit (monopole mode), a maximum magnetic field of 48 A/m (600 mG) was modeled (Case 52). For ease of reference, the graphic representation of the modeling is provided as Figures 9.3-3 and 9.3-4, respectively (see Figures 4-114 and 4-132 from Appendix II-I). These modeled results are well below the applicable ICNIRP health protective guideline for static magnetic fields (400 A/m or 5,000 mG).

To analyze a combined HVAC/HVDC onshore interconnection arrangement, a single scenario was modeled with four 275 kV HVAC circuits and one 525 kV HVDC circuit in a single trench. It should be noted that this case was modeled using a range of HVAC and HVDC voltages, and that the data presented for the 275 kV HVAC/525 kV HVDC case are conservatively presented as having the maximum MF level of all configurations considered. Under this scenario (Case 46), a maximum magnetic field of 78 A/m (975 mG) was modeled. For ease of reference, the graphic representation of the modeling is provided as Figure 9.3-5 (see Figure 4-110 from Appendix II-I). These modeled results

[82] The maximum coverage over the top of the cable conduits could be up to 30 ft (9 m) in some specialty installation scenarios.

are well below the applicable ICNIRP health protective guideline for time-varying magnetic fields (180 A/m or 2,000 mG).

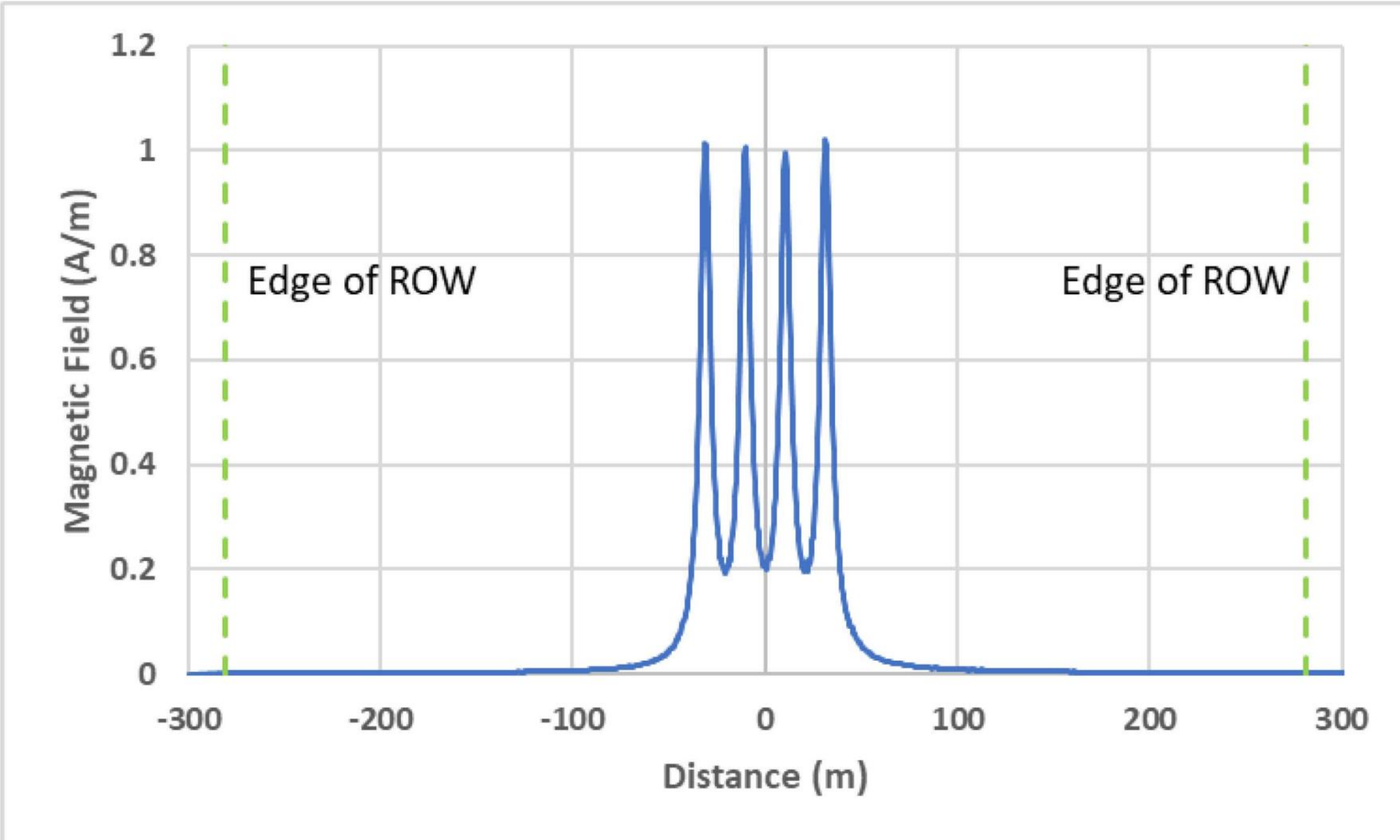
### 9.3.4 Onshore Substation

As described in Section 4.9 of Volume I, the Project includes up to three onshore substations (one for each POI) in New Jersey and up to two onshore substations in New York. Atlantic Shores is currently in the process of evaluating multiple potential POI locations and has filed or will file for associated queue positions in both states. At each onshore substation site, the transmission voltage will be stepped up or down, as necessary, in preparation for interconnection with the electric grid. At this point in Project development, several onshore substation options are being considered (HVAC with 230 to 275 kV incoming voltage; HVDC with 320 to 525 kV incoming voltage; and air-insulated switchgear or gas-insulated switchgear design). A quantitative assessment of potential onshore substation EMF levels for a conceptual level 230 kV air-insulated switchgear design is provided in Section 4.2.2 of Appendix II-I.

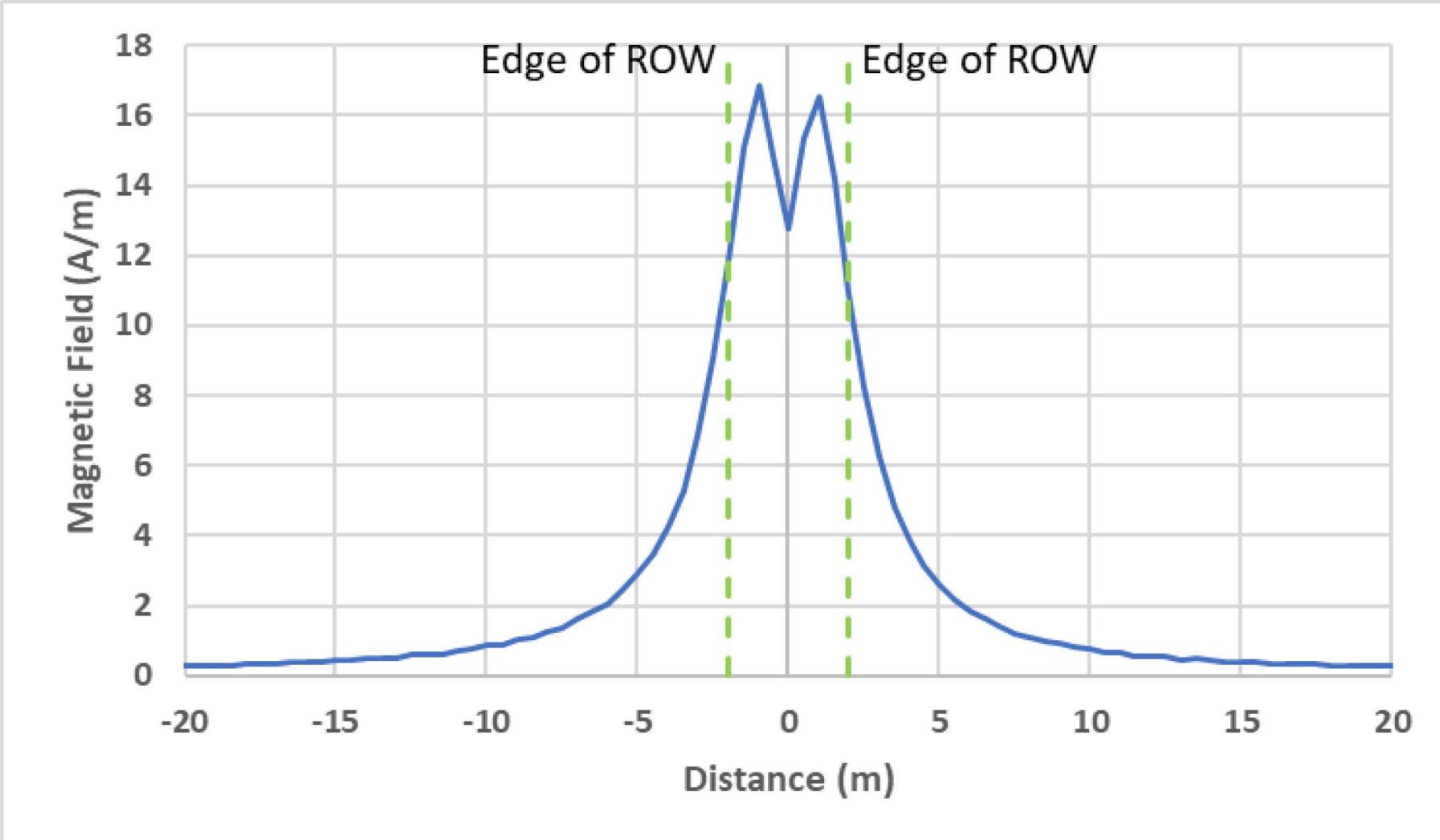
For the purposes of assessing potential risks to human health from the onshore substation, the National Institutes of Environmental Health Sciences (NIESH) has stated:

> *The strength of the EMF from equipment within substations, such as transformers, reactors, and capacitor banks, decreases rapidly with increasing distance. Beyond the substation fence or wall, the EMF produced by the substation equipment is typically indistinguishable from background levels (NIESH 2002).*

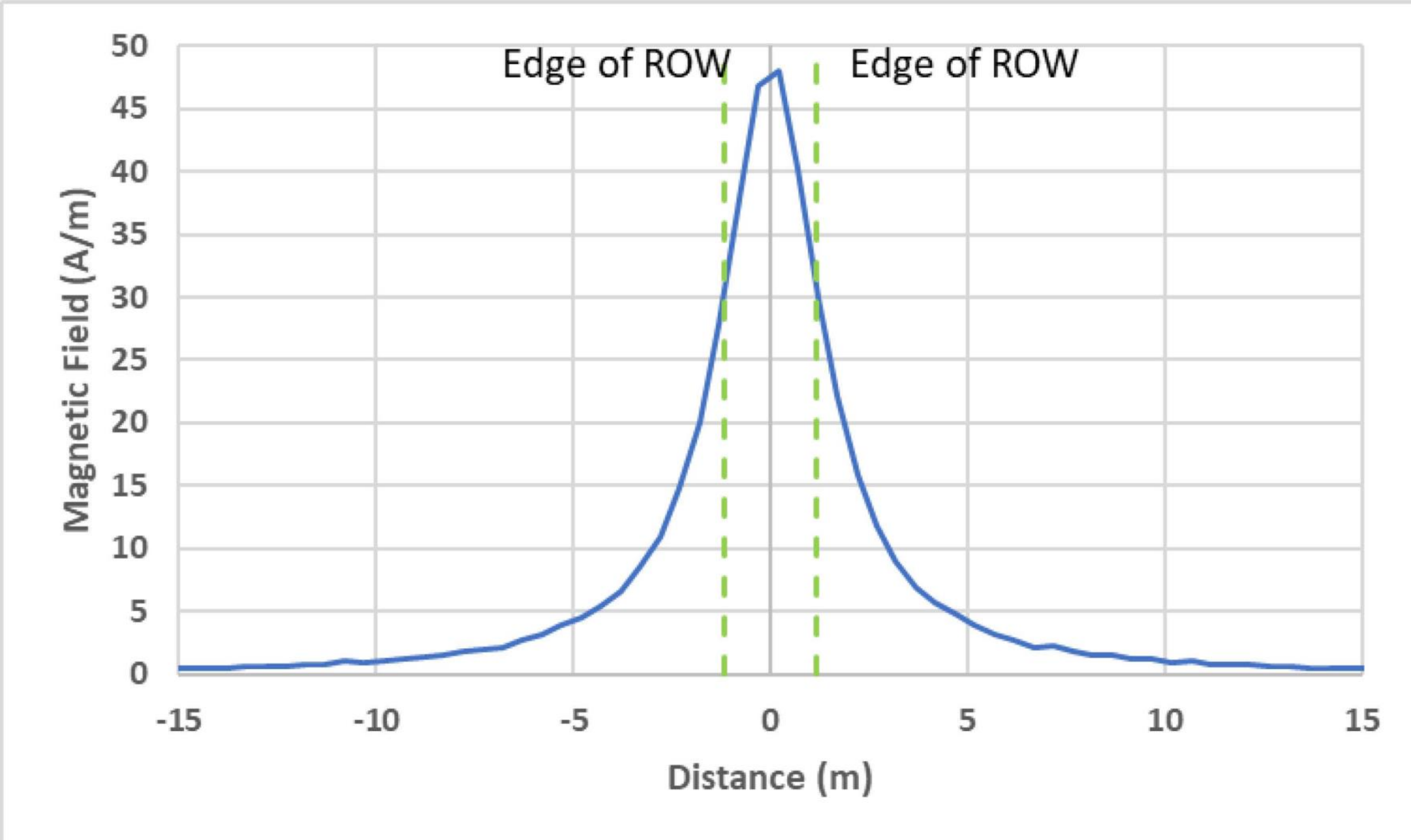
Therefore, no risk to human health for the public outside the onshore substation fence is expected.



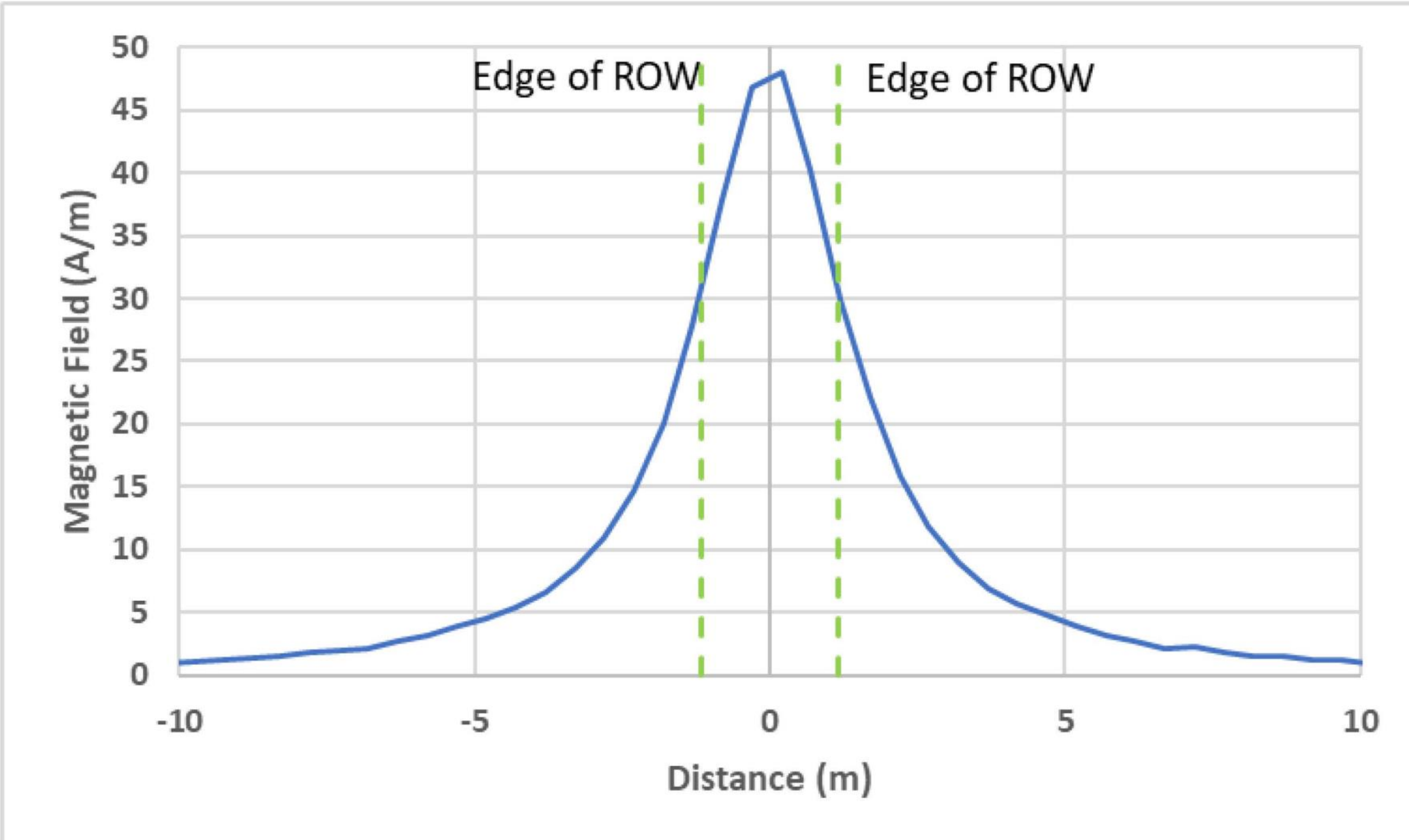

**Electromagnetic Field (EMF) Assessment, Case 29:** Magnetic field results at the seabed for four 230 kV high voltage alternating current (HVAC) export cables (2,000 mm$^2$ Cu) installed via horizontal directional drilling at the landfall sites.



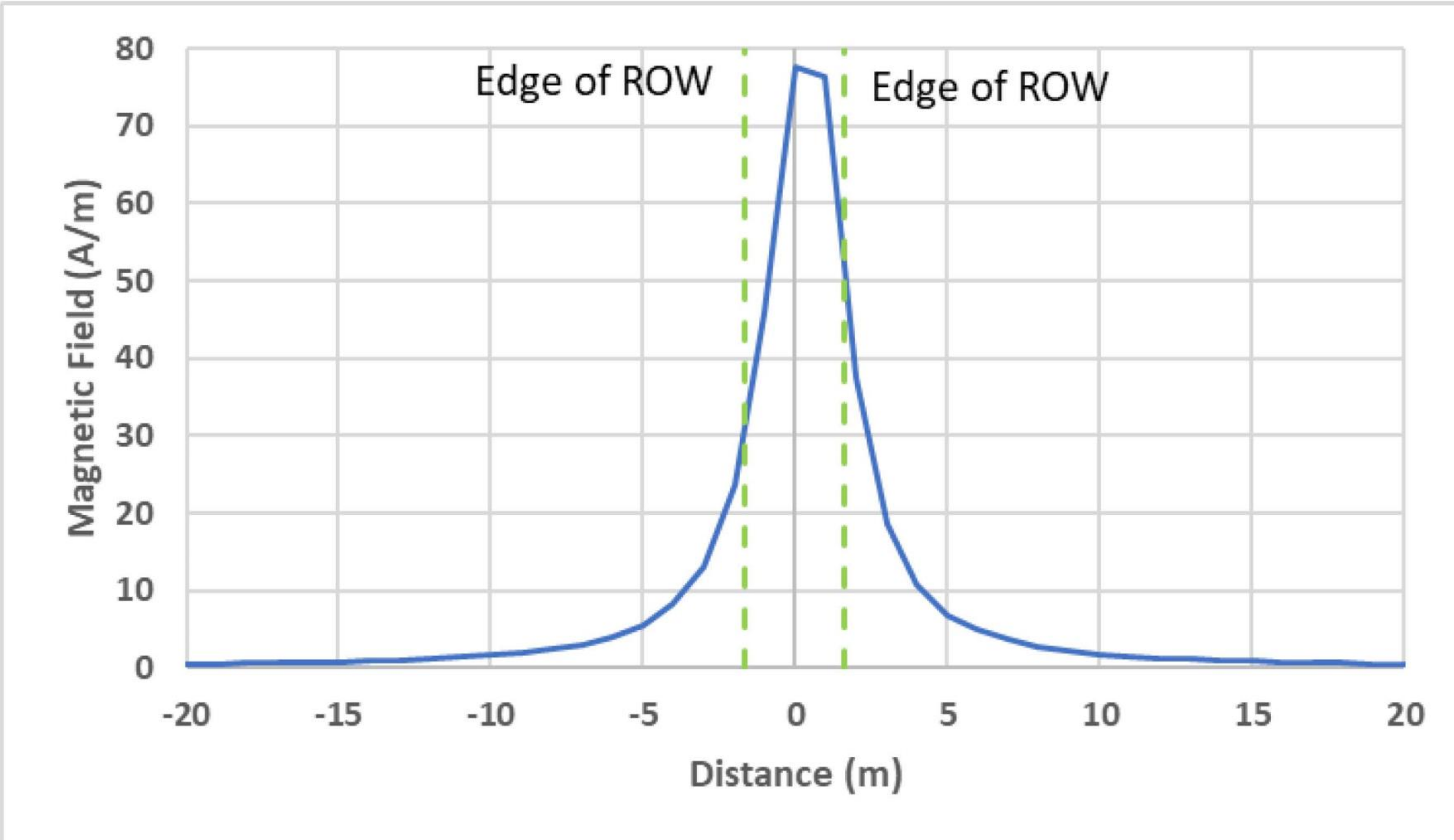

**Electromagnetic Field (EMF) Assessment, Case 42:** Magnetic field results at the surface for 230 kV high voltage alternating current (HVAC) onshore interconnection cables (four circuits, 3,000 $mm^2$ Cu single core) installed underground in a narrow right-of-way corridor.




**Electromagnetic Field (EMF) Assessment, Case 48:** Magnetic field results at the surface for 320 kV high voltage direct current (HVDC) onshore interconnection cables (one circuit, 2,500 mm² Cu) installed underground.




**Electromagnetic Field (EMF) Assessment, Case 52:** Magnetic field results at the surface for 525 kV high voltage direct current (HVDC) onshore interconnection cables (2,500 mm² Cu) installed underground and operating in monopole mode.




**Electromagnetic Field (EMF) Assessment, Case 46:** Magnetic field results at the surface for 275 kV HVAC Onshore interconnection transmission cables (3000 $mm^2$ Cu Single Core) and 525 kV HVDC Onshore interconnection transmission cables (2500 $mm^2$ Cu) installed underground and operating in monopole mode.



**Figure 9.3-5**
*EMF Results for 275 kV HVAC and 525 kV HVDC Onshore Interconnection Cables*

## 9.4 Summary of Proposed Health, Safety, and Environmental Protection Measures

HSSE are critical components of all Atlantic Shores planning and activities. Given their importance, Atlantic Shores has prepared HSSE plans and systems to mitigate risk and plan effective responses. Atlantic Shores is implementing multiple measures to protect HSSE.

### Offshore

- An NSRA was prepared to assess navigation safety risks (See Appendix II-T). The WTG orientation and uniform grid layout was selected to avoid and minimize the risk of collision and allision. As part of the Project SMS, a draft ERP was developed in part to address the unlikely events of collisions, allisions, vessels in distress, man overboard, and SAR (See Appendix I-D).

- An extensive EMF modeling assessment was conducted for the offshore cables and OSSs to assess potential effects to marine life (See Appendix II-I).

- To facilitate safe navigation, all offshore structures will include marine navigation lighting and marking in accordance with USCG and BOEM guidance. Atlantic Shores will continue to work with the USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities.

- Each foundation will include unique alphanumeric identification and lights that are visible in all directions, and sound signals on select foundations.

- AIS will be used to mark each WTG, OSS, and met tower position (virtually or using physical transponders). The number, location, and type of AIS transponders will be determined in consultation with USCG.

- The Project facilities are designed to withstand maximum scenario severe weather events based on site-specific meteorological, oceanographic, and geological conditions and will conform to all applicable standards.

- The Project will undergo a thorough and well-vetted structural design process in accordance with applicable standards and based on site-specific conditions. The Project design will be reviewed by BOEM and the BSEE and will also be verified by an independent CVA pursuant to 30 CFR §§ 585.705-585.714 as part of the FDR and FIR.

- A Site Manager will be employed to control access to offshore facilities, only allowing personnel with proper training, certificates, and medical fitness. Proper signage restricting access will be installed on the WTG, OSS, and met tower foundations.

- Temporary safety buffer zones will be established around offshore working areas to reduce hazards.

- Solid and liquid wastes will be managed in accordance with applicable regulations to reduce the risk of spills, discharges, and accidental releases.
- Mitigation measures will be implemented to assist with SAR including implementation of WTG rotor emergency braking systems during a SAR event, measures to assist in search detection (e.g., installation of VHF direction finding equipment and high-resolution infrared detection systems), and access ladders to open refuge areas on foundations for distressed mariners.
- The Project will be monitored 24 hours per day and will be equipped with a SCADA system which provides an interface between the Project facilities and all environmental and condition monitoring sensors and allows the operator to control the Project equipment remotely.
- Offshore cables will be equipped with DTS, DAS, and/or OLPD to constantly assess and monitor the status of the offshore cables.

### Onshore

- An extensive EMF modeling assessment was conducted to assess the landfall sites, the underground onshore interconnection cables, and the onshore substations / converter stations (see Appendix II-I). All modeled EMF levels are well below guidelines protective of human health.
- Once operational, onshore substations and/or converter stations will be equipped with fencing, screening barriers, camera systems, signage, and physical barriers as part of a security plan.
- Active, onshore worksites will be secured with temporary fencing and signage to prevent public access and trenches or holes will be covered in compliance with permit requirements.
- A TMP including traffic control measures (e.g., signage, police details, lane closures, detours, etc.) will be developed and implemented as part of the onshore cable route state permitting.
- Refueling and major equipment maintenance will be performed offsite (e.g., at commercial service stations or a contractor’s yard) to the maximum extent practicable.
- A SPCC or SWPPP will be developed as part of the onshore cable route state permitting and maintained during construction, and spill kits will be provided at all locations where hazardous materials are stored.
- Solid and liquid wastes will be managed in accordance with applicable regulations to reduce the risk of spills, discharges, and accidental releases.

### Offshore and Onshore

- The Project will result in a region-wide net decrease in harmful air pollutant emissions and GHGs that contribute to climate change.

# 10.0 References

## Volume I

[AREC and AWS] Atlantic Renewable Energy Corporation, AWS Scientific, Inc. 2004. New Jersey offshore wind energy: Feasibility study. Final Version. http://www.njcleanenergy.com/files/file/FinalNewJersey.pdf

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial wind lease issuance and site assessment activities on the Atlantic Outer Continental Shelf offshore Rhode Island and Massachusetts: Environmental Assessment. https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/BOEM_RI_MA_EA_2012-070_719.pdf

[BOEM] Bureau of Ocean Energy Management. 2018. Draft guidance regarding the use of a project design envelope in a construction and operations plan. https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf

[BOEM] Bureau of Ocean Energy Management. 2020. Vineyard Wind 1 offshore wind energy project supplement to the Draft Environmental Impact Statement. https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf

[BYNDC] Brooklyn Navy Yard. c2020. Brooklyn Navy Yard. [accessed 2020 July 20]. https://brooklynnavyyard.org/.

[EPA] Environmental Protection Agency. 2020. Emissions & Generation Resource Integrated Database (eGRID) eGRID2018. [accessed 2021 January 20]. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

[GCT] Global Container Terminals Inc. c2020. GCT New York. [accessed 2020 July 20]. https://globalterminals.com/terminals/.

[GMI] Geo-Marine, Inc. 2010. New Jersey Department of Environmental Protection baseline studies final report: Volume I: Overview, summary, and application. https://www.nj.gov/dep/dsr/ocean-wind/Ocean%20Wind%20Power%20Ecological%20Baseline%20Studies_Volume%20One.pdf

[IRENA] International Renewable Energy Agency. 2019. Future of wind: Deployment, investment, technology, grid integration and socio-economic aspects (A Global Energy Transformation paper), International Renewable Energy Agency, Abu Dhabi. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Oct/IRENA_Future_of_wind_2019.pdf

[IPCC] Intergovernmental Panel on Climate Change. 2022. Sixth Assessment Report: Climate Change 2022: Mitigation of Climate Change, Working Group III. https://www.ipcc.ch/report/ar6/wg3/

[MMS] U.S. Department of the Interior, Minerals Management Service. 2004. Review of existing and emerging environmentally friendly offshore dredging technologies. OCS Report MMS 2004-076. https://www.boem.gov/sites/default/files/non-energy-minerals/2004-076.pdf

[NJBPU] New Jersey Board of Public Utilities. 2020. NJBPU takes major steps forward for offshore wind in New Jersey. [accessed 2021 January 28]. https://www.nj.gov/bpu/newsroom/2020/approved/20200909a.html.

[NJDEP] New Jersey Department of Environmental Protection. 2020. New Jersey Global Warming Response Act 80x50 report: Evaluating our progress and identifying pathways to reduce emissions 80% by 2050. https://www.nj.gov/dep/climatechange/docs/nj-gwra-80x50-report-2020.pdf

[NYSERDA] New York State Energy and Research Development Authority. 2022. NYSERDA Offshore Wind Master Plan. https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/About-Offshore-Wind/Master-Plan

[USCG] U.S. Coast Guard. 2020a. The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. Final Report, 14 May 2020. USCG-2019-0131.

[USCG] U.S. Coast Guard. 2020b. Shipping Safety Fairways Along the Atlantic Coast. Advanced Notice of Rule Making. 33 CFR Part 166. Document No. USCG-2019-0279.

[USCG] U.S. Coast Guard. 2021a. Port Access Route Study: Seacoast of New Jersey including Offshore Approaches to Delaware Bay, Delaware. Final Report, September 2021. Document No. USCG-2021-20797. https://www.federalregister.gov/documents/2021/09/24/2021-20797/port-access-route-study-seacoast-of-new-jersey-including-offshore-approaches-to-the-delaware-bay

[USCG] U.S. Coast Guard 2021b. Port Access Study: Northern New York Bight. Final Report, September 2021. Document No. USCG- 2021-19464. https://www.federalregister.gov/documents/2021/09/09/2021-19464/port-access-route-study-northern-new-york-bight

[WHO] World Health Organization. 2021. Climate change and human health: WHO calls for urgent action to protect health from climate change – Sign the call. [accessed 2021 February 15]. https://www.who.int/globalchange/global-campaign/cop21/en/

Atlantic Offshore Terminals. c2020. Arthur Kill Terminal. [accessed 2020 July 20]. https://www.atlanticterminals.com/projects.html.

Azavea. 2020. Last Tow: Fishing Route Analytics Report.

Brayton Point LLC. c2019. Brayton Point Commerce Center. [accessed 2020 July 20]. http://www.braytonpointcommercecenter.com/.

Carr-Harris, Andrew and Corey Lang. 2019. Sustainability and tourism: the effect of the United States' first offshore wind farm on the vacation rental mark. Resource and Energy Economics, Volume 57, August 2019, Pages 51-67.

Connecticut Port Authority. c2019. Connecticut Port Authority. [accessed 2020 July 20]. https://ctportauthority.com/about-us/port-of-bridgeport/.

COWI North America, Inc. 2019. 2018 Ports Assessment: Port Ivory. [accessed 7/24]. Prepared for New York State Energy Research and Development Authority.

COWI North America, Inc. 2017. Assessment of ports and infrastructure. [accessed 7/29]. Prepared for New York State Energy Research and Development Authority.

DNV GL. 2016. Recommended practice: Subsea power cables in shallow water. http://rules.dnvgl.com/docs/pdf/dnvgl/RP/2016-03/DNVGL-RP-0360.pdf

Green City Times. 2020. Offshore wind farms in the United States: Block Island leads the way. [accessed 2021 January 20]. https://www.greencitytimes.com/the-block-island-wind-farm/

GT USA Wilmington, LLC. c2020. The Port of Wilmington. [accessed 2020 July 20]. https://www.portofwilmington.com/.

ICF. 2020. Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations. Prepared for: U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Sterling, Virginia. OCS Study BOEM 2020-041.

Kassel R. 2020. State of the Environmental City: Making New York City the hub of New York's offshore wind industry. Capalino+Company; [accessed 2020 July 20]. https://www.capalino.com/state-of-the-environmental-city-making-new-york-city-the-hub-of-new-yorks-offshore-wind-industry/.

Leonhard SB, Stenberg C, StØttrup J. 2011. Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities Follow-up Seven Years after Construction. DTU Aqua Report No 246-2011.

Parsons, George, Jeremy Firestone, Lingxiao Yan, and Jenna Toussaint, 2020. The effect of offshore wind power Projects on recreational beach use on the east coast of the United States; Evidence from contingent-behavior data. Published in Energy Policy, Volume 144, September 2020, 111659.

PNCT. c2020. PNCT terminal information. [accessed 2020 July 17]. https://www.pnct.net/.

Port of Albany. c2019. Port of Albany. [accessed 2020 July 17]. https://www.portofalbany.us/.

Port of Coeymans, Inc. c2020. Port of Coeymans Marine Terminal. [accessed 2020 July 17]. http://portofcoeymans.com/.

Port of New Bedford. c2018. Marine Commerce Terminal Port of New Bedford. [accessed 2020 July 20]. https://portofnewbedford.org/marine-commerce-terminal/

Ramboll. 2020. New Jersey offshore wind strategic plan: Navigating our future. https://www.nj.gov/bpu/pdf/Final_NJ_OWSP_9-9-20.pdf

South Jersey Port Corporation. c2020. Paulsboro Marine Terminal. [accessed 2020 July 17]. https://www.southjerseyport.com/facilities/paulsboro-marine-terminal/.

State of New Jersey. c1996-2020. New Jersey Wind Port. [accessed 2020 July 20]. https://nj.gov/windport/.

Tradepoint Atlantic. c2020. Redwood Capital Investments. [accessed 2020 July 20]. https://www.tradepointatlantic.com/.

Vineyard Wind. 2020. Vineyard Wind selects GE Renewable Energy as preferred turbine supplier for America's First utility scale offshore wind project. [accessed 2021 January 20]. https://www.vineyardwind.com/press-releases/2020/12/1/vineyard-wind-selects-ge-renewable-energy-as-preferred-turbine-supplier.

Virginia Port Authority. c2020. Portsmouth Marine Terminal. [accessed 2020 July 20]. http://www.portofvirginia.com/facilities/portsmouth-marine-terminal-pmt/.

Windfair. 2020. Dominion Energy completes construction of first offshore wind project in U.S. federal waters. [accessed 2021 January 20]. https://w3.windfair.net/wind-energy/pr/34899-dominion-energy-developer-offshore-wind-turbine-usa-federal-water-pilot-project-electrcity-costs-carbon-emissions-economy-jobs-virginia-cvow

The White House. 2021. Executive Order on Tackling the Climate Crisis at Home and Abroad. https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/

## Volume II

### 1.0 Introduction

[BOEM] Bureau of Ocean Energy Management. 2018. Draft Guidance Regarding the Use of a Project Design Envelope. [published January, 2018; accessed March 25, 2021]. https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf

### 2.1 Geology

Atlantic City Municipal Utilities Authority. 2020. [accessed November 12, 2020]. https://www.acmua.org/.

[BOEM] Bureau of Ocean Energy Management. Office of Renewable Energy Programs. 2020. Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585. [published May 27, 2020; accessed December 3, 2020]. https://www.boem.gov/sites/default/files/documents/about-boem/GG-Guidelines.pdf.

[BOEM]. Bureau of Ocean Energy Management. 2017. Munitions and Explosives of Concern Survey Methodology and In-field Testing for Wind Energy Areas on the Atlantic Outer Continental Shelf. OCS Study BOEM 2017-063. [accessed November 24, 2020]. https://www.boem.gov/Renewable-Energy-Environmental-Studies/.

Grow, JA. Klitgord, KD. Schlee, JS. 1988. Structure and Evolution of Baltimore Canyon Trough. In: Sheridan RE, Grow, JA, editors. Volumes 1-2, The Atlantic Continental Margin: U.S., Chapter 13. The Geological Society of America. [published January 1988; accessed October 9, 2020]. https://www.researchgate.net/publication/282505673_Structure_and_evolution_of_Baltimore_Canyon_Trough.

[MARCO] Mid-Atlantic Regional Council on the Ocean. Mid-Atlantic Ocean Data Portal. C2020. US Government Publishing Office; NOAA Office of Coast Survey; US Army Corps of Engineers; Mapped by MarineCadastre.gov. [accessed October 23, 2020] https://portal.midatlanticocean.org/data-catalog/maritime-industries/#layer-info-ocean-disposal-sites168.

McHugh, Cecilia M.G. Olson, Hilary Clement. 2002. Pleistocene Chronology of Continental Margin Sedimentation: New Insights Into Traditional Models, New Jersey. Marine Geology, Volume 186, Issues 3-4, July 2002, pages 389-411. [published 2002; accessed January 31, 2021]. https://www.sciencedirect.com/science/article/pii/S0025322702001986.

New Jersey American Water. c2019. 2019 Annual Water Quality Report: Coastal North System. [published 2019; accessed November 15, 2020]. https://www.amwater.com/ccr/coastalnorth.pdf.

[NJDEP] New Jersey Department of Environmental Protection. New Jersey Geological Survey. 2009. Kirkwood-Cohansey Water-table Aquifer. [published 2009; accessed November 15, 2020]. https://www.state.nj.us/dep/njgs/enviroed/infocirc/kirkwood-cohansey.pdf.

[NJDEP] New Jersey Department of Environmental Protection Office of Science. July 2010. Ocean/Wind Power Ecological Baseline Studies: Final Report. Volume I: Overview, Summary, and Application; Section 2.2.1, Marine Geology. [published July 2010; accessed October 9, 2020]. https://www.nj.gov/dep/dsr/ocean-wind/Ocean%20Wind%20Power%20Ecological%20Baseline%20Studies_Volume%20One.pdf.

[NJDEP] New Jersey Department of Environmental Protection Division of Water Supply and Geoscience. C2020. SWAP-Frequently Asked Questions. [accessed December 7, 2020]. https://www.state.nj.us/dep/watersupply/swap/faq.htm#q5.

[NJDOH] New Jersey Department of Public Health. February 6, 2020. New Jersey State Health Assessment Data: Monmouth County Public Health Profile Report. [published February 6, 2020; accessed 2020 Nov 15]. https://www-doh.state.nj.us/doh-shad/community/highlight/profile/PrivateWell.Testing/GeoCnty/13.html.

[NJWSA] New Jersey Water Supply Authority. 2017. The Manasquan System. [accessed November 15, 2020]. https://www.njwsa.org/manasquan.html.

New York State Energy and Research Development Authority (NYSERDA). 2019. "Geotechnical and Geophysical Desktop Study to Support Offshore Wind Energy Development in the New York Bight" NYSERDA Report Number 19-10. Prepared by Fugro, Norfolk, VA. nyserda.ny.gov/publications

Stockton University Coastal Research Center: New Jersey Geologic History. c2020. Galloway (NJ). [accessed November 12, 2020]. https://stockton.edu/coastal-research-center/njbpn/geologic-hist.html.

TerraSond Acteon Geospatial Solutions. Marine Geospatial Technical Report 2020. https://acteon.com/geo-services/terrasond

[USGS] United States Geological Survey. 2019. WaterWorlds—Continental Margin. C 2021a. [published June 17, 2019; accessed January 31, 2021]. https://www.usgs.gov/news/waterwords-continental-margin?qt-news_science_products=4#qt-news_science_products.

[USGS] United States Geological Survey. Trek Through Time. C 2021b. [accessed January 31, 2021]. https://www.usgs.gov/science-explorer-results?es=Trek+through+Time.

[USGS] United States Geological Survey. U.S. Geological Survey. 2019. Water Worlds—Methane Seep. C2021c. [published June 13, 2019; accessed February 7, 2021]. https://www.usgs.gov/news/waterwords-methane-seep?qt-news_science_products=4#qt-news_science_products.

[USGS] United States Geological Survey. U.S. Geological Survey Gas Hydrates Project. C 2021d. [accessed February 7, 2021]. https://www.usgs.gov/centers/whcmsc/science/us-geological-survey-gas-hydrates-project?qt-science_center_objects=0#qt-science_center_objects.

## 2.2 Physical Oceanography and Meteorology

Ashley GM, Halsey SD, Buteux CB. 1986. New Jersey's longshore current pattern. Journal of Coastal Research. 2(4):453-463.

[BOEM] Bureau of Ocean Energy Management. 2017. Habitat mapping and assessment of northeast wind energy areas; [accessed 2020 August 5]. https://espis.boem.gov/ final%20reports/5647.pdf.

[BOEM] Bureau of Ocean Energy Management. 2020. Potential earthquake, landslide, tsunami and geo-hazards for the U.S. offshore pacific wind farms; [accessed 2021 February 5]. https://www.boem.gov/sites/default/files/documents/environment/RPS-Final-Report-Geohazards_0.pdf.

Bumpus DF. 1965. Residual drift along the bottom on the continental shelf in the Middle Atlantic Bight area 1. Limnology and Oceanography, 10(suppl): R50-R53.

Buteux CB. 1982. Variations in magnitude and direction of longshore currents along the central New Jersey coast [Master's thesis] New Brunswick: Rutgers University.

Castelao R., Glenn S., Schofield O. 2010. Temperature, salinity, and density variability in the central Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 115(C10).

Chen K., He R. 2010. Numerical investigation of the Middle Atlantic Bight shelfbreak frontal circulation using a high-resolution ocean hindcast model. Journal of Physical Oceanography. 40(5): 949-964.

Chen Z. 2018. Dynamics and Spatio-Temporal Variability of the Mid-Atlantic Bight Cold Pool [doctoral dissertation]. New Brunswick (NJ). Rutgers University.

Chen Z, Curchitser E, Chant R, Kang D. 2018. Seasonal variability of the cold pool over the Mid-Atlantic Bight Continental Shelf. Journal of Geophysical Research: Oceans. 123(11):8203-26.

Chen, Z., and E. N. Curchitser. 2020: Interannual Variability of the Mid-Atlantic Bight Cold Pool. J. Geophys. Res. Oceans, 125. https://doi.org/10.1029/2020JC016445.

Clare MA, Talling PJ, Challenor P, Malgesini, G, Hunt J. 2014. Distal turbidites reveal a common distribution for large (> 0.1 km3) submarine landslide recurrence: Geology.42(3): 263-266.

Ganim J. Cold Pool. 2019. MARACOOS. Newark (DE): Mid-Atlantic Regional Association Coastal Ocean Observing System; [published 2019 April 23; accessed 2020 November 30]. https://www.integratedecosystemassessment.noaa.gov/regions/northeast/components/cold-pool/.

Goldsmith KA, Lau S, Poach ME, Sakowicz GP, Trice TM, Ono CR, Nye J, Shadwick, EH, StLaurent KA, Saba GK. 2019. Scientific considerations for acidification monitoring in the US Mid-Atlantic Region. Estuarine, Coastal and Shelf Science. 225:106189.

Landsea C W, Franklin J L, 2013. Atlantic Hurricane Database Uncertainty and Presentation of a New Database Format. Mon. Wea. Rev., 141, 3576-3592.

Lentz SJ. 2017. Seasonal warming of the Middle Atlantic Bight Cold Pool. Journal of Geophysical Research: Oceans. 122(2):941-954.

Locarnini RA, Mishonov AV, Baranova OK, Boyer TP, Zweng MM, Garcia HE, Reagan JR, Seidov D, Weathers K, Paver CR, Smolyar I. 2018. World ocean atlas 2018, Volume 1: Temperature. A. Mishonov Technical Ed. NOAA Atlas NESDIS 81.

[MAROA] Mid-Atlantic Regional Ocean Assessment. 2020. Oceanographic setting and processes; [accessed 2020 August 5]. https://roa.midatlanticocean.org/ ocean-ecosystem-and-resources/characterizing-the-mid-atlantic-ocean-ecosystem/oceanographic-setting-and-processes/.

Miles, J., T. Martin, and L. Goddard, 2017: Current and wave effects around windfarm monopile foundations. Coastal engineering (Amsterdam), 121, 167-178.

Miles, Travis, Sarah Murphy, Josh Kohut, Sarah Borsetti, and Daphne Munroe, 2020. Could federal wind farms influence continental shelf oceanography and alter associated ecological processes? A literature review. Science Center for Marine Fisheries, Rutgers University. Available from https://scemfis.org/wp-content/uploads/2021/01/ColdPoolReview.pdf (February 2021).

Miller KG, Browning JV, Mountain GS, Sheridan RE, Sugarman PJ, Glenn S, Christensen BA. 2014. History of continental shelf and slope sedimentation on the US middle Atlantic margin. Geological Society. London. Memoirs. 41(1):21-34.

[NEIEA] Northeast Integrated Ecosystem Assessment. n.d. Cold Pool; [accessed 2020 October 22]. https://www.integratedecosystemassessment.noaa.gov/regions/northeas t/components/cold-pool/

[NFHL] National Flood Hazard Layer. 2020. Examining Flood Map Changes in New Jersey; [accessed 2021 March 9]. https://hazards-fema.maps.arcgis.com/apps/webappv iewer/index.html?.

[ONJSC] Office of the New Jersey State Climatologist – Rutgers University. 2020. Monthly climate tables; [accessed 2020 August 5]. http://climate.rutgers.edu/stateclim_v1/nclimdiv/index.php?stn=NJ03&elem=pcpn.

[PNNL] Pacific Northwest National Laboratory. 2020. Mid-Atlantic Bight Wave Hindcast to Support DOE Lidar Buoy Deployments: Model Validation; [accessed 2021 February 5].

Saunders PM. 1977. Wind stress on the ocean over the eastern continental shelf of North America. Journal of Physical Oceanography. 7(4):555-566.https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-29814. pdf.

Schultze, L. K. P., L. M. Merckelbach, J. Horstmann, S. Raasch, and J. R. Carpenter, 2020: Increased Mixing and Turbulence in the Wake of Offshore Wind Farm Foundations. Journal of Geophysical Research: Oceans, 125

Tides and Currents. 2020a. Atlantic City, NJ . Station ID: 8534720; [accessed 2020 August 5].https://tidesandcurrents.noaa.gov/stationhome.html?id=8534720.

Tides and Currents. 2020b. Sandy Hook, NJ . Station ID: 8531680; [accessed 2020 August 5]. https://tidesandcurrents.noaa.gov/stationhome.html?id=85316 80.

[USDOI] United States Department of the Interior. 1982. Final environmental impact statement OCS SALE No.76 Outer continental shelf oil and gas lease sale offshore the Mid-Atlantic States.

Voynova, Y. G., M. J. Oliver, and J. H. Sharp, 2013: Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. Journal of Geophysical Research. Oceans, 118, 6437-6450.

Zweng MM, Reagan JR, Seidov D, Boyer TP, Locarnini RA, Garcia HE, Mishonov AV, Baranova OK, Weathers K, Paver CR, Smolyar I. 2018. World Ocean Atlas 2018. Volume 2: Salinity. A. Mishonov Technical Ed. NOAA Atlas NESDIS 82.

### 3.1 Air Quality

[BOEM 2012] Bureau of Ocean Energy Management Office of Renewable Energy Programs. 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment: OCS EIS/EA BOEM 2012-003.

[IEA 2020] International Energy Agency. 2020. Global CO2 emissions in 2019. [Published February 11, 2020; accessed October 30, 2020]. https://www.iea.org/articles/global-co2-emissions-in-2019.

[EPA 2020a] Environmental Protection Agency Emissions & Generation Resource Integrated Database (eGRID). 2018. eGRID Summary Tables 2018; [published March 9, 2020, accessed October 30, 2020]. https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf.

[EPA 2020b] Environmental Protection Agency. eGRID Related Materials. [accessed October 30, 2020]. https://www.epa.gov/egrid/egrid-related-materials.

[EPA 2020c] Environmental Protection Agency AirData Air Quality Monitors. [accessed October 30, 2020]. https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=5f239fd3e72f424f98ef3d5def547eb5.

[EPA 2020d] Environmental Protection Agency CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool; [published June 2020; accessed February 18, 2021] https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool

[NJDEP 2020] State of New Jersey Department of Environmental Protection Bureau of Evaluation and Planning. 2020. New Jersey Air Emission Inventories; [published 2020; accessed November 3, 2020]. https://www.nj.gov/dep/baqp/inventory.html.

[NJDEP 2020a] New Jersey Department of Environmental Protection. 2020. Greenhouse Gas Emissions in New Jersey; [updated August 2020; accessed February 18, 2021]

[NJDEP 2020b] Barr A, Orlando P, Kettig R, Barry R, Karmarkar-Deshmukh R, Kamel M. New Jersey's Global Warming Response Act 80x50 Report. Trenton (NJ): New Jersey Department of Environmental Protection.

[NJDEP 2020c] New Jersey Department of Environmental Protection. 2020. 2019 New Jersey Air Quality Report.

[NOAA 2022] National Oceanic & Atmospheric Administration Global Monitoring Laboratory. Trends in Atmospheric Carbon Dioxide; [accessed October 30, 2020]. https://www.esrl.noaa.gov/gmd/ccgg/trends/global.html#global

[NPS 2010] National Park Service. 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised: Natural Resource Report NPS/NRPC/NRR—2010/232https://www.nj.gov/dep/dsr/trends/ghg.pdf.

[NPS 2020] National Park Service. 2020. Class I Areas. [published May 18, 2020; accessed October 29, 2020]. https://www.nps.gov/subjects/air/class1.htm.

New York State Climate Action Council. 2021. Draft Scoping Plan; [published December 30, 2021; accessed April 21, 2022]. https://climate.ny.gov/Our-Climate-Act/Draft-Scoping-Plan.

[USACE 2017] Department of the Army Corps of Engineers. 2017. Waterborne Commerce of the United States, Calendar Year 2016, Part 1– Waterways and Harbors, Atlantic Coast. IWR-WCUS-16-1.

### 3.2 Water Quality

[ASA] Applied Science Associates, Inc. 2008. Results from Modeling of Sediment Dispersion during Installation of the Proposed Bayonne Energy Center Submarine Cable. Narragansett (RI): ASA Project 2007-025. http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=28172.

Atlantic City Municipal Utilities Authority. 2020. Annual Water Quality Report- Reporting Year 2020. Atlantic City (NJ): Atlantic City Municipal Utilities Authority; [accessed 12 November 2020]. https://www.acmua.org/.

Balthis WL, Hyland JL, Fulton MH, Wirth EF, Kiddon JA, Macauley J. 2009. Ecological Condition of Coastal Ocean Waters Along the U.S. Mid-Atlantic Bight: 2006. NOAA Technical Memorandum NOS NCCOS 109, NOAA National Ocean Service: Charleston (SC); 29412-9110.

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia: Final Environmental Assessment. US Department of Interior, Bureau of Ocean Energy Management.

BOEM 2021. South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement. Sterling (VA): BOEM; OCS EIS/EA BOEM 2020-057.

Bricker SB, Clement CG, Pirhalla DE, Orlando SP, Farrow DRG. 1999. National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries. Silver Springs (MD): NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science.

Castelao, R., S. Glenn, and O. Schofield, 2010: Temperature, salinity, and density variability in the central Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 115, C10005.

Chen Z, Curchitser E, Chant R, Kang D. 2018. Seasonal Variability of the Cold Pool Over the Mid-Atlantic Bight Continental Shelf. Journal of Geophysical Research: Oceans. 123: 8203-8226.

Chen, Z., and E. N. Curchitser, 2020: Interannual Variability of the Mid-Atlantic Bight Cold Pool. Journal of geophysical research. Oceans, 125.

County of Monmouth, Office of Economic Development. Energy and Utilities 2022. [accessed November 21, 2022) https://www.visitmonmouth.com/Page.aspx?Id=1539#:~:text=The%20majority%20of%20the%20county's,Brook%20Treatment%20Plant%20in%20Neptune.

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

[EPA] Environmental Protection Agency. 2010 NCCA 2010 Water Quality Indicator Status [dataset]. Washington D.C.: EPA Office of Wetlands, Oceans, and Watersheds; [accessed 30 November 2020]. https://www.epa.gov/national-aquatic-resource-surveys/data-national-aquatic-resource-surveys.

EPA. 2012. National Coastal Condition Report IV. Washington DC: EPA, Office of Water and Office of Research and Development Report No. EPA-842-R-10-003.

EPA. 2015. National Coastal Condition Assessment 2010. Washington, DC: Office of Water and Office of Research and Development. Report No. EPA 841-R-15-006.

EPA. 2016a. National Aquatic Resources Surveys-Indicators: Dissolved Oxygen; Washington D.C.: EPA Office of Wetlands, Oceans, and Watersheds; [accessed 30 November 2020].https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen.

EPA. 2016b. National Aquatic Resources Surveys-Indicators: Chlorophyll a; Washington D.C.: EPA Office of Wetlands, Oceans, and Watersheds; [accessed 30 November 2020].https://www.epa.gov/national-aquatic-resource-surveys/indicators-chlorophyll.

EPA. 2017. The Effects: Dead Zones and Harmful Algal Blooms; Washington D.C.: EPA Office of Water; [accessed 30 November 2020]. https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms.

Ganim J. Cold Pool. 2019. MARACOOS. Newark (DE): Mid-Atlantic Regional Association Coastal Ocean Observing System; [published 2019 April 23; accessed 30 November 2020]. https://www.integratedecosystemassessment.noaa.gov/regions/northeast/components/cold-pool/

Green L, Addy K, Sanbe N. 1996. Natural Resources Fact Sheet: Measuring Water Clarity. University of Rhode Island, Department of Natural Resources Science, Cooperative Extension. Report No. 96-1.

Johnson A. 2018. The Effects of Turbidity and Suspended Sediments on ESA-Listed Species from Projects Occurring in the Greater Atlantic Region. Greater Atlantic Region Policy Series 18-02. NOAA Fisheries Greater Atlantic Regional Fisheries Office.

Kohut J, Haldeman C, Kerfoot J. 2014. Monitoring Dissolved Oxygen in New Jersey Coastal Waters Using Autonomous Gliders. Edison (NJ): EPA Office of Research and Development National Risk Management Laboratory. Report No. EPA/600/R-13/180.

Lentz SJ. 2017. Seasonal warming of the Middle Atlantic Bight Cold Pool. Journal of Geophysical Research: Oceans. 122: 941–954.

Mallin M, Johnson V, Ensign S. 2008. Comparative impacts of stormwater runoff on water quality of an urban, a suburban, and a rural stream. Environmental Monitoring and Assessment. 159: 475–491.

Miles, Travis, Sarah Murphy, Josh Kohut, Sarah Borsetti, and Daphne Munroe, 2020. Could federal wind farms influence continental shelf oceanography and alter associated ecological processes? A literature review. Science Center for Marine Fisheries, Rutgers University. Available from https://scemfis.org/wp-content/uploads/2021/01/ColdPoolReview.pdf%20(February%202021).

Miles, J., T. Martin, and L. Goddard, 2017: Current and wave effects around windfarm monopile foundations. Coastal engineering (Amsterdam), 121, 167-178.

NASA Earth Observatory. Phytoplankton Bloom off New Jersey [date unknown]. [published 2016 July 6; accessed September 2020]. https://earthobservatory.nasa.gov/images/88340/phytoplankton-bloom-off-new-jersey.

[NJDEP] New Jersey Department of Environmental Protection. 2015a. New Jersey's Marine HAB Monitoring. Presentation by NJDEP Bureau of Marine Water Monitoring to the New Jersey Water Monitoring Council. [published 2015 September 23; accessed September 2020]. https://www.nj.gov/dep/wms/Schuster_NJDEPMarineHabmon.pdf.

NJDEP. 2015b. Sanitary Survey Report for Shellfish Growing Area AONorthCent (Bayhead to Monmouth Beach). NJDEP Water Monitoring and Standards.

NJDEP. 2016. New Jersey Integrated Water Quality Assessment Report. https://www.nj.gov/dep/wms/bears/docs/2016FinIntReport-withAppendices.pdf.

NJDEP. 2018. NJDEP NSSP Monitoring Network [dataset]. Trenton (NJ): NJDEP Bureau of GIS; [last modified 2018 December 27; accessed 30 November 2020].

NJDEP. 2019a. 2016 New Jersey Integrated Water Quality Assessment Report. NJDEP Division of Water Monitoring and Standards, Bureau of Environmental Analysis, Restoration and Standards. https://www.arcgis.com/home/webmap/viewer.html?webmap=5f6e08fc9e354467a2fd455790ef114a&extent=-76.286,38.8572,-73.0505,40.5141

NJDEP. 2019b. CyanoHAB Events 2017. Trenton (NJ): NJDEP Bureau of Freshwater and Biological Monitoring; [last updated 2019 November 18; accessed 30 November 2020]. https://www.nj.gov/dep/wms/bfbm/2017cyanoHABevents.html.

NJDEP. 2019c. CyanoHAB Events 2018. Trenton (NJ): NJDEP Bureau of Freshwater and Biological Monitoring; [last updated 2019 November 18; accessed 30 November 2020]. https://www.nj.gov/dep/wms/bfbm/2018cyanoHABevents.html.

NJDEP. 2019d. NJPDES Surface Water Discharges in New Jersey, (1:12,000) [dataset]. Trenton (NJ): NJDEP Bureau of GIS; [last updated 2019 December 26; accessed 30 November 2020]. https://gisdata-njdep.opendata.arcgis.com/datasets/njpdes-surface-water-discharges-in-new-jersey-112000?geometry=-79.673%2C38.921%2C-70.286%2C40.401.

NJDEP. 2020a. Chlorophyll Remote Sensing [dataset]. Leeds Point (NJ): NJDEP Bureau of Marine Water Monitoring; [last updated 2020 February 3; accessed 30 November 2020]. http://njdep.rutgers.edu/aircraft/.

NJDEP. 2020b. NJDEP Harmful Algal Bloom (HAB) Interactive Mapping and Reporting System. Trenton (NJ): NJDEP Bureau of Freshwater and Biological Monitoring; [accessed 30 November 2020]. https://njdep.maps.arcgis.com/apps/opsdashboard/index.html#/49190166531d4e5a811c9a91e4a41677.

NJDEP. 2020c. CyanoHAB Events 2019. Trenton (NJ): NJDEP Bureau of Freshwater and Biological Monitoring; [last updated 2020 March; accessed 30 November 2020]. https://www.nj.gov/dep/wms/bfbm/2019cyanoHABevents.html.

NJDEP. 2020d. Bureau of Marine Water Monitoring Laboratory Facilities. Leeds Point (NJ): NJDEP Bureau of Marine Water Monitoring; [last updated 2020 June; accessed 30 November 2020]. https://www.nj.gov/dep/bmw/labfacility.htm.

NJDEP. 2020e. Nutrient Monitoring Networks. Leeds Point (NJ): NJDEP Bureau of Marine Water Monitoring; [accessed 2020 30 November 2020]. https://www.state.nj.us/dep/bmw/coastalwaterquality.htm.

NJDEP. 2020f. Stormwater Utilities. Trenton (NJ): NJDEP; [last updated 2020 September 16; accessed September 2020]. https://www.nj.gov/dep/dwq/stormwaterutility.html.

NJDEP. 2022. Healthy Community Planning Report: Monmouth County, Red Bank Borough; [accessed 7 November 2022]. https://www.nj.gov/health/hcpnj/documents/county-reports/HCPNJ_fullreports/MONMOUTH_RED%20BANK%20BORO.pdf.

New Jersey Department of Health. 2020. Monmouth County Public Health Profile Report; [last updated 2022 July 18; accessed November 16, 2022]. https://www-doh.state.nj.us/doh-shad/community/highlight/profile/PrivateWell.Testing/GeoCnty/13.html

[NOAA] National Oceanic and Atmospheric Administration. Summertime Dissolved Oxygen Levels—What Do They Mean for Fish…and Fishermen? [date unknown(a)]. Chesapeake Bay Interpretive Buoy System; [accessed 30 November 2020]. https://buoybay.noaa.gov/news/summertime-dissolved-oxygen-levels-what-do-they-mean-for-fish-and-fishermen.

NOAA. Nutrient Biogeochemistry [date unknown(b)]. Miami (FL): NOAA Atlantic Oceanographic and Meteorological Laboratory's Ocean Chemistry and Ecosystem Division; [accessed 30 November 2020]. https://www.aoml.noaa.gov/ocd/ocdweb/nutrients.html.

NOAA. What is Upwelling? [date unknown(c)]. Silver Springs (MD): NOAA National Ocean Service; [last updated 2020 April 9; accessed 30 November 2020]. https://oceanservice.noaa.gov/facts/upwelling.html.

NOAA. 2018. Ocean Disposal Sites [dataset]. North Charleston (SC): Office for Coastal Management; [published 2018 October 31; accessed 30 November 2020]. https://www.fisheries.noaa.gov/inport/item/54193.

NYC H20 Hub. 2021. Silver Lake Reservoir Shining in Staten Island. [Accessed 20 April 2022]. https://storymaps.arcgis.com/stories/916b995ed91040e99dab72964fa2a188.

New York Harmful Algal Bloom System (HABs). 2023. The New York Harmful Algal Bloom System Interactive Mapper. [Accessed 17 August 2023]. https://nysdec.maps.arcgis.com/apps/webappviewer/index.html?id=ae91142c812a4ab997ba739ed9723e6e

NYSDEC Division of Water, Bureau of Water Assessment and Monitoring. 2019. Water Quality Classifications (WQC) – NYS; [published 13 April 2010; accessed 20 April 2022]. http://gis.ny.gov/gisdata/metadata/nysdec.wtrcls.xml.

NYSDEC. 2022. Shellfish Closures, Part 41: Sanitary Condition of Shellfish Lands. [Accessed 20 April 2022]. https://www.dec.ny.gov/outdoor/103483.html#12837.

[MDMR] State of Maine Department of Marine Resources. 2016. The Scoop on Fecal Coliform. Augusta (ME): MDMR; [accessed 30 November 2020]. https://www.maine.gov/dmr/shellfish-sanitation-management/programs/growingareas/coliform.html.

Schultze, L. K. P., L. M. Merckelbach, J. Horstmann, S. Raasch, and J. R. Carpenter, 2020: Increased Mixing and Turbulence in the Wake of Offshore Wind Farm Foundations. Journal of Geophysical Research: Oceans, 125.

[VDH] Virginia Department of Health. 2020. Classification of Shellfish Growing Areas. Richmond (VA): VDH; [accessed 30 November 2020]. https://www.vdh.virginia.gov/environmental-health/environmental-health-services/shellfish-safety/classification-of-shellfish-growing-areas/.

Voynova, Y. G., M. J. Oliver, and J. H. Sharp, 2013: Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. Journal of Geophysical Research. Oceans, 118, 6437-6450.

West Point Partners, LLC. 2013. Application to the United States Army Corps of Engineers (New York District) for a Department of the Army Individual Permit. Volume 1 of 2. Fairfield (CT): West Point Partners, LLC.

http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BC191AEEA-9CFF-4D39-9654-E21B59A3629A%7D.

### 4.1 Wetlands and Other Waters of the United States

Franklin Township Public Schools. 2021. The four regions of New Jersey. Somerset (NJ): Franklin Township Public Schools; [accessed 22 January 2021]. https://www.franklinboe.org/cms/lib/NJ01000817/Centricity/Domain/1362/four%20regions%20of%20nj-unit%201%20lesson%202-1.pptx.

Citizens United to Protect the Maurice River and its Tributaries, Inc. (CUPMR). 2008. Plants of Southern New Jersey. Millville (NJ): CUPMR; [accessed 22 January 2021]. https://www.cumauriceriver.org/botany/mariveg.html

Natural Resources Conservation Service (NRCS). 2020. Soil Data Access (SDA) Hydric Soils List. Washington D.C.: USDA NRCS; [accessed 22 January 2021]. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1316620.html

New Jersey Department of Military and Veteran Affairs (DMAVA). 2020. Field Guide to the Beach Habitats of the National Guard Training Center. Sea Girt (NJ): New Jersey Army National Guard; [accessed 22 January 2021]. https://www.nj.gov/military/construction-facilities-management/environmental-management/documents/3307-booklet-FINAL.pdf

New Jersey Department of Environmental Protection (NJDEP). 2020. New Jersey Coastal Management Program. Trenton (NJ): NJDEP, Bureau of Climate Resilience Planning; [updated October 21, 2020; accessed 22 January 2021]. https://www.state.nj.us/dep/cmp/

New Jersey Department of Environmental Protection and Energy (NJDEP) and United States Army Corps of Engineers (USACE). 1993. *Memorandum of Agreement Between the State of New Jersey and the Department of the Army.* [accessed 22 January 2021]. http://www2.law.mercer.edu/elaw/wetlands/new%20jersey%20corps%20assumption%20moa.pdf

New Jersey Department of Environmental Protection (NJDEP). 2017. Background Information: Coastal Resiliency and Building Ecological Solutions. Trenton (NJ): State of New Jersey; [updated October 18, 2017; accessed 22 January 2021]. https://www.nj.gov/dep/seeds/bescch/2_bkgrdinfo.htm.

New York Department of Environmental Conservation (NYSDEC). 2022. Tidal Wetlands Permit Program. [accessed 25 March 2022]. https://www.dec.ny.gov/permits/6039.html

New York State Department of State (NYSDOS) Division of Administrative Rules. 2021. 6 CRR-NY 661.4; [updated 30 April 2021; accessed 8 November 2022]. https://govt.westlaw.com/nycrr/Document/I4ecd4445cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

Soil Survey Staff. 2020. Web Soil Survey. Washington D.C.: Natural Resources Conservation Service, United States Department of Agriculture; [accessed 22 January 2021]. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Stockton University. 2021. New Jersey Geologic History: New Jersey Coastal Composition. Galloway (NJ): Stockton University; [accessed 22 January 2021]. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Stockton University. 2021. New Jersey geologic history. Galloway (NJ): Stockton University; [accessed 22 January 2021]. https://stockton.edu/coastal-research-center/njbpn/geologic-hist.html.

U. S. Fish and Wildlife Service (USFWS). 2021. National Wetlands Inventory. Washington D.C.: U.S. Department of the Interior, Fish and Wildlife Service; [updated October 1, 2019; accessed 22 January 2021]. http://www.fws.gov/wetlands/.

Yang L, Jin S, Danielson P, Homer CG, Gass L, Bender SM, Case A, Costello C, Dewitz JA, Fry JA, Funk M, Granneman BJ, Liknes GC, Rigge MB, and Xian G. 2018. A New Generation of the United States National Land Cover Database—Requirements, Research Priorities, Design, and Implementation Strategies. Journal of Photogrammetry and Remote Sensing. 146: 108-123. https://doi.org/10.1016/j.isprsjprs.2018.09.006.

## 4.2 Coastal and Terrestrial Habitat and Fauna

New Jersey Department of Environmental Protection (NJDEP). 2020. New Jersey Coastal Management Program. Trenton (NJ): NJDEP, Bureau of Climate Resilience Planning; [updated October 21, 2020; accessed 25 January 2021]. https://www.state.nj.us/dep/cmp/.

[NYSDEC] New York State Department of Environmental Conservation. 2011. Significant Natural Community Occurrences - Long Island & NYC [dataset]. Albany (NY): NYSDEC Natural Heritage Program; [published 21 April 2011; accessed 14 November 2022]. http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1241.

[NYSDOS] New York Department of State. 2022. Significant Coastal Fish and Wildlife Habitats. Albany (NY); NYDOS; [accessed 11 November 2022]. https://dos.ny.gov/significant-coastal-fish-wildlife-habitats.

## 4.3 Birds

American Wind Wildlife Institute. 2016. Wind Turbine Interactions with Wildlife and Their Habitats: A Summary of Research Results and Priority Questions. (Updated June 2016). Washington, DC. Available at Www.Awwi.Org.

Atlantic Seabirds. 2019. Interactive map of the ten Black-capped Petrels captured at sea offshore Cape Hatteras, NC, and tracked by satellite. Available at https://www.atlanticseabirds.org/bcpe-2019.

Baker, A., P. Gonzalez, R. I. G. Morrison, & B. A. Harrington. 2020. Red Knot (Calidris canutus), version 1.0. *in* Billerman, S. M. (ed). Birds of the World. Cornell Lab of Ornithology, Ithaca, NY, USA Available at https://doi-org.uri.idm.oclc.org/10.2173/bow.redkno.01.

Biodiversity Research Institute. 2021. Tracking of Red Knots on the U.S. Atlantic Coast: A preliminary report on tag deployments by Atlantic Shores. Report to Environmental Design and Research and Atlantic Shores Offshore Wind, LLC. Portland, ME. 11pp.

BOEM. 2021. Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement Volume II. OCS EIS/EA BOEM 2021-0012. https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-2.pdf.

Burger, J., C. Gordon, J. Lawrence, J. Newman, G. Forcey, & L. Vlietstra. 2011. Risk evaluation for federally listed (roseate tern, piping plover) or candidate (red knot) bird species in offshore waters: A first step for managing the potential impacts of wind facility development on the Atlantic Outer Continental Shelf. Renew. Energy 36: 338–351.

Choi, D.Y., T.W. Wittig, and B.M. Kluever. 2020. An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States. PLoS ONE 15 (8).

Cochran, William W. 1985. Ocean Migration of Peregrine Falcons: Is the Adult Male Pelagic? In Proceedings of Hawk Migration Conference IV, edited by M. Harwood, 223–37. Rochester, NY: Hawk Migration Association of North America. Cook, A. S. C. P., A. Johnston, L. J. Wright, & N. H. K. Burton. 2012. A Review of Flight Heights and Avoidance Rates of Birds in Relation to Offshore Wind Farms. BTO Research Report Number 618. British Trust for Ornithology, Thetford, UK. 61 pp. Available at http://www.bto.org/sites/default/files/u28/downloads/Projects/Final_Report_SOSS02_BTOReview.pdf.

Curtice, C., J. Cleary, E. Shumchenia, & P. Halpin. 2016. Marine-life Data and Analysis Team (MDAT) technical report on the methods and development of marine-life data to support regional ocean planning and management. Prepared on behalf of the Marine-life Data and Analysis Team (MDAT). Available at http://seamap.env.duke.edu/models/MDAT/MDAT-Technical-Report.pdf.

Desholm, Mark, and Johnny Kahlert. 2005. Avian Collision Risk at an Offshore Wind Farm. Biology Letters 1 (3): 296–98. https://doi.org/10.1098/rsbl.2005.0336.

DeSorbo, C. R., C. Persico, & L. Gilpatrick. 2018. Studying migrant raptors using the Atlantic Flyway. Block Island Raptor Research Station, Block Island, RI: 2017 season. BRI Report # 2018-12 submitted to The Nature Conservancy, Block Island, Rhode Island, and The Bailey Wildlife Foundation, Cambridge, Massachusetts. Biodiversity Research Institute, Portland, Maine. 35 pp.

DeSorbo, C. R., C. P. Persico, L. Gilpatrick, A. Gilbert, A. Dalton, & M. Burton. 2019. Studying migrant raptors using the Atlantic Flyway: Block Island Raptor Research Station, Block Island, RI: 2018 season. BRI Report # 2019-10 submitted to The Nature Conservancy, Block Island, Rhode Island, and The Bailey Wildlife Foundation, Cambridge, Massachusetts. Biodiversity Research Institute, Portland, Maine. 33 pp plus appendices.

DeSorbo, C. R., K. G. Wright, & R. Gray. 2012. Bird migration stopover sites: ecology of nocturnal and diurnal raptors at Monhegan Island. Report BRI 2012-09 submitted to the Maine Outdoor Heritage

Fund, Pittston, Maine, and the Davis Conservation Foundation, Yarmouth, Maine. Biodiversity Research Institute, Gorham, Maine. 43 pp. Available at http://www.briloon.org/raptors/monhegan.

Dierschke, V., R. W. Furness, & S. Garthe. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biol. Conserv. 202: 59–68.

Dolinski, Lauren. 2019. Landscape Factors Affecting Foraging Flight Altitudes of Great Blue Heron in Maine; Relevance to Wind Energy Development. Orono, ME: University of Maine.

Drewitt, A. L., & R. H. W. Langston. 2006. Assessing the Impacts of Wind Farms on Birds. Ibis (Lond. 1859). 148: 29–42.

Erickson, W. P., Wolfe, M. M., Bay, K. J., Johnson, D. H., & Gehring, J. L. 2014. A comprehensive analysis of small-passerine fatalities from collision with turbines at wind energy facilities. PloS ONE, 9(9), e107491. https://doi.org/10.1371/journal.pone.0107491.

Fliessbach, K. L., K. Borkenhagen, N. Guse, N. Markones, P. Schwemmer, & S. Garthe. 2019. A ship traffic disturbance vulnerability index for Northwest European seabirds as a tool for marine spatial planning. Front. Mar. Sci. 6: 192.

Fox, A. D., M. Desholm, J. Kahlert, T. K. Christensen, & I. Krag Petersen. 2006. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis 148 (01): 129–44. https://doi.org/10.1111/j.1474-919X.2006.00510.x.

Fox, A. D., & I. K. Petersen. 2019. Offshore wind farms and their effects on birds. Dansk Orn. Foren. Tidsskr. 113: 86–101.

Furness, R. W., H. M. Wade, & E. A. Masden. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. J. Environ. Manage. 119: 56–66. https://doi.org/10.1016/j.jenvman.2013.01.025.

Garthe, S., & O. Hüppop. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41 (4): 724–34. https://doi.org/10.1111/j.0021-8901.2004.00918.x.

Garthe, S., N. Markones, & A.-M. Corman. 2017. Possible impacts of offshore wind farms on seabirds: a pilot study in Northern Gannets in the southern North Sea. J. Ornithol. 158: 345–349.

Gochfeld, M., & J. Burger. 2020. Roseate Tern (*Sterna dougallii*), version 1.0. *in* Billerman, S. M. (ed). Birds of the World. Cornell Lab of Ornithology, Ithaca, NY, USA Available at https://doi-org.uri.idm.oclc.org/10.2173/bow.roster.01.

Goodale, M. W., & A. Milman. 2016. Cumulative adverse effects of offshore wind energy development on wildlife. J. Environ. Plan. Manag. 59: 1–21.

Goodale, M. W., & I. J. Stenhouse. 2016. A conceptual model for determining the vulnerability of wildlife populations to offshore wind energy development. Human-Wildlife Interact. 10: 53–61.

Haney, J. C. 1987. Aspects of the pelagic ecology and behavior of the Black-capped Petrel

(*Pterodroma hasitata*). Wilson Bull. 99: 153–168.

Hartman, J. C., K. L. Krijgsveld, M. J. M. Poot, R. C. Fijn, M. F. Leopold, & S. Dirksen. 2012. Effects on birds of Offshore Wind farm Egmond aan Zee (OWEZ). An overview and integration of insights obtained. Report 12-005. Bureau Waardenburg, Culemborg, Netherlands.

Hill, R., K. Hill, R. Aumuller, A. Schulz, T. Dittmann, C. Kulemeyer, & T. Coppack. 2014. Of birds, blades, and barriers: Detecting and analysing mass migration events at alpha ventus. In Ecological Research at the Offshore Windfarm Alpha Ventus, edited by Federal Maritime and Hydrographic Agency and Federal Ministry of the Environment Nature Conservation and Nuclear Safety, 111–32. Berlin, Germany: Springer Spektrum. https://doi.org/10.1007/978-3-658-02462-8.

Howell, J.E., A.E. McKellar, R.H.M. Espie, and C.A. Morrissey. 2019. Predictable Shorebird Departure Patterns from a Staging Site Can Inform Collision Risks and Mitigation of Wind Energy Developments. Ibis, August. https://doi.org/10.1111/ibi.12771.

Hüppop, O., J. Dierschke, K.-M. Exo, E. Fredrich, & R. Hill. 2006. Bird migration studies and potential collision risk with offshore wind turbines. Ibis 148 (March): 90–109. https://doi.org/10.1111/j.1474-919X.2006.00536.x.

Jacobsen, Erik Mandrup, Flemming Pagh Jensen, and Jan Blew. 2019. Avoidance Behaviour of Migrating Raptors Approaching an Offshore Wind Farm. In Wind Energy and Wildlife Impacts: Balancing Energy Sustainability with Wildlife Conservation, edited by Regina Bispo, Joana Bernardino, Helena Coelho, and José Lino Costa, 43–50. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-05520-2_3.

Jakubas D, Wojczulanis-Jakubas K, Iliszko LM, Kidawa D, Boehnke R, Błachowiak-Samołyk K, Stempniewicz L. 2020. Flexibility of little auks foraging in various oceanographic features in a changing Arctic. Sci Rep 10: 8283 https://doi.org/10.1038/s41598-020-65210-x.

Jodice, P. G. R., R. A. Ronconi, E. Rupp, G. E. Wallace, & Y. Satgé. 2015. First satellite tracks of the Endangered Black-capped Petrel. Endangered Species Research 29: 23–33.

Johnston, A., A. S. C. P. Cook, L. J. Wright, E. M. Humphreys, & N. H. K. Burton. 2014. Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology 51 (1): 31–41. https://doi.org/10.1111/1365-2664.12191.

Katzner, T., B. W. Smith, T. A. Miller, D. Brandes, J. Cooper, M. Lanzone, D. Brauning, C. Farmer, S. Harding, D. E. Kramar, C. Koppie, C. Maisonneuve, M. Martell, E. K. Mojica, C. Todd, J. A. Tremblay, M. Wheeler, D. F. Brinker, T. E. Chubbs, R. Gubler, K. O'Malley, S. Mehus, B. Porter, R. P. Brooks, B. D. Watts, & K. L. Bildstein. 2012. Status, biology, and conservation priorities for North America's eastern Golden Eagle (Aquila chrysaetos) population. Auk 129: 168–176.

Kerlinger, P. 1985. Water-crossing behavior of raptors during migration. Wilson Bull. 97: 109–113.

Krijgsveld, K. L., R. C. Fljn, M. Japink, P. W. van Horssen, C. Heunks, M. P. Collier, M. J. M. Poot, D. Beuker, & S. Birksen. 2011. Effect Studies Offshore Wind Farm Egmond aan Zee: Final Report on Fluxes, Flight Altitudes and Behaviour of Flying Birds. Bureau Waardenburg report no. 10-219. Institute for Marine Resources & Ecosystem Studies, Wageningen UR, Netherlands.

Langston, R. H. W. 2013. Birds and wind projects across the pond: A UK perspective. Wildl. Soc. Bull. 37: 5–18.

Lee, D. S. 2000. Status and Conservation Priorities for Black-capped Petrels in the West Indies. Pp. 11–18 *in* Schreiber, E. A. & D. S. Lee (eds). Status and Conservation of West Indian Seabirds. Society of Caribbean Ornithology, Ruston, LA

Leonhard, S. B., J. Pedersen, P. N. Grøn, H. Skov, J. Jansen, C. J. Topping, & I. K. Petersen. 2013. Wind farms affect Common Scoter and Red-throated Diver behaviour. In Danish Offshore Wind: Key Environmental Issues – A Follow-up. The Environment Group: The Danish Energy Agency, The Danish Nature Agency, DONG Energy and Vattenfall, pp. 70–93 (Chapter 5).

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K. L. Krijgsveld, M. Leopold, & M. Scheidat. 2011. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters 6 (3): 035101. https://doi.org/10.1088/1748-9326/6/3/035101.

Loring, P. H., J. D. McLaren, P. A. Smith, L. J. Niles, S. L. Koch, H. F. Goyert, & H. Bai. 2018. Tracking Movements of Threatened Migratory rufa Red Knots in U.S. Atlantic Outer Continental Shelf Waters. OCS Study BOEM 2018-046. US Department of the Interior, Bureau of Ocean Energy Management, Sterling (VA) 145 pp. OCS Study BOEM 2018-046. U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, VA. 145 pp.

Loring, P. H., P. W. C. Paton, J. D. McLaren, H. Bai, R. Janaswamy, H. F. Goyert, C. R. Griffin, & P. R. Sievert. 2019. Tracking offshore occurrence of Common Terns, endangered Roseate Terns, and threatened Piping Plovers with VHF arrays. OCS Study BOEM 2019-017. US Department of the Interior, Bureau of Ocean Energy Management, Sterling, VA. 140 pp. Available at https://espis.boem.gov/final reports/BOEM_2019-017.pdf.

Loring, P.H., J.D. McLaren, H.F. Goyert, and P.W.C. Paton. 2020. Supportive Wind Conditions Influence Offshore Movements of Atlantic Coast Piping Plovers during Fall Migration. Condor 122 (3): 1–16. https://doi.org/10.1093/condor/duaa028.

Loring, P., A. Lenske, J. McLaren, M. Aikens, A. Anderson, Y. Aubrey, E. Dalton, A. Dey, C. Friis, D. Hamilton, B. Holberton, D. Kriensky, D. Mizrahi, L. Niles, K. L. Parkins, J. Paquet, F. Sanders, A. Smith, Y. Turcotte, A. Vitz, & P. Smith. 2021. Tracking Movements of Migratory Shorebirds in the US Atlantic Outer Continental Shelf Region. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-008. 104 p.

Masden, E. A., D. T. Haydon, A. D. Fox, R. W. Furness, R. Bullman, & M. Desholm. 2009. Barriers to movement: impacts of wind farms on migrating birds. ICES J. Mar. Sci. 66: 746–753. Available at http://icesjms.oxfordjournals.org/cgi/doi/10.1093/icesjms/fsp031.

Mateos-Rodríguez, María, and Felix Liechti. 2012. How Do Diurnal Long-Distance Migrants Select Flight Altitude in Relation to Wind? Behavioral Ecology 23 (2): 403–9. https://doi.org/10.1093/beheco/arr204.

Mendel, B., P. Schwemmer, V. Peschko, S. Müller, H. Schwemmer, M. Mercker, & S. Garthe. 2019.

Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). J. Environ. Manage. 231: 429–438.

MMO. 2018. Displacement and habituation of seabirds in response to marine activities. A report produced for the Marine Management Organisation,. MMO Project No: 1139, May 2018, 69 pp. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715604/Displacement_and_habituation_of_seabirds_in_response_to_marine_activities.pdf.

Montevecchi, W.A. 2006. Influences of Artificial Light on Marine Birds. In Ecological Consequences of Artificial Night Lighting, edited by Catherine Rich and Travis Longcore, 94–113. Washington, D.C.: Island Press. https://doi.org/10.1111/bph.13539.

Normandeau Associates, Inc. (Normandeau). 2022. Postconstruction Bird and Bat Monitoring at the Coastal Virginia Offshore Wind Pilot Project, First Annual Report, December 2022. Prepared for Dominion Energy by Normandeau Associates, Inc., Gainsville, FL. 127 pp.

NYSERDA. 2010. Pre-development Assessment of Avian Species for the Proposed Long Island New York City Offshore Wind Project Area. NYSERDA Report No. 9998-03. New York State Energy Research and Development Authority.

NYSERDA. 2015. Master Plan: Shipping and Navigation Study. NYSERDA, no. 15.

O'Connell, A. F., A. T. Gardner, A. T. Gilbert, & K. Laurent. 2009. Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States, Final Report (Database Section - Seabirds). OCS Study BOEM 2012-076. Prepared by the USGS Patuxent Wildlife Research Center, Beltsville, MD. U.S. Department of the Interior, Geological Survey, and Bureau of Ocean Energy Management Headquarters. 362 pp. Available at http://www.gomr.boemre.gov/homepg/espis/espismaster.asp?appid=1.

Percival, S. M. 2010. Kentish Flats Offshore Wind Farm: Diver Surveys 2009-10. Durham, UK.

Peschko, V., B. Mendel, M. Mercker, J. Dierschke, & S. Garthe. 2021. Northern gannets (*Morus bassanus*) are strongly affected by operating offshore wind farms during the breeding season. J. Environ. Manage.: 1–12. Available at https://doi.org/10.1016/j.jenvman.2020.111509.

Petersen, I. K., T. K. Christensen, J. Kahlert, M. Desholm, & A. D. Fox. 2006. Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Report by The National Environmental Research Institute to DONG energy and Vattenfall A/S. 161 pp.

Petersen, I. K., & A. D. Fox. 2007. Changes in bird habitat utilisation around the Horns Rev 1 offshore wind project, with particular emphasis on Common Scoter. Report commissioned by Vattenfall A/S by National Environmental Research Institute, University of Aarhus, Denmark.

Petersen, J.K. and Maim, T. 2006. Offshore Windmill Farms: Threats to or Possibilities for the Marine Environment. Ambio 35 (2): 75–80. http://www.ncbi.nlm.nih.gov/pubmed/16722252.

Rodríguez, A., Dann, P., & Chiaradia, A. 2017. Reducing Light-Induced Mortality of Seabirds: High Pressure Sodium Lights Decrease the Fatal Attraction of Shearwaters. Journal for Nature

Conservation 39: 68–72. https://doi.org/10.1016/j.jnc.2017.07.001.

Schwemmer, P., Pederson, R., Haecker, K., Bocher, P., Fort, J., Mercker, M., Jiguet, F., Elts, J., Marja, R., Piha, M., Rousseau, P., & Garthe, S. (2023). Assessing potential conflicts between offshore wind farms and migration patterns of a threatened shorebird species. Animal Conservation, 26(3), 303–316. https://doi.org/10.1111/acv.12817.

Simons, T. R., D. S. Lee, & J. C. Hanley. 2013. Diablotin (*Pterodroma hasitata*): A biography of the endangered Black-capped Petrel. Marine Ornithology 41: S3–S43.

Skov, H., M. Desholm, S. Heinänen, J. A. Kahlert, B. Laubek, N. E. Jensen, R. Žydelis, & B. P. Jensen. 2016. Patterns of migrating soaring migrants indicate attraction to marine wind farms. Biology Letters 12 (12): 20160804. https://doi.org/10.1098/rsbl.2016.0804.

Skov, H., S. Heinanen, T. Norman, R. M. Ward, S. Mendez-Roldan, & I. Ellis. 2018. ORJIP Bird Collision and Avoidance Study. Final Report - April 2018. Report by NIRAS and DHI to The Cabon Trust, U.K. 247 pp.

Stenhouse, I. J., A. M. Berlin, A. T. Gilbert, M. W. Goodale, C. E. Gray, W. A. Montevecchi, L. Savoy, & C. S. Spiegel. 2020. Assessing the exposure of three diving bird species to offshore wind areas on the U.S. Atlantic Outer Continental Shelf using satellite telemetry. Divers. Distrib. n/a. Available at https://doi.org/10.1111/ddi.13168.

Tjørnløv, R. S., Skov, H., Armitage, M., Barker, M., Jørgensen, J. B., Mortensen, L. O., Thomas, K., Uhrenholdt, T., & 11820296. 2023. Resolving Key Uncertainties of Seabird Flight and Avoidance Behaviours at Offshore Wind Farms: Final report for the study period 2020-2021 (Issue February). https://group.vattenfall.com/uk/contentassets/1b23f720f2694bd1906c007effe2c85a/aowfl_aberdeen_seabird_study_final_report_20_february_2023.pdf.

U.S. Fish and Wildlife Service. 2018. Threatened Species Status for Black-Capped Petrel with a Section 4(d) Rule. Federal Register 83: 50560–50574.

U.S. Fish and Wildlife Service. 2021. Birds of Conservation Concern 2021. Department of the Interior, Falls Church, VA. 48 pp.

Vanermen, N., T. Onkelinx, W. Courtens, M. Van de walle, H. Verstraete, & E. W. M. Stienen. 2015. Seabird avoidance and attraction at an offshore wind farm in the Belgian part of the North Sea. Hydrobiologia 756: 51–61. https://doi.org/10.1007/s10750-014-2088-x.

Wade, H. M., E. A. Masden, A. C. Jackson, & R. W. Furness. 2016. Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments. Marine Policy 70: 108–13. https://doi.org/10.1016/j.marpol.2016.04.045.

Welcker, J., & Nehls, G. 2016. Displacement of Seabirds by an Offshore Wind Farm in the North Sea. Marine Ecology Progress Series 554: 173–82. https://doi.org/10.3354/meps11812.

Williams, K. A., I. J. Stenhouse, E. E. Connelly, & S. M. Johnson. 2015. Mid-Atlantic Wildlife Studies: Distribution and Abundance of Wildlife along the Eastern Seaboard 2012-2014. Biodiversity Research

Institute. Portland, Maine. Science Communications Series BRI 2015-19. 32 pp.

Willmott, J. R., G. Forcey, & A. Kent. 2013. The relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic Outer Continental Shelf: An assessment method and database. OCS Study BOEM 2013-207. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. 275 pp.

Winship, Arliss J., Brian P. Kinlan, Timothy P. White, Jeffery B. Leirness, and J. Christensen. 2018. Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report. OCS Study BOEM 2018-010. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. 67 pp.

### 4.4 Bats

Alerstam T. 2000. Bird migration performance on the basis of flight mechanics and trigonometry. In: Domenici P, Blake RW, editors. Biomechanics in Animal Behaviour. Oxford: BIOS Scientific Publishers. p 105-124

Alerstam T. 2008. Great-circle migration of arctic birds. Proceedings conf. RIN08– Animal Navigation, paper no 23, 9 pp (CD). Royal Institute of Navigation, London

Allen GM. 1923. The red bat in Bermuda. Journal of Mammalogy 4(1):61–61.

Arnett EB, Brown WK, Erickson WP, Fiedler JK, Hamilton BL, Henry TH, Jain A, Johnson GD, Kerns J, Koford RR, Nicholson CP, O'Connell TJ, Piorkowski MD, Tankersley RD Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61–78.

Arnett EB, Baerwald EF. 2013. Impacts of wind energy development on bats: implications for conservation. In: Adams RA, Scott SC, editors. Bat Evolution, Ecology, and Conservation. New York (NY): Springer. p. 435–456.

Arnett EB, Baerwald EF, Mathews F, Rodrigues L, Rodríguez-Durán A, Rydell J, Villegas-Patraca R, Voigt CC. 2016. Impacts of wind energy development on bats: a global perspective. In: Voight C, Kingston T, editors. Bats in the Anthropocene: conservation of bats in a changing world. Springer, Cham. p. 295-323.

Ahlén I, Baagøe H J, Bach L. 2009. Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 90(6):1318–1323.

Bailey LA, Brigham RM, Bohn SJ, Boyles JG, Smit B. 2019. An experimental test of the allotonic frequency hypothesis to isolate the effects of light pollution on bat prey selection. Oecologia 190(2):367–74.

Bauer S, Ens BJ, Klaassen M. 2010. Many routes lead to Rome: potential causes for the multi-route migration system of red knots, *Calidris canutus islandica*. Ecology 91:1822–1831.

Bennett VJ, Hale AM. 2014. Red Aviation Lights on Wind Turbines Do Not Increase Bat–Turbine Collisions. Animal Conservation. 17. 10.1111/acv.12102

Boyles JG, Cryan PM, McCracken GF, Kunz TH. 2011. Economic importance of bats in agriculture. Science 332(6025):41–42.

Brabant, R., Y. Laurent, & B. Jonge Poerink. 2018. First ever detections of bats made by an acoustic recorder installed on the nacelle of offshore wind turbines in the North Sea. 2018 WinMon report 2018. Royal Belgian Institute of Natural Sciences. Available at http://www.vliz.be/imisdocs/publications/320069.pdf.

Bunkley JP, Barber JR. 2015. Noise reduces foraging efficiency in pallid bats (*Antrozous pallidus*). Ethology 121(11):1116–21.

Bunkley JP, McClure CJ, Kleist NJ, Francis CD, Barber JR. 2015. Anthropogenic noise alters bat activity levels and echolocation calls. Global Ecology and Conservation 3:62–71.

Caceres MC, Barclay RM. 2000. *Myotis septentrionalis*. Mammalian species (634):1-4.

Carter TC, Feldhamer GA. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219(2-3):259–68.

Cryan PM. 2008. Mating behavior as a possible cause of bat fatalities at wind turbines. The Journal of Wildlife Management 72(3):845–849.

Cryan PM, Brown AC. 2007. Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation139(1-2):1–11.

Cryan PM, Barclay RM. 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy 90(6):1330–1340.

Cryan PM, Jameson JW, Baerwald EF, Willis CK, Barclay RM, Snider EA, Crichton EG. 2012. Evidence of late-summer mating readiness and early sexual maturation in migratory tree-roosting bats found dead at wind turbines PLoS One 7(10): e47586.

Cryan PM, Gorresen PM, Hein CD, Schirmacher MR, Diehl RH, Huso MM, Hayman DTS, Fricker PD, Bonaccorso FJ, Johnson DH, Heist K, Dalton DC. 2014. Behavior of bats at wind turbines. Proceedings of the National Academy of Sciences 111(42):15126–15131.

Cravens ZM, Boyles JG. 2019. Illuminating the physiological implications of artificial light on an insectivorous bat community. Oecologia 189(1):69–77.

Cravens ZM, Brown VA, Divoll TJ, Boyles JG. 2018. Illuminating prey selection in an insectivorous bat community exposed to artificial light at night. Journal of Applied Ecology 55(2):705–13.

Cravens ZM, Boyles JG. 2019. Illuminating the physiological implications of artificial light on an insectivorous bat community. Oecologia 189(1):69–77.

Davies TW, Bennie J, Gaston KJ. 2012. Street lighting changes the composition of invertebrate communities. Biology Letters 8(5):764–7.

Dowling Z, Sievert PR, Baldwin E, Johnson L, von Oettingen S, Reichard J. 2017. Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA. Sterling (VA): U.S. Department of the Interior, BOEM, Office of Renewable Energy Programs. OCS Study BOEM 2017-054. [published June 2017; accessed 30 October 2020]. https://www.boem.gov/Flight-Activity-and-Offshore-Movements-of-Nano-Tagged-Bats-on-Marthas-Vineyard/

Dowling ZR, O'Dell DI. 2018. Bat Use of an Island off the Coast of Massachusetts. Northeastern Naturalist. 25(3):362-82.

Druecker JD. 1972. Aspects of reproduction in *Myotis volans*, *Lasionycteris noctivagans*, and *Lasiurus cinereus*. Unpublished Ph.D. dissertation, Albuquerque (NM): Department of Biology. University of New Mexico.

Fleming TH, Eby P. 2003. Ecology of bat migration. In: Kunz TH, Fenton MB, editors. Bat Ecology. Chicago (IL): The University of Chicago Press. p. 156–208.

Frick WF, Baerwald EF, Pollock JF, Barclay RM, Szymanski JA, Weller TJ, Russell AL, Loeb SC, Medellin RA, McGuire LP. 2017. Fatalities at wind turbines may threaten population viability of a migratory bat. Biological Conservation 209:172–7.

Geo-Marine, Inc. 2010. New Jersey Department of Environmental Protection Baseline Studies. Final Report Volume II: Avian Studies. [published July 2010; accessed 2020 November]. https://www.nj.gov/dep/dsr/ocean-wind/Ocean%20Wind%20Power%20Ecological%20Baseline%20Studies_Volume%20Two.pdf.

Gill Jr RE, Tibbitts TL, Douglas DC, Handel CM, Mulcahy DM, Gottschalck JC, Warnock N, McCaffery BJ, Battley PF, Piersma T. 2009. Extreme endurance flights by landbirds crossing the Pacific Ocean: ecological corridor rather than barrier Proceedings of the Royal Society B: Biological Sciences 276(1656):447–57.

Griffin DR. 1940. Notes on the life histories of New England cave bats. Journal of Mammalogy 21(2):181–7.

Griffin DR. 1945. Travels of banded cave bats. Journal of Mammalogy 26(1):15–23.

Haddock JK, Threlfall CG, Law B, Hochuli DF. 2019. Light pollution at the urban forest edge negatively impacts insectivorous bats. Biological Conservation 236:17–28.

Hatch SK, Connelly EE, Divoll TJ, Stenhouse IJ, Williams KA. 2013. Offshore Observations of Eastern Red Bats (*Lasiurus borealis*) in the Mid-Atlantic United States Using Multiple Survey Methods. PLoS ONE 8(12): e83803. doi:10.1371/journal.pone.0083803

Hayes MA, Hooton LA, Gilland KL, Grandgent C, Smith RL, Lindsay SR, Collins JD, Schumacher SM, Rabie PA, Gruver JC. 2019. A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities. Ecological Applications 29(4):e01881.

Hedenström A. 2009. Optimal migration strategies in bats. Journal of Mammalogy 90:1298–1309.

Henderson LE, Broders HG. 2008. Movements and resource selection of the northern long-eared myotis *(Myotis septentrionalis)* in a forest—agriculture landscape. Journal of Mammalogy. 15;89(4):952-63.

Hüppop O, Hill R. 2016. Migration phenology and behaviour of bats at a research platform in the south-eastern North Sea. Lutra 59(1-2):5–22.

Jansson S, Malmqvist E, Brydegaard M, Åkesson S, Rydell J. 2020. A Scheimpflug lidar used to observe insect swarming at a wind turbine. Ecological Indicators 117:106578.

Johnson JB, Gates JE, Zegre NP. 2011. Monitoring seasonal bat activity on a coastal barrier island in Maryland, USA. Environmental Monitoring and Assessment 173:685–699.

Jonasson KA, Willis CK. 2012. Hibernation energetics of free-ranging little brown bats. Journal of Experimental Biology 215(12):2141–9.

Lacoeuilhe A, Machon N, Julien JF, Le Bocq A, Kerbiriou C. 2014. The influence of low intensities of light pollution on bat communities in a semi-natural context. PLoS ONE 9(10):e103042. https://doi.org/10.1371/journal.pone.0103042.

Lagerveld S, Poerink BJ, de Vries P. 2015. Monitoring bat activity at the Dutch EEZ in 2014. Report no. C094/15. Wageningen (UR): IMARES.

Lagerveld S, Gerla D, van der Wal J, de Vries P, Brabant R, Stienen E, Deneudt K, Manshanden J, Scholl M. 2017. Spatial and temporal occurrence of bats in the southern North Sea area. Report no. Wageningen University & Research Report C090/17). Wageningen (UR): Wageningen University & Research Centre.

Lagerveld S, Noort CA, Meesters L, Bach L, Bach P, Geelhoed S. 2020. Assessing fatality risk of bats at offshore wind turbines. Report no. C025/20. Wageningen (UR): Wageningen Marine Research. [published March 2020; accessed 2020 November]. https://doi.org/10.18174/518591

Mackiewicz J, Backus RH. 1956. Oceanic records of *Lasionycteris noctivagans* and *Lasiurus borealis*. Journal of Mammalogy 37(3):442–3.

May ML. 2013. A critical overview of progress in studies of migration of dragonflies (Odonata: Anisoptera) with emphasis on North America. Journal of Insect Conservation 17(1):1–5.

Merriam CH. 1887. Do any Canadian bats migrate? Evidence in the affirmative. Transactions of the Royal Society of Canada 4:85–87.

Menzel MA, Owen SF, Ford WM, Edwards JW, Wood PB, Chapman BR, Miller KV. 2002. Roost tree selection by northern long-eared bat (*Myotis septentrionalis*) maternity colonies in an industrial forest of the central Appalachian Mountains. Forest Ecology and Management 155(1-3):107–14.

[NJDEP] New Jersey Department of Environmental Protection. 2018. New Jersey's Wildlife Action Plan. Trenton (NJ): NJDEP Division of Fish and Wildlife.

[NJDFW] New Jersey Division of Fish and Wildlife. 2017. New Jersey Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. 33 pp.

[NYSDEC] New York Department of Environmental Conservation. 2019. Northern Long-eared Bat (Northern Myotis); *Myotis septentrionalis*. [Accessed 7 April 2022] https://www.dec.ny.gov/animals/106713.html.

NYSERDA Metocean Buoys Wildlife Sensors Deployed in Support of Offshore Wind Energy. [published 2021; accessed 15 November 2020]. https://remote.normandeau.com/nys_buoy_overview.php.

Pelletier SK, Omland K, Watrous KS, Peterson TS. 2013. Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities, Final Report. Herndon (VA): U.S. Dept of the Interior, Bureau of Ocean Energy Management, Headquarters. OCS Study BOEM 2013-01163. 119 pp.

Pelletier S, Peterson T. 2013. Wind Power and Bats Offshore: What are the Risks? A Current Understanding of Offshore Bat Activity. Providence (RI): Presentation to the American Wind Power Association Offshore Wind Power, October 2013.

Peterson TS, Pelletier SK, Boyden SA, Watrous KS. 2014. Offshore acoustic monitoring of bats in the Gulf of Maine. Northeastern Naturalist 21(1):86–107.

Peterson T. 2016. Long-term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, Mid-Atlantic, and Great Lakes. Report by Stantec Consulting. Report for US Department of Energy (DOE).

Peurach SC. 2003. High-altitude collision between an airplane and a hoary bat, *Lasiurus cinereus*. Bat Research News 44(1):2–3.

Roby PL, Gumbert MW, Lacki MJ. 2019. Nine years of Indiana bat (*Myotis sodalis*) spring migration behavior. Journal of Mammalogy 100(5):1501–1511.

Russell RW, May ML, Soltesz KL, Fitzpatrick JW. 1998. Massive swarm migrations of dragonflies (Odonata) in eastern North America. The American Midland Naturalist 140(2):325–342.

Russo D, Cosentino F, Festa F, De Benedetta F, Pejic B, Cerretti P, Ancillotto L. 2019. Artificial illumination near rivers may alter bat-insect trophic interactions. Environmental Pollution 252:1671–7.

Rydell J, Entwistle A, Racey PA. 1996. Timing of foraging flights of three species of bats in relation to insect activity and predation risk. Oikos 1:243–52.

Rydell J, Bach L, Dubourg-Savage MJ, Green M, Rodrigues L, Hedenström A. 2010a. Mortality of bats at wind turbines links to nocturnal insect migration. European Journal of Wildlife Research 56(6): 823–827.

Rydell J, Bach L, Dubourg-Savage MJ, Green M, Rodrigues L, Hedenström A. 2010b. Bat mortality at wind turbines in northwestern Europe. Acta Chiropterologica 12(2):261–274.

Shannon HJ. 1916. Insect migrations as related to those of birds. The Scientific Monthly 3(3):227–40.

Schaub A, Ostwald J, Siemers BM. 2008. Foraging bats avoid noise. The Journal of Experimental Biology 211:3174–3180.

Schimpp SA, Li H, Kalcounis-Rueppell MC. 2018. Determining species specific nightly bat activity in sites with varying urban intensity. Urban Ecosystems 21(3):541–550.

Sjollema AL, Gates JE, Hilderbrand RH, Sherwell J. 2014. Offshore activity of bats along the Mid-Atlantic Coast. Northeastern Naturalist 21(2):154–163.

Stone EL, Harris S, Jones G. 2015. Impacts of artificial lighting on bats: a review of challenges and solutions. Mammalian Biology 80(3):213–9.

Stone EL, Jones G, Harris S. 2009. Street lighting disturbs commuting bats. Current Biology 19:1123–1127.

Stone EL, Jones G, Harris S. 2012. Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. Global Change Biology 18(8):2458–65.

Stone EL, Wakefield A, Harris S, Jones G. 2015. The impacts of new street light technologies: experimentally testing the effects on bats of changing from low-pressure sodium to white metal halide. Philosophical Transactions of the Royal Society B: Biological Sciences 370(1667):20140127

Šuba, J., Petersons, G., & Rydell, J. 2012. Fly-and-forage strategy in the bat Pipistrellus nathusii during autumn migration. Acta Chiropterologica,14(2), 379-385.

Szewczak JM. 2018. Echolocation call characteristics of eastern US bats. Arcata (CA): Humboldt State University Bat Lab and SonoBat, USA.

Thomas O. 1921. Bats on migration. Journal of Mammalogy 2:167.

Thompson M, Beston JA, Etterson M, Diffendorfer JE, Loss SR. 2017. Factors associated with bat mortality at wind energy facilities in the United States. Biological Conservation 215:241–245.

Thompson RH, Thompson AR, Brigham RM. 2015. A flock of Myotis bats at sea. Northeastern Naturalist. 22(4).

[USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; 4(d) rule for the northern long-eared bats. Washington (DC): Department of the Interior, Fish and Wildlife Service. CFR81:9 1900-1922.

[USFWS] U.S. Fish and Wildlife Service. 2019. National Listing Workplan 5-year Workplan (May 2019 Version). Washington (DC): Department of the Interior, Fish and Wildlife Service.

[USFWS] U.S. Fish and Wildlife Service. 2023. News Release: U.S. Fish and Wildlife Service Extends Effective Data to Reclassify Northern Long-eared Bat as Endangered. Washington (DC): Department of the Interior, Fish and Wildlife Service. [Accessed 29 March 2023]. https://www.fws.gov/media/extension-effective-date-northern-long-eared-bat-endangered-listing

[USFWS NJFO] U.S. Fish and Wildlife Service, New Jersey Field Office. 2017. NJ Division of Fish & Wildlife, Bat Conservation in Winter. [Updated 8 November 2017, Accessed 7 April 2022]. https://www.state.nj.us/dep/fgw/ensp/bat_winter.htm

Valdez EW, Cryan PM. 2009. Food habits of the hoary bat (*Lasiurus cinereus*) during spring migration through New Mexico. The Southwestern Naturalist 54(2):195–200.

Van Gelder RG, Wingate DB. 1961. The taxonomy and status of bats in Bermuda. American Museum Novitates No. 2029.

Voigt CC, Sörgel K, Šuba J, Keišs O, Pētersons G. 2012. The insectivorous bat *Pipistrellus nathusii* uses a mixed-fuel strategy to power autumn migration. Proceedings of the Royal Society B: Biological Sciences 279(1743):3772–3778.

Voigt CC, Roeleke M, Marggraf L, Pētersons G, Voigt-Heucke SL. 2017. Migratory bats respond to artificial green light with positive phototaxis. PLoS ONE 12(5):e0177748.

Voigt CC, Rehnig K, Lindecke O, Pētersons G. 2018. Migratory bats are attracted by red light but not by warm-white light: Implications for the protection of nocturnal migrants. Ecology and Evolution 8(18):9353–61.

Weaver SP, Hein CD, Simpson TR, Evans JW, Castro-Arellano I. 2020. Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. Global Ecology and Conservation 8:e01099.

Westbrook JK, Nagoshi RN, Meagher RL, Fleischer SJ, Jairam S. 2016. Modeling seasonal migration of fall armyworm moths. International Journal of Biometeorology 60(2):255–67.

Wikelski M, Moskowitz D, Adelman JS, Cochran J, Wilcove DS, May ML. 2006. Simple rules guide dragonfly migration. Biology Letters 2(3):325–329.

Whitaker JO Jr. 1998. Life history and roost switching in six summer colonies of eastern pipistrelles in buildings. Journal of Mammalogy 79(2):651–9.

Zimmerling JR, Francis CM. 2016. Bat mortality due to wind turbines in Canada. The Journal of Wildlife Management 80(8):1360–9.

### 4.5 Benthic Resources

Afsharian, S., Taylor, P.A. 2019: On the potential impact of Lake Erie wind farms on water temperatures and mixed-layer depths: Some preliminary 1-D modeling using COHERENS. J. of Geophy. Res.: Oceans, 124, 1736–1749.

Anderson, EP, Mackas, DL. 1986. Lethal and sublethal effects of a molybdenum mine tailing on marine zooplankton: mortality, respiration, feeding and swimming behavior in Calanus marshallae, Metridia pacifica and Euphausia pacifica. Mar Environ Res. 19(2):131-155.

[ASA] Applied Science Associates, Inc. 2008. Results from Modeling of Sediment Dispersion during Installation of the Proposed Bayonne Energy Center Submarine Cable. Narragansett (RI): ASA Project 2007-025.
http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=28172.

[ASMFC] Atlantic States Marine Fisheries Commission. 2015. Horseshoe Crab (Limulus polyphemus). [published 2015 December; accessed 12 November 2020].
http://www.asmfc.org/uploads/file/5dfd4c1aHorsehoeCrab.pdf.

ASMFC. 2018. Jonah Crab (Cancer borealis). [published 2018 January; accessed 12 November 2020].
http://www.asmfc.org/uploads/file/5dfd4c3cJonahCrab.pdf.

Auld AH, Schubel JR. 1978. Effects of suspended sediment on fish eggs and larvae: a laboratory assessment. Estuarine and Coastal Marine Science 6:153–164.

Balthis WL, Hyland JL, Fulton MH, Wirth EF, Kiddon JA, Macauley J. 2009. Ecological Condition of Coastal Ocean Waters Along the U.S. Mid-Atlantic Bight: 2006. NOAA Technical Memorandum NOS NCCOS 109, NOAA National Ocean Service: Charleston (SC); 29412-9110.

Barnegat Bay Partnership. 2020. Knobbed Whelk (*Busycon carica*). [accessed 12 November 2020).
https://www.barnegatbaypartnership.org/species/knobbed-whelk/.

Berry WJ, Rubinstein NI, Hinchey EK, Klein-MacPhee G, Clarke DG (2011). Assessment of Dredging-Induced Sedimentation Effects on Winter Flounder (Pseudopleuronectes americanus) Hatching Success: Results of Laboratory Investigations, Proceedings of the Western Dredging Association Technical Conference and Texas A&M Dredging Seminar, Nashville, Tennessee, June 5-8, 2011.

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment.

BOEM. 2020. Vineyard Wind 1 Offshore Wind Energy Project Supplement to the Draft Environmental Impact Statement. Sterling (VA): BOEM; OCS EIS/EA BOEM 2020-025.

BOEM 2021a. South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement. Sterling (VA): BOEM; OCS EIS/EA BOEM 2020-057.

Brooks RA, Bell SS, Purdy CN, Sulak KJ. 2004. The benthic community of offshore sand banks: a literature synopsis of the benthic fauna resources in potential MMS OCS sand mining areas. Gainesville (FL): USGS Florida Integrated Science Center, Center for Aquatic Resource Studies. USGS Scientific Investigation Report No. 2004-5198.

Brooks RA, Purdy CN, Bell SS, Sulak KJ. 2006. The benthic community of the eastern U.S. continental shelf: A literature synopsis of benthic faunal resources. *Continental Shelf Research* 26:804-818.Cargnelli LM, Griesbach SJ, Packer DB, Weissberger E. 1999. Essential Fish Habitat Source Document: Atlantic Surfclam, *Spinsula solidissima*, Life History and Habitat Characteristics. Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-142.

Carpenter JR, Merckelbach L, Callies U, Clark S, Gaslikova L, Baschek B. 2016. Potential Impacts of Offshore Wind Farms on North Sea Stratification. PLoS ONE 11(8). https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0160830.

Castelao, R., S. Glenn, and O. Schofield. 2010: Temperature, salinity, and density variability in the central Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 115. C10005.

Chen Z. 2018. Dynamics and Spatio-Temporal Variability of the Mid-Atlantic Bight Cold Pool [doctoral dissertation]. New Brunswick (NJ). Rutgers University.

Chen, Z., and E. N. Curchitser. 2020: Interannual Variability of the Mid-Atlantic Bight Cold Pool. J. Geophys. Res. Oceans, 125. https://doi.org/10.1029/2020JC016445.

Chesapeake Bay Program. 2020. Field Guide. [accessed 12 November 2020]. https://www.chesapeakebay.net/discover/field-guide.

Colden A, Lipcius R. 2015. Lethal and Sublethal Effects of Sediment Burial on the Eastern Oyster, Crassostrea virginica. Marine Ecology Progress Series 527: 105-117. DOI: 10.3354/meps11244.

Corbett W. 2019. The Behavioural and Physiological Effects of Pile-driving Noise on Marine Species. Masters Thesis. University of Exeter.

CSA Ocean Sciences Inc. and Exponent. 2019. Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049. 59 pp.

Ellers O. 1995. Discrimination among wave-generated sounds by a swash-riding clam. Biological Bulletin 189(2): 128-137.

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

English PA et al. 2017. Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report. Norfolk (VA): Fugro Marine GeoServices Inc. and Fugro GB Marine Ltd. OCS Study, BOEM 20147-026.

Essink K. 1999. Ecological effects of dumping of dredged sediments; options for management. Journal of Coastal Conservation 5: 69-80. DOI:10.1007/BF02802741.

Federal Geographic Data Committee (FGDC). 2012. Coastal and Marine Ecological Classification Standard, June 2012. FGDC-STD-018-2012. 353 pp.

Fisheries and Oceans Canada. 2020. Jonah Crab. [accessed 12 November 2020]. https://www.dfo-mpo.gc.ca/species-especes/profiles-profils/jonah-crab-crabe-nordique-eng.html.

Freese L, Auster P, Heifetz J, Wing B. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Marine Ecology Progress Series, 182, 119-126. DOI:10.3354/meps182119.

Ganim J. Cold Pool. 2019.  MARACOOS. Newark (DE): Mid-Atlantic Regional Association Coastal Ocean Observing System; [published 2019 April 23; accessed 12 November 2020]. https://www.integratedecosystemassessment.noaa.gov/regions/northeast/components/cold-pool/.

Greene J, Anderson M, Morse D, Shumway C, Clark M. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One. The Nature Conservancy, Eastern U.S. Division, Boston, MA.

Guarinello M, Carey D, Read LB. 2017. Year 1 Report for 2016 Summer Post-Construction Surveys to Characterize Potential Impacts and Response of Hard Bottom Habitats to Anchor Placement at the Block Island Wind Farm (BIWF). INSPIRE Environmental prepared for Deepwater Wind Block Island LLC. May.

Guida V, Drohan A, Welch H, McHenry J, Johnson D, Kenter V, Brink J, Timmons D, Estela-Gomez E. 2017. Habitat Mapping and Assessment of Northeast Wind Energy Areas. Sterling, VA: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. 312 p.

Harsanyi P, Scott K, Easton BAA, de la Cruz Ortiz G, Chapman ECN, Piper AJR, Rochas CMV, and Lyndon AR. The Effects of Anthropogenic Electromagnetic Fields (EMF) on the Early Development of Two Commercially Important Crustaceans, European Lobster, Homarus gammarus (L.) and Edible Crab, Cancer pagurus (L.). Journal of Marine Science and Engineering,10(5):564. https://doi.org/10.3390/jmse10050564. Hart Crowser IPE, Illingworth and Rodkin, Inc. 2009. Acoustic Monitoring and In-site Exposures of Juvenile Coho Salmon to Pile Driving Noise at the Port of Anchorage Marine Terminal Redevelopment Project, Knik Arm, Anchorage, Alaska. Report by Hart Crowser, Inc./Pentec Environmental and Illingworth and Rodkin, Inc. for URS Corporation for US Department of Transportation, Maritime Administration; Port of Anchorage; and Integrated Concepts and Research Corporation.

Hawkins AD, Pembroke AE, Popper AN. 2015. Information gaps in understanding the effects of noise on fishes and invertebrates. Reviews in Fish Biology and Fisheries 25(1): 39-64. https://doi.org/10.1007/s11160-014-9369-3.

HDR. 2019a. Benthic Monitoring during Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-019.

HDR. 2019b. Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028.

Houghton J, Starkes J, Stutes J, Havey M, Reyff JA, Erikson D. 2010. Acoustic monitoring of in situ exposures of juvenile coho salmon to pile driving noise at the port of Anchorage Marine Terminal redevelopment project, Knik Arm, Alaska. Paper presented at: Alaska Marine Sciences Symposium, Anchorage.

Hutchison ZL, Sigray P, He H, Gill AB, King J, and Gibson C. 2018. Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003.

ICF. 2020. Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2020-041.

JASCO Research Ltd. 2006. Vancouver Island Transmission Reinforcement Project: Atmospheric and Underwater Acoustics Assessment Report. Prepared for British Columbia Transmission Corporation 49 pp.

Johnson A. 2018. The Effects of Turbidity and Suspended Sediments on ESA-Listed Species from Projects Occurring in the Greater Atlantic Region. Greater Atlantic Region Policy Series 18-02. NOAA Fisheries Greater Atlantic Regional Fisheries Office. [accessed 28 February 2019]. http://www.greateratlantic.fisheries.noaa.gov/policyseries.

Kerckhof F, Gegraer S, Norro A, Rumes B. 2011. Offshore intertidal hard substrata: a new habitat promoting non-indigenous species in the Southern North Sea: an exploratory study. Royal Belgian Institute of Natural Sciences. Brussels, Belgium.

Kinlan B, Poti M, Dorfam D, Caldow C, Packer D, Nizinski M. 2016. Model output for deep-sea coral habitat suitability in the U.S. North and Mid-Atlantic from 2013 (NCEI Accession 0145923) [dataset]. [published 2016 April 6; accessed 2020 October]. https://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:145923.

Kjelland ME, Woodley CM, Swannack TM, Smith DL. 2015. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. Environmental Systems and Decisions 35:334–350. DOI 10.1007/s10669-015-9557-2.

Lentz SJ. 2017. Seasonal warming of the Middle Atlantic Bight Cold Pool. Journal of Geophysical Research: Oceans, 122: 941-954.

Leonhard SB, Stenberg C, StØttrup J. 2011. Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities Follow-up Seven Years after Construction. DTU Aqua Report No 246-2011.

Lüedeke J. 2015. Review of 10 Years of Research of Offshore Wind Farms in Germany: The State of Knowledge of Ecological Impacts. Advances in Environmental and Geological Science and Engineering. 8th International Conference on Environmental and Geological Science and Engineering, 2015 June 27-29; Salerno, Italy. p. 25-37.

MacGillivray A. 2018. Underwater noise from pile driving of conductor casing at a deep-water oil platform. The Journal of the Acoustical Society of America. 143(1):450-459.

Madsen PT, Wahlberg M, Tougaard J, Lucke K, Tyack PL. 2006. Wind turbine underwater noise and marine mammals: Implications of current knowledge and data needs. Mar Ecol Prog Ser. 309:279-295.

[MAFMC] Mid-Atlantic Fishery Management Council. 2020. Ocean Quahog Fishery Information Document. [published July 2020; accessed 12 November 2020]. https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/5f21a253ee0fc40b9f984c71/1596039765965/6_2020_OQ_FishInfoDoc_2020_07_27.pdf.

McPherson CR, Quijano JE, Weirathmueller MJ, Hiltz KR, Lucke K. 2019. Browse to North-West-Shelf Noise Modelling Study: Assessing Marine Fauna Sound Exposures. Technical report by JASCO Applied Sciences for Jacobs.

Meißner K, Schabelon H, Bellebaum J, Sordyl H. 2006. Impacts of submarine cables on the marine environment: A literature review. Report by the Institute of Applied Ecology Ltd for the Federal Agency of Nature Conservation, Germany.

Miles, T., Murphy, S., Kohut, J., Borsetti, S., and Munroe, D., 2020. Could federal wind farms influence continental shelf oceanography and alter associated ecological processes? A literature review. Science Center for Marine Fisheries, Rutgers University. [accessed 1 February 2021]. https://scemfis.org/wp-content/uploads/2021/01/ColdPoolReview.pdf.

Morley EL, Jones G, Radford AN. 2014. The importance of invertebrates when considering the impacts of anthropogenic noise. Proceedings of the Royal Society of London Series B. 281(1776).

Mosher J. 1972. The responses of Macoma balthica (bivalvia) to vibrations. Proceedings of the Malacological Society of London 40.

Moum JN, Smyth WD. 2019. Upper Ocean Mixing. Encyclopedia of Ocean Sciences (3rd Edition). 1: 71-79.

Narvaez, D. A., D. M. Munroe, E. E. Hofmann, J. M. Klinck, and E. N. Powell, 2015: Long-term dynamics in Atlantic surfclam (Spisula solidissima) populations: the role of bottom water temperature. Journal of Marine Systems, 141, 136-148.

Nelson GA, Wilcox SH, Glenn R, Pugh TL. 2018. A Stock Assessment of Channeled Whelk in Nantucket Sound, Massachusetts. Massachusetts Division of Marine Fisheries, Technical Report TR-66. [published 2018 April; accessed 12 November 2020]. https://www.mass.gov/files/documents/2018/04/03/TR-66%20Final.pdf.

[NJDEP] New Jersey Department of Environmental Protection. 2021. Garden State North Reef. Trenton (NJ): NJDEP Fish and Wildlife; [published August 2021; accessed 16 March 2023]. https://www.state.nj.us/dep/fgw/pdf/reefs/garden_state_north.pdf.

NMFS. 2021. Updated Recommendations for Mapping Fish Habitat. Gloucester (MA): NMFS GARFO Habitat Conservation and Ecosystem Services Division.

NOAA. 2020. Species Directory. [accessed 12 November 2020]. https://www.fisheries.noaa.gov/species-directory.

NOAA Fisheries. 2022. InPort – NEFSC Bottom Trawl Surveys. [accessed 1 March 2022. https://www.fisheries.noaa.gov/inport/item/22557.

Normandeau, Exponent, Tricas T, and Gill A. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

[NROC] Northeast Regional Ocean Council. 2009. Northeast Ocean Data Portal. [accessed 17 December 2020]. http://www.northeastoceandata.org.

Page HM, Dugan JE, Culver CS, Hoesterey JC. 2006. Exotic invertebrate species on offshore oil platforms. Marine Ecology Progress Series. 325: 101-107.

Page H, Dugan J, Schroder D, Love M, Nishimoto M, Love M, Hoesterey J. 2007. Trophic Links and Condition of a temperate reef fish: Comparisons among offshore oil platform and natural reefs. Marine Ecology Series. 44:245-256.

Paskyabi, M. B., 2015: Offshore Wind Farm Wake Effect on Stratification and Coastal Upwelling. Energy Procedia, 80, 131-140.

Pangerc T, Theobald PD, Wang LS, Robinson SP, Lepper PA. 2016. Measurement and characterisation of radiated underwater sound from a 3.6 MW monopile wind turbine. J Acoust Soc Am. 140(4):2913-2922.

Raox A, Tecchio A, Pezy JP, Lassalle G, Dregaer S, Wilhelmsson D, Cachera M, Ernande B, LeGuen C, Haraldsson M, et al. 2017. Benthic and fish aggregation inside an offshore wind farm: Which effects on the trophic web functioning? Ecological Indicators. 72:33-46.

Rausche F, Beim J. 2012. Analyzing and Interpreting Dynamic Measurements Taken During Vibratory Pile Driving. Paper presented at: International Conference on Testing and Design Methods for Deep Foundations. Kanazawa, Japan.

Roberts L, Elliott M. 2017. Good or bad vibrations? Impacts of anthropogenic vibration on the marine epibenthos. Science of The Total Environment 595: 255-268. https://doi.org/10.1016/j.scitotenv.2017.03.117.

Robinson SP, Lepper PA, Ablitt J. 2007. The measurement of the underwater radiated noise from marine piling including characterisation of a" soft start" period. Paper presented at: OCEANS 2007 - Europe. IEEE; Aberdeen, UK.

Ross SW, Rhode M, Viada ST, Mather R. 2015. Fish species associated with shipwreck and natural hard-bottom habitats from the middle to outer continental shelf of the Middle Atlantic Bight near Norfolk Canyon. NOAA National Marine Fisheries Service. [accessed 14 October 2022] https://spo.nmfs.noaa.gov/sites/default/files/ross.pdf.

Sellheim K, Stachowicz JJ, Coates RC. 2010. Effects of a nonnative habitat-forming species on mobile and sessile epifaunal communities. Marine Ecology Progress Series. 398: 69-80.

Spiga I, Caldwell GS, Bruintjes R. 2016. Influence of Pile Driving on the Clearance Rate of the Blue Mussel, Mytilus edulis (L.). Meetings on Acoustics: Fourth International Conference on the Effects of Noise on Aquatic Life. Volume 27(1), 10–16 Jul 2016, Dublin, Ireland. https://doi.org/10.1121/2.0000277.

Steimle FW, Zetlin C. 2000. Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. Marine Fisheries Review. 62(2).

Stevenson D, Chiarella L, Stephen D, Reid R, Wilhelm K, McCarthy J, Pentony M. 2004. Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat. Woods Hole (MA): NOAA Fisheries; [accessed 18 January 2022]. http://roa.midatlanticocean.org/wp-content/uploads/2016/01/stevenson-et-al-2004.pdf.

[SMAST] University of Massachusetts Dartmouth, School of Marine Science and Technology . 2016. Average (2003-2012) Presence/Abundance from SMAST Survey Northeast United States [dataset]. North Dartmouth (MA): University of Massachusetts Dartmouth, SMAST; [published 2016 April; accessed 14 October 2022]. https://www.northeastoceandata.org/data-explorer/?habitat|biological.

The Nature Conservancy. 2015. Northwest Atlantic Marine Ecosystem Assessment- Soft Sediments (Chapter 3) [dataset]. Arlington (VA): Conservation Gateway; [accessed 2020 December 16].

http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reports data/marine/data/Pages/default.aspx.

Topham E, McMillan D. 2017. Sustainable decommissioning of an offshore wind farm. Renewable Energy. 102:470-480.

Tougaard J, Madsen PT, Wahlberg M. 2008. Underwater noise from construction and operation of offshore wind farms. Bioacoustics. 17(1-3):143-146.

Tougaard J, Carstensen J, Teilmann J. 2009. Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (Phocoena phocoena). Journal of the Acoustical Society of America. 126(1):11-14.

Toupoint, N., L. Gilmore-Solomon, F. Bourque, B. Myrand, F. Pernet, F. Olivier, and R. Tremblay, 2012: Match/mismatch between the Mytilus edulis larval supply and seston quality: effect on recruitment. Ecology, 93, 1922-1934.

Turner, EJ. Miller, DC. 1991. Behavior and growth of Mercenaria during simulated storm events. Mar Biol. 111:55-64.

[URI] University of Rhode Island. 2020. Habitat Restoration-Species Gallery. Kingston (RI): University of Rhode Island; [accessed 1 December 2020]. https://www.edc.uri.edu/restoration/html/gallery/seagrass.htm.

[USACE] United States Army Corps of Engineers. 2017. Deprecated USACE Placement Areas. Washington D.C.: USACE; [published 14 March 2017; updated and accessed 16 March 2023]. https://www.arcgis.com/apps/mapviewer/index.html?layers=aed16678ea814ddc8fdb5d96f723d90b.

[USDA] United States Department of Agriculture. 2021. National Invasive Species Information Center-Aquatic Invertebrates. [accessed 22 January 2021]. https://www.invasivespeciesinfo.gov/aquatic/invertebrates.

[USGS] United States Geological Survey. 2021. NAS-Nonindigenous Aquatic Species. [updated and accessed 15 March 2023]. https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=183.

Voynova, Y. G., M. J. Oliver, and J. H. Sharp. 2013: Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. J. Geophys. Res. Oceans, 118, 6437-6450. doi:10.1002/2013JC008793.

Wahlberg M, Westerberg H. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. Mar Ecol Prog Ser. 288:295-309.

Watling, L and Norse, EA. 1998. Disturbance of the Seabed by Mobile Fishing Gear: A Comparison to Forest Clearcutting. Conservation Biology, 12(6), 1180-1197. https://doi.org/10.1046/j.1523-1739.1998.0120061180.x

West Point Partners, LLC. 2013. Application to the United States Army Corps of Engineers (New York District) for a Department of the Army Individual Permit. Volume 1 of 2. Fairfield (CT): West Point Partners, LLC. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BC191AEEA-9CFF-4D39-9654-E21B59A3629A%7D.

Wilber, DH and Clarke, DG. 2001. Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management, 21: 4, 855-875. https://doi.org/10.1007/s10669-015-9557-2.

Wilber, DH and Clarke, DG. 2007. Defining and assessing benthic recovery following dredging and dredged material disposal. Presentation from the 2007 WODCON XVIII Conference in Lake Buena Vista, FL.

Wilhelmsson D, Malm T, Öhman MC. 2006. The influence of offshore windpower on demersal fish. ICES Journal of Marine Science, 63: 775-784

Woodruff DL, Schultz IR, Marshall KE, Ward JA, Cullinan VI. 2012. Effects of Electromagnetic Fields on Fish and Invertebrates, Task 2.1.3: Effects on Aquatic Organisms Fiscal Year 2011 Progress Report. Prepared for U.S. Department of Energy. Richland, Washington: Pacific Northwest National Laboratory.

Woodruff DL, Schultz IR, Marshall KE, Ward JA, Cullinan VI. 2013. Effects of Electromagnetic Fields on Fish and Invertebrates, Task 2.1.3: Effects on Aquatic Organisms, Fiscal Year 2012 Progress Report. PNNL-22154. Prepared for U.S. Department of Energy. Richland, Washington: Pacific Northwest National Laboratory.

Zykov MM, Bailey L, Deveau TJ, Racca RG. 2013. South Stream Pipeline – Russian Sector – Underwater Sound Analysis. Technical report by JASCO Applied Sciences for South Stream Transport B.V.

### 4.6 Finfish, Invertebrates, and Essential Fish Habitat

Adams PB. 1980. Life history patterns in marine fishes and their consequences for management. NOAA – Fisheries Bulletin. 78(1).

Afsharian, S., Taylor, P.A. 2019: On the potential impact of Lake Erie wind farms on water temperatures and mixed-layer depths: Some preliminary 1-D modeling using COHERENS. J. of Geophy. Res.: Oceans, 124, 1736–1749.

Anderson, EP, Mackas, DL. 1986. Lethal and sublethal effects of a molybdenum mine tailing on marine zooplankton: mortality, respiration, feeding and swimming behavior in Calanus marshallae, Metridia pacifica and Euphausia pacifica. Mar Environ Res. 19(2):131-155.

Andersson MH. 2011. Offshore wind farms – ecological effects of noise and habitat alteration on fish. Stockholm University, Department of Zoology. ISBN 978-91-7447-172-4.

Andersson MH, Dock-Åkerman E, Ubral-Hedenberg R, Öhman MC, Sigray P. 2007. Swimming behavior of roach (Rutilus rutilus) and three-spined stickleback (Gasterosteus aculeatus) in response to wind power noise and single-tone frequencies. Ambio. 36(8):636-638.

André M, Solé M, Lenoir M, Durfort M, Quero C, Mas A, Lombarte A, van der Schaar M, López-Bejar M, Morell M, Zaugg S, and Houégnigan L. 2011. Low-frequency sounds induce acoustic trauma in cephalopods. Frontiers in Ecology and the Environment, 9(9), 489-493. https://doi.org/10.1890/100124.

[ASA] Applied Science Associates, Inc. 2008. Results from Modeling of Sediment Dispersion during Installation of the Proposed Bayonne Energy Center Submarine Cable. Narragansett (RI): ASA Project 2007-025. http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=28172.

[ASMFC] Atlantic States Marine Fisheries Commission. Fisheries Management. 2020. Arlington (VA): ASMFC; [accessed 2020 November 13]. http://www.asmfc.org/fisheries-management/program-overview.

Auld AH, Schubel JR. 1978. Effects of suspended sediment on fish eggs and larvae: a laboratory assessment. Estuarine and Coastal Marine Science 6:153–164.

Baker, K and Howson, U. 2021. Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf Biological Assessment. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. Published October 2018, Revised February 2021. https://www.boem.gov/sites/default/files/documents/renewable-energy/OREP-Data-Collection-BA-Final.pdf.

Balthis WL, Hyland JL, Fulton MH, Wirth EF, Kiddon JA, Macauley J. 2009. Ecological Condition of Coastal Ocean Waters Along the U.S. Mid-Atlantic Bight: 2006. NOAA Technical Memorandum NOS NCCOS 109, NOAA National Ocean Service: Charleston (SC); 29412-9110.

Berrien P, and Subunka J. 1999. Distribution Patterns of Fish Eggs in the U.S. Northeast Continental Shelf Ecosystem, 1977-1987. NOAA Technical Report NMFS 145.

Berry WJ, Rubinstein NI, Hinchey EK, Klein-MacPhee G, Clarke DG (2011). Assessment of Dredging-Induced Sedimentation Effects on Winter Flounder (Pseudopleuronectes americanus) Hatching Success: Results of Laboratory Investigations, Proceedings of the Western Dredging Association Technical Conference and Texas A&M Dredging Seminar, Nashville, Tennessee, June 5-8, 2011.

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia- Final Environmental Assessment. OCS EIS/EA BOEM 2012-003.

BOEM. 2020. Vineyard Wind 1 Offshore Wind Energy Project Supplement to the Draft Environmental Impact Statement. OCS EIS/EA BOEM 2020-025.

BOEM. 2021. South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement. Sterling (VA): BOEM; OCS EIS/EA BOEM 2020-057.

Bolle LJ, de Jong CAF, Bierman SM, van Beek PJ, van Keeken OA, Wessels PW, van Damme CJ, Winter HV, de Haan D, Dekeling RPA. 2012. Common sole larvae survive high levels of pile-driving sound in controlled exposure experiments. PLoS ONE. 7:e33052.

Braun CB, Grande T. 2008. Evolution of Peripheral Mechanisms for the Enhancement of Sound Reception. In: Webb JF, Fay RR, Popper AN, editors. Fish Bioacoustics. NY, USA: Springer. p. 99-144.

Brooks RA, Bell SS, Purdy CN, Sulak KJ. 2004. The benthic community of offshore sand banks: a literature synopsis of the benthic fauna resources in potential MMS OCS sand mining areas. Gainesville (FL): USGS Florida Integrated Science Center, Center for Aquatic Resource Studies. USGS Scientific Investigation Report No. 2004-5198.

Budelmann, BU. 1992. Reprinted from: Webster DB, Popper AN, R. R. Fay RR, editors. The Evolutionary Biology of Hearing. Springer New York. pp. 141-155.

Buerkle U. 1973. Gill-net catches of cod (Gadus morhua L.) in relation to trawling noise. Marine Behaviour and Physiology. 2:277-281.

Carpenter, J. R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016: Potential impacts of offshore wind farms on North Sea stratification. PLoS One, 11. e0160830.

Cargnelli LM, Griesbach SJ, McBride C, Zetlin CA, Morse WW. 1999. Essential Fish Habitat Source Document: Longfin Inshore Squid, *Loligo pealeii*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-146.

Casper BM, Popper AN, Matthews F, Carlson TJ, Halvorsen MB. 2012. Recovery of barotrauma injuries in Chinook salmon, Oncorhynchus tshawytscha from exposure to pile driving sound. PLoS ONE. 7(6):e39593.

Castelao, R., S. Glenn, and O. Schofield. 2010: Temperature, salinity, and density variability in the central Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 115. C10005.

Causon PD, Gill AB. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. Environmental Science and Policy. 89: 340-347.

Chen Z. 2018. Dynamics and Spatio-Temporal Variability of the Mid-Atlantic Bight Cold Pool [doctoral dissertation]. New Brunswick (NJ). Rutgers University.

Chen, Z., and E. N. Curchitser. 2020: Interannual Variability of the Mid-Atlantic Bight Cold Pool. J. Geophys. Res. Oceans, 125. https://doi.org/10.1029/2020JC016445.

Chesapeake Bay Program. 2020. Field Guide. Annapolis (MD): Chesapeake Bay Program; [accessed 2020 December 4]. https://www.chesapeakebay.net/who/contact.

Cones SF, Jézéquel Y, Ferguson S, Aoki N, and Mooney TA. 2022. Pile driving noise induces transient gait disruptions in the longfin squid (Doryteuthis pealeii). Frontiers in Marine Science, 9. https://doi.org/10.3389/fmars.2022.1070290.

CSA Ocean Sciences Inc. and Exponent. 2019. Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049. 59 pp.

De Mesel I, Kerckhof F, Norro A, Rumes B, and Degraer S. 2015. Succession and seasonal dynamics of the epifauna community on offshore wind farm foundations and their role as stepping stones for non-indigenous species. Hydrobiologia, 756(1), 37-50. https://doi.org/10.1007/s10750-014-2157-1.

Dionne PE, Zydlewski GB, Kinnison MT, Zydlewski J, and Wippelhauser GS. 2013. Reconsidering residency: characterization and conservation implications of complex migratory patterns of shortnose sturgeon (Acispenser brevirostrum). Canadian Journal of Fisheries and Aquatic Sciences, 70(1). https://doi.org/10.1139/cjfas-2012-0196

Dunton KJ, Jordaan A, McKown KA, Conover DO, Frisk MG. 2010. Abundance and distribution of Atlantic sturgeon (Acipenser oxyrinchus) within the Northwest Atlantic Ocean, determined from five fishery-independent surveys. Stony Brook (NY): Stony Brook University. Fisheries Bulletin 108: 450–465.

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

English PA et al. 2017. Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report. Norfolk (VA): Fugro Marine GeoServices Inc. and Fugro GB Marine Ltd. OCS Study, BOEM 20147-026.

Essink K. 1999. Ecological effects of dumping of dredged sediments; options for management. Journal of Coastal Conservation 5: 69-80. DOI:10.1007/BF02802741.

Farmer, N.A., Garrison, L.P., Horn, C. et al. The distribution of manta rays in the western North Atlantic Ocean off the eastern United States. Sci Rep 12, 6544 (2022). https://doi.org/10.1038/s41598-022-10482-8

Federal Register. 2018. Endangered and Threatened Wildlife and Plants; Final Rule to List the Giant Manta Ray as Threatened under the Endangered Species Act. A Rule by NOAA on January 22, 2018. [accessed January 29, 2021]. https://www.federalregister.gov/documents/2018/01/22/2018-01031/endangered-and-threatened-wildlife-and-plants-final-rule-to-list-the-giant-manta-ray-as-threatened.

Federal Register 2012. Endangered and Threatened Wildlife and Plants; Threatened and Endangered Status for Distinct Populations Segments of Atlantic Sturgeon in the Northeast Region. A Rule by NOAA on February 6, 2012. [accessed January 29, 2021]. https://www.federalregister.gov/documents/2012/02/06/2012-1946/endangered-and-threatened-wildlife-and-plants-threatened-and-endangered-status-for-distinct.

Fewtrell JL, McCauley RD. 2012. Impact of air gun noise on the behaviour of marine fish and squid. Marine Pollution Bulletin. 64(5):984-993.

Fisheries Hydroacoustic Working Group (FHWG). 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities. 12 Jun 2008 ed.

Freese L, Auster P, Heifetz J, Wing B. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Marine Ecology Progress Series, 182, 119-126. DOI:10.3354/meps182119.

Ganim J. Cold Pool. 2019.  MARACOOS. Newark (DE): Mid-Atlantic Regional Association Coastal Ocean Observing System; [published 2019 April 23; accessed 2020 November 30]. https://www.integratedecosystemassessment.noaa.gov/regions/northeast/components/cold-pool/.

[GARFO] Greater Atlantic Regional Fisheries Office. 2020. GARFO Acoustics Tool: Analyzing the effects of pile driving on ESA-listed species in the Greater Atlantic Region. https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic.

Gedamke J, Harrison J, Hatch LT, Angliss RP, Barlow JP, Berchok CL, Caldow C, Castellote M, Cholewiak DM, DeAngelis ML et al. 2016. Ocean noise strategy roadmap. Washington, DC: National Oceanic and Atmospheric Administration.

Geo-Marine Inc. 2010. NJDEP Ocean/Wind Power Ecological Baseline Studies Final Report - Volume IV: Fish and Fisheries Studies. Plano (TX). https://www.nj.gov/dep/dsr/ocean-wind/.

Gilbert C. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic Bight)- Atlantic and Shortnose Sturgeon. Biological Report 82(11.122).

Golder Associates Inc., 2008. Source water and cooling water data and impingement mortality and entrainment characterization for Monroe power plant. July 2008. Prepared for Detroit Edison Company. Project 063-9564.

Gudger, E. W. 1922. The most northerly record of the capture in Atlantic waters of the United States of the giant ray, Manta birostris. Science 55(1422):338–340.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, E. Estela-Gomez. 2017. Habitat Mapping and Assessment of Northeast Wind Energy Areas. Sterling, VA: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. 312 p.

Guarinello M, Carey D, Read LB. 2017. Year 1 Report for 2016 Summer Post-Construction Surveys to Characterize Potential Impacts and Response of Hard Bottom Habitats to Anchor Placement at the Block Island Wind Farm (BIWF). INSPIRE Environmental prepared for Deepwater Wind Block Island LLC. May.

Halvorsen MB, Casper BM, Woodley CM, Carlson TJ, Popper AN. 2011. Predicting and mitigating hydroacoustic impacts on fish from pile installations. Project 25–28. National Cooperative Highway Research Program Research Results Digest. 363:2011.

Halvorsen MB, Heaney KD. 2018. Propagation characteristics of high-resolution geophysical surveys: open water testing. Prepared by CSA Ocean Sciences Inc. for U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-052.

Hart Crowser IPE, Illingworth and Rodkin, Inc. 2009. Acoustic Monitoring and In-site Exposures of Juvenile Coho Salmon to Pile Driving Noise at the Port of Anchorage Marine Terminal Redevelopment Project, Knik Arm, Anchorage, Alaska. Report by Hart Crowser, Inc./Pentec Environmental and Illingworth and Rodkin, Inc. for URS Corporation for US Department of Transportation, Maritime Administration; Port of Anchorage; and Integrated Concepts and Research Corporation.

Haugen JB, Papastamatiou Y. 2019. Observation of a porbeagle shark Lamna nasus aggregation at a North Sea oil platform. Journal of Fish Biology. DOI: 10.1111/jfb.14149.

HDR. 2019a. Benthic Monitoring during Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-019.

HDR. 2019b. Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028. 281pp.

HDR. 2020. Seafloor Disturbance and Recovery Monitoring at the Block Island Wind Farm, Rhode Island – Summary Report. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2020-019.

Hendrickson LC, Homes EM. 2004. Essential Fish Habitat Source Document: Northerm Shortfin Squic, *Illex illecebrosus*, Life History and Habitat Characteristics, Second Edition. NOAA Technical Memorandum NMFS-NE-191.

Houghton J, Starkes J, Stutes J, Havey M, Reyff JA, Erikson D. 2010. Acoustic monitoring of in situ exposures of juvenile coho salmon to pile driving noise at the port of Anchorage Marine Terminal redevelopment project, Knik Arm, Alaska. Paper presented at: Alaska Marine Sciences Symposium, Anchorage.

Hutchison ZL, Bartley ML, DeGraer S, English P, Khan A, Livermore J, Rumes B, and King JW. 2020. Offshore Wind Energy and Benthic Habitat Changes: Lessons from Block Island Wind Farm. Oceanography, 33(4), 58-69. https://doi.org/10.5670/oceanog.2020.406.

Hutchison ZL, Sigray P, He H, Gill AB, King J, and Gibson C. 2018. Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003.

ICF. 2020. Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations. Prepared for: U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Sterling (VA). OCS Study BOEM 2020-041.

JASCO Research Ltd. 2006. Vancouver Island Transmission Reinforcement Project: Atmospheric and Underwater Acoustics Assessment Report. Prepared for British Columbia Transmission Corporation 49 pp.

Johnson JH, Dropkin DS, Warkentine BE, Rachlin JW, Andrews WD. 1997. Food Habits of Atlantic Sturgeon off the Central New Jersey Coast. Transactions of the American Fisheries Society. 126 (1): 166-170.

Jones IT, Peyla JF, Clark H, Song Z, Stanley JA, and Mooney TA. 2021. Changes in feeding behavior of longfin squid (Doryteuthis pealeii) during laboratory exposure to pile driving noise. Marine Environmental Research, 165, 105250. https://doi.org/10.1016/j.marenvres.2020.105250.

Jones IT, Schumm M, Stanley JA, Hanlon RT, and Mooney TA. 2023. Longfin squid reproductive behaviours and spawning withstand wind farm pile driving noise. ICES Journal of Marine Science, 2023, 1-10. https://doi.org/10.1093/icesjms/fsad117

Jones IT, Stanley JA, Mooney TA. 2020. Impulsive pile driving noise elicits alarm responses in squid (Doryteuthis pealeii). Marine Pollution Bulletin, 150, 110792. https://doi.org/10.1016/j.marpolbul.2019.110792.

Kane J. 2005. The demography of Calanus finmarchicus (Copepoda: Calanoida) in the Middle Atlatnic Bight, USA, 1977 – 2001. Narragansett (RI): NOAA – NMFS.

Klimley AP, Wyman MT, Kavet R. 2017. Chinook salmon and green sturgeon migrate through San Francisco Estuary despite large distortions in the local magnetic field produced by bridges. PLoS ONE, 12(6): e0169031. https://doi.org/10.1371/journal.pone.0169031.

Kohut J, Brodie J. 2019. White Paper-Partners in Science Workshop: Offshore Wind and the Mid-Atlantic Cold Pool. New Brunswick (NJ): Rutgers, The State University of New Jersey; [hosted 2019 July 17; accessed 2020 December 16]. https://rucool.marine.rutgers.edu/wp-content/uploads/2020/10/PartnersWorkshop_WhitePaper_Final.pdf.

Ladich F, Popper AN. 2004. Parallel evolution in fish hearing organs. In: Manley GA, Popper AN, Fay RR, editors. Evolution of the Vertebrate Auditory System NY, USA: Springer-Verlag. p. 98-127.

Lentz SJ. 2017. Seasonal warming of the Middle Atlantic Bight Cold Pool. Journal of Geophysical Research: Oceans, 122: 941-954.

Leonhard SB, Stenberg C, StØttrup J. 2011. Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities Follow-up Seven Years after Construction. DTU Aqua Report No 246-2011.

Madsen PT, Wahlberg M, Tougaard J, Lucke K, Tyack PL. 2006. Wind turbine underwater noise and marine mammals: Implications of current knowledge and data needs. Mar Ecol Prog Ser. 309:279-295.

McGregor F, Richardson AJ, Armstrong AJ, Armstrong AO, and Dudgeon CL. 2019. Rapid wound healing in a reef manta ray masks the extent of vessel strike. PLoS ONE 14(12): e0225681. https://doi.org/10.1371/journal.pone.0225681

McPherson CR, Quijano JE, Weirathmueller MJ, Hiltz KR, Lucke K. 2019. Browse to North-West-Shelf Noise Modelling Study: Assessing Marine Fauna Sound Exposures. Technical report by JASCO Applied Sciences for Jacobs.

Meißner K, Schabelon H, Bellebaum J, Sordyl H. 2006. Impacts of submarine cables on the marine environment: A literature review. Report by the Institute of Applied Ecology Ltd for the Federal Agency of Nature Conservation, Germany.

Miles, T., Murphy, S., Kohut, J., Borsetti, S., and Munroe, D., 2020. Could federal wind farms influence continental shelf oceanography and alter associated ecological processes? A literature review. Science Center for Marine Fisheries, Rutgers University. [accessed 2021 February]. https://scemfis.org/wp-content/uploads/2021/01/ColdPoolReview.pdf.

Miller TJ, Hare JA, Alade LA. 2016. A state-space approach to incorporating environmental effects on recruitment in an age-structured assessment model with an application to southern New England yellowtail flounder. Canadian Journal of Fisheries and Aquatic Sciences, 76(9): 1528-1540.

Mitson RB, Knudsen HP. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquat Living Resour. 16(3):255-263.

Mooney TA, Hanlon RT, Christensen-Dalsgaard J, Madsen PT, Ketten DR, and Nachtigall PE. 2010. Sound detection by the longfin squid (Loligo pealeii) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. The Journal of Experimental Biology 213, 3748-3759. https://doi.org/10.1242/jeb.048348.

Mooney, TA, Samson JE, and Zacarias S. 2016. Loudness-dependent behavioral responses and habituation to sound by the longfin squid (Doryteuthis pealeii). Journal of Comparative Physiology A, 202(7):489-501. DOI:10.1007/s00359-016-1092-1.

Morley EL, Jones G, Radford AN. 2014. The importance of invertebrates when considering the impacts of anthropogenic noise. Proceedings of the Royal Society of London Series B. 281(1776).

Moum JN, Smyth WD. 2019. Upper Ocean Mixing. Encyclopedia of Ocean Sciences (3rd Edition). 1: 71-79.

Mueller-Blenkle C, McGregor PK, Gill AB, Andersson MH, Metcalfe J, Bendall V, Sigray P, Wood DT, Thomsen F. 2010. Effects of Pile-driving Noise on the Behaviour of Marine Fish. COWRIE Ref: Fish 06-08; Cefas Ref: C3371.

[NCDEQ] North Carolina Department of Environmental Quality. 2021. About our Reefs. Raleigh (NC): Division of Marine Fisheries; [accessed 2021 February 1]. http://portal.ncdenr.org/web/mf/about-nc-reefs.

[NJDEP] New Jersey Department of Environmental Protection. 2021. Garden State North Reef. Trenton (NJ): NJDEP Fish and Wildlife; [published August 2021; accessed 16 March 2023]. https://www.state.nj.us/dep/fgw/pdf/reefs/garden_state_north.pdf.

[NMFS] National Marine Fisheries Service. 1998. Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages. https://repository.library.noaa.gov/view/noaa/15971.

NMFS. 2021. Ecology of the Northeast US Continental Shelf. Woods Hole (MA): National Marine Fisheries Service, Northeast Fisheries Science Center; [accessed 2021 October 28]. https://apps-nefsc.fisheries.noaa.gov/nefsc/ecosystem-ecology/zooplankton.html.

NOAA. 2005. Notice of Public Scoping and Intent to Prepare an Environmental Impact Statement. Federal Register. 70(7):1871-1875.

NOAA. 2016. Endangered Species Act Status Review Report: Giant Manta Ray (*Manta birostris*) and Reef Manta Ray (*Manta alfredi*). Silver Springs (MD): National Marine Fisheries Service. https://www.cio.noaa.gov/services_programs/prplans/pdfs/ID353_FinalWorkProduct_MantaRay.pdf.

NOAA. 2020a. Essential Fish Habitat Mapper. Silver Springs (MD): NOAA Office of Habitat Conservation; [updated 2020 November 20; accessed 2022 March]. https://www.habitat.noaa.gov/apps/efhmapper/.

NOAA. 2020b. The Greater Atlantic Region ESA Section 7 Mapper. Gloucester (MA) :Greater Atlantic Regional Fisheries Office; [updated 2019 November; accessed 2021 February 3]. https://www.fisheries.noaa.gov/resource/map/greater-atlantic-region-esa-section-7-mapper.

NOAA. 2020c. Species Directory. Silver Springs (MD): NOAA; [accessed 2020 November 13]. https://www.fisheries.noaa.gov/species-directory.

NOAA. 2020d. What is a benthic habitat map? Silver Springs (MD): NOAA National Ocean Service; [updated 2020 April 7; accessed 2021 February 1]. https://oceanservice.noaa.gov/facts/benthic.html.

NOAA. 2020e. What are Pelagic Fish? Silver Springs (MD): NOAA National Ocean Service; [updated 2020 May 1; accessed 2021 February 1]. https://oceanservice.noaa.gov/facts/pelagic.html.

NOAA. 2021a. Species Directory – ESA Threatened and Endangered. Silver Springs (MD): NOAA Fisheries; [accessed 2021 January 26]. https://www.fisheries.noaa.gov/species-directory/threatened-endangered.

NOAA. 2021b. Fisheries Glossary-Voices of the Bay. Silver Springs (MD): National Marine Sanctuaries; (accessed 2021 February 1). https://sanctuaries.noaa.gov/education/voicesofthebay/glossary.html.

NOAA. 2021c. Essential Fish (EFH) Habitat Mapper. accessed September 24, 2018. https://www.habitat.noaa.gov/protection/efh/efhmapper/.

NOAA Fisheries. 2022. InPort – NEFSC Bottom Trawl Surveys. [accessed 1 March 2022. https://www.fisheries.noaa.gov/inport/item/22557.

Normandeau, Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

[NROC] Northeast Regional Ocean Council. 2009. Northeast Ocean Data Portal. [accessed 17 December 2020]. http://www.northeastoceandata.org.

[NYSDEC]. New York States Department of Environmental Conservation. 2022. Shortnose Sturgeon. [accessed 25 March 2022]. https://www.dec.ny.gov/animals/26012.html.

Olsen K, Agnell J, Pettersen F, Løvik A. 1983. Observed fish reactions to a surveying vessel with special reference to herring, cod, capelin and polar cod. FAO Fisheries Reports. 300:131-138.

Ona E, Godø OR, Handegard NO, Hjellvik V, Patel R, Pedersen G. 2007. Silent research vessels are not quiet. J Acoust Soc Am. 121(4):EL145-EL150.

Orr TL, Herz SM, Oakley DL. 2013. Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments. OCS Study. BOEM 2013-0116.

Pangerc T, Theobald PD, Wang LS, Robinson SP, Lepper PA. 2016. Measurement and characterisation of radiated underwater sound from a 3.6 MW monopile wind turbine. J Acoust Soc Am. 140(4):2913-2922.

Paskyabi, M. B., 2015: Offshore Wind Farm Wake Effect on Stratification and Coastal Upwelling. Energy Procedia, 80, 131-140.

Paxton AB, Newton EA, Adler AM, Van Hoeck RV, Iversen ES, Taylor J, Peterson CH, Silliman BR. 2020. Artificial habitats host elevated densities of large reef-associated predators. PLoS ONE 15(9). https://doi.org/10.1371/journal.

Popper AN, Fay RR. 2011. Rethinking sound detection by fishes. Hear Res. 273(1):25-36.

Popper AN, Hastings MC. 2009. The effects of human-generated sound on fish. Integr Zool. 4(1):43-52.

Popper AN, Hawkins AD, Fay RR, Mann DA, Bartol S, Carlson TJ, Coombs S, Ellison WT, Gentry RL, Halvorsen MB et al. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA Press and Springer.

Purser J, Radford AN. 2011. Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (Gasterosteus aculeatus). PLoS ONE. 6(2):e17478.

Rausche F, Beim J. 2012. Analyzing and Interpreting Dynamic Measurements Taken During Vibratory Pile Driving. Paper presented at: International Conference on Testing and Design Methods for Deep Foundations. Kanazawa, Japan.

Reubens JT, Degraer S, Vincx M. 2011. Aggregation and feeding behaviour of pouting (Trisopterus luscus) at wind turbines in the Belgian part of the North Sea. Fisheries Research, 108(1), 223-227. https://doi.org/10.1016/j.fishres.2010.11.025.

Riefolo L, Lanfredi C, Azzellino A, Tomasicchio GR, Felice DA, Penchev V, Vicinanza D. 2016. Offshore wind turbines: an overview of the effects on the marine environment. Paper presented at: 26th International Ocean and Polar Engineering Conference. International Society of Offshore and Polar Engineers; Rhodes, Greece.

Ross SW, Rhode M, Viada ST, Mather R. 2015. Fish species associated with shipwreck and natural hard-bottom habitats from the middle to outer continental shelf of the Middle Atlantic Bight near Norfolk Canyon. NOAA National Marine Fisheries Service. [accessed 14 October 2022] https://spo.nmfs.noaa.gov/sites/default/files/ross.pdf.

[SAFMC] South Atlantic Fishery Management Council. 2021. Artificial Reef Habitats. North Charleston (SC): SAFMC; [accessed 2021 February 1]. https://safmc.net/uncategorized/artificial-reef-habitats/.

Sage LE, SS Herman. 1972. Zooplankton of Sandy Hook Bay, New Jersey. Chesapeake Science. 13(1): 29-39.

Sarà G, Dean JM, D'Amato D, Buscaino G, Oliveri A, Genovese S, Ferro S, Buffa G, Lo Martire M, Mazzola S. 2007. Effect of boat noise on the behaviour of bluefin tuna Thunnus thynnus in the Mediterranean Sea. Mar Ecol Prog Ser. 331:243-253.

Schwarz AL, Greer GL. 1984. Responses of Pacific Herring, Clupea harengus pallasi, to Some Underwater Sounds. Can J Fish Aquat Sci. 41(8):1183-1192.

Sherk JA, O'Connor JM, Neumann DA, Prince RD, Wood KV. 1974. Effects of suspended and deposited sediments on estuarine organisms. Phase II. University of Maryland Natural Resources Institute, Reference 74-20.

Sherman K, Lasker R, Richards W, Kendall A. 1983. Ichthyoplankton and Fish Recruitment Studies in Large Marine Ecosystems. Marine Fisheries Review 45 (10-12).

Slacum HW, Burton WH, Methratta ET, Weber, ED, Llansó RJ, Dew-Baxter J. 2010. Assemblage Structure in Shoal and Flat- Bottom Habitats on the Inner Continental Shelf of the Middle Atlantic Bight, USA. Marine and Coastal Fisheries, 2(1): 277-298.

Soria, M, Fréon P, Gerlotto F. 1996. Analysis of vessel influence on spatial behaviour of fish schools using a multi-beam sonar and consequences for biomass estimates by echo-sounder. ICES Journal of Marine Science 53(2): 453-458. https://doi.org/10.1006/jmsc.1996.0064.

Sogard SM, Able KW, Fahay MP. 1992. Early life history of the tautog, *Tautog onitis*, in the Mid-Atlantic Bight. NOAA Fishery Bulletin, U.S., 90: 529-539.

Solé M, Lenoir M, Durfort M, López-Bejar M, Lombarte A, van der Schaar M, and André M. 2013. Does exposure to noise from human activities compromise sensory information from cephalopod statocysts? Deep Sea Research Part II: Topical Studies in Oceanography, 95, 160-181. https://doi.org/10.1016/j.dsr2.2012.10.006.

Solé M, Sigray P, Lenoir M, van der Schaar M, Lalander E, and André M. 2017. Offshore exposure experiments on cuttlefish indicate received sound pressure and particle motion levels associated with acoustic trauma. Scientific Reports, 7, 45899. https://doi.org/10.1038/srep45899.

Solé M, De Vreese S, Fortuño JM, van der Schaar M, Sánchez AM, and André M. 2022. Commercial cuttlefish exposed to noise from offshore windmill construction show short-range acoustic trauma. Environmental Pollution, 312(1), 119853. https://doi.org/10.1016/j.envpol.2022.119853.

Stadler JH, Woodbury DP. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. Paper presented at: Inter-Noise 2009: Innovations in Practical Noise Control. Ottawa, Canada.

Steimle FW, Figley W. 1996. The Importance of Artificial Reef Epifauna to Black Sea Bass Diets in the Middle Atlantic Bight. North American Journal of Fisheries Management. 16: 433-439.

Steimle FW, Zetlin C. 2000. Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. Marine Fisheries Review. 62(2).

Stein AB, Friedland FD, Sutherland M. 2004a. Atlantic Sturgeon Marine Distribution and Habitat Use along the Northeastern Coast of the United States. Transactions of the American Fisheries Society. 133: 527–537.

Stein AB, Friedland FD, Sutherland M. 2004b. Atlantic Sturgeon Marine Bycatch and Mortality on the Continental Shelf of the Northeast United States. North American Journal of Fisheries Management. 24:171–183.

Stenberg C, Støttrup JG, van Deurs M, Berg CW, Dinesen GE, Mosegaard H, Grome TM, Leonhard SB. 2015. Long-term effects of an offshore wind farm in the North Sea on fish communities. Mar Ecol Prog Ser. 528:257-265.

Stevens BG, Schweitzer C, Price A. 2019. Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight. Final Report to the Atlantic Coastal Fish Habitat Partnership.

Steves BP, Cowen RK, Malchoff MH. 1999. Settlement and Nursery Habitats for Demersal Fishes on the Continental Shelf of the New York Bight. Fish. Bull. 98:167–188.

Suedel BC, McQueen AD, Wilkens JL, and Fields MP. 2019. Evaluating Effects of Dredging-Induced Underwater Sound on Aquatic Species: A Literature Review. ERDC/EL TR-19-18. Vicksburg (MI): U.S. Army Corps of Engineers – Engineer Research and Development Center; [accessed 2023 March 11]. https://erdc-library.erdc.dren.mil/jspui/handle/11681/34245.

Sullivan MC, Cowen RK, Steves BP. 2005. Evidence for atmosphere-ocean forcing of yellowtail flounder (Limanda ferruginea) recruitment in the Middle Atlantic Bight. Fisheries Oceanography, 14(5):386-399.

The Nature Conservancy. 2015. Northwest Atlantic Marine Ecosystem Assessment- Soft Sediments (Chapter 3) [dataset]. Arlington (VA): Conservation Gateway; [accessed 2020 December 16]. http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/data/Pages/default.aspx.

Thomsen F, Lüdemann K, Kafemann R, Piper W. 2006. Effects of offshore wind farm noise on marine mammals and fish. Hamburg, Germany: Report by Biola for COWRIE Ltd.

Topham E, McMillan D. 2017. Sustainable decommissioning of an offshore wind farm. Renewable Energy. 102:470-480.

Tougaard J, Madsen PT, Wahlberg M. 2008. Underwater noise from construction and operation of offshore wind farms. Bioacoustics. 17(1-3):143-146.

Turner, EJ. Miller, DC. 1991. Behavior and growth of Mercenaria during simulated storm events. Mar Biol. 111:55-64.

[USACE] United States Army Corps of Engineers. 2017. Deprecated USACE Placement Areas. Washington D.C.: USACE; [published 14 March 2017; updated and accessed 16 March 2023]. https://www.arcgis.com/apps/mapviewer/index.html?layers=aed16678ea814ddc8fdb5d96f723d90b.

[USDOE] US Department of Energy, Minerals Management Service. (2009). Final Environmental Impact Statement for the Proposed Cape Wind Energy Project, Nantucket Sound, Massachusetts (Adopted), DOE/EIS-0470. Retrieved from https://www.boem.gov/Cape-Wind-FEIS/.

Vabø R, Olsen K, Huse I. 2002. The effect of vessel avoidance of wintering Norwegian spring spawning herring. Fish Res. 58(1):59-77.

Vanhellemont Q, Ruddick K. 2014. Turbid wakes associated with offshore wind turbines observed with Landsat 8. Remote Sensing of Environment, 145: 105-115.

Voynova, Y. G., M. J. Oliver, and J. H. Sharp. 2013: Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. J. Geophys. Res. Oceans, 118, 6437-6450. doi:10.1002/2013JC008793.

Wahlberg M, Westerberg H. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. Mar Ecol Prog Ser. 288:295-309.

Walsh HJ, Richardson DE, Marancik KE, and Hare JA. 2015. Long-Term Changes in the Distributions of Larval and Adult Fish in the Northeast U.S. Shelf Ecosystem. PLoS ONE, 10(9): e0137382. DOI:10.1371/journal.pone.0137382.

Watling, L and Norse, EA. 1998. Disturbance of the Seabed by Mobile Fishing Gear: A Comparison to Forest Clearcutting. Conservation Biology, 12(6), 1180-1197. https://doi.org/10.1046/j.1523-1739.1998.0120061180.x.

West Point Partners, LLC. 2013. Application to the United States Army Corps of Engineers (New York District) for a Department of the Army Individual Permit. Volume 1 of 2. Fairfield (CT): West Point Partners, LLC. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BC191AEEA-9CFF-4D39-9654-E21B59A3629A%7D.

White SL, Johnson R, Lubinski BA, Eackles MS, Secor DH, and Kazyak DC. 2021. Stock Composition of the Historical New York Bight Atlantic Sturgeon Fishery Revealed through Microsatellite Analysis of Archived Spines. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 13:720–727. https://doi.org/10.1002/mcf2.10187.

Wiernicki CJ, Liang D, Bailey H, and Secor DH. 2020. The Effect of Swim Bladder Presence and Morphology on Sound Frequency Detection for Fishes. Reviews in Fisheries Science and Aquaculture, 28(4), 459-477. https://doi.org/10.1080/23308249.2020.1762536.

Wilber, DH and Clarke, DG. 2001. Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management, 21: 4, 855-875.

Wilber, DH and Clarke, DG. 2007. Defining and assessing benthic recovery following dredging and dredged material disposal. Presentation from the 2007 WODCON XVIII Conference in Lake Buena Vista, FL.

Wilber DH, Brown L, Griffin M, DeCelles GR, and Carey DA. 2022. Demersal fish and invertebrate catches relative to construction and operation of North America's first offshore wind farm. ICES Journal of Marine Science, 2022, 0, 1–15. DOI:10.1093/icesjms/fsac051.

Wilhelmsson D, Malm T, Öhman MC. 2006. The influence of offshore windpower on demersal fish. ICES Journal of Marine Science, 63: 775-784.

Woodruff DL, Schultz IR, Marshall KE, Ward JA, Cullinan VI. 2013. Effects of Electromagnetic Fields on Fish and Invertebrates, Task 2.1.3: Effects on Aquatic Organisms, Fiscal Year 2012 Progress Report. PNNL-22154. Prepared for U.S. Department of Energy. Richland, Washington: Pacific Northwest National Laboratory.

Wysocki LE, Amoser S, Ladich F. 2007. Diversity in ambient noise in European freshwater habitats: Noise levels, spectral profiles, and impact on fishes. J Acoust Soc Am. 121(5):2559-2566.

Zykov MM, Bailey L, Deveau TJ, Racca RG. 2013. South Stream Pipeline – Russian Sector – Underwater Sound Analysis. Technical report by JASCO Applied Sciences for South Stream Transport B.V.

### 4.7 Marine Mammals

[BOEM] Bureau of Ocean Energy Management. 2012. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017. Final Programmatic Environmental Impact Statement. US Department of the Interior. BOEM 2012-030. https://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing/Five_Year_Program/2012-2017_Five_Year_Program/2012-2017_Final_PEIS.pdf.

[BOEM] Bureau of Ocean Energy Management. 2014. Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Area Final Programmatic Environmental Impact Statement http://www.boem.gov/BOEM-2014-001-v1/.

[CeTAP] Cetacean and Turtle Assessment Program, University of Rhode Island. 1982. A Characterization of marine mammals and turtles in the mid- and North Atlantic aeas of the US Outer Continental Shelf, final report. Contract AA551-CT8-48. Bureau of Land Management, Washington, DC.

[CWFNJ] Conserve Wildlife Foundation of New Jersey. 2015. Harbor Seals in New Jersey https://www.arcgis.com/apps/MapJournal/index.html?appid=d2266f32c36449e0b9630453e56c3888&webmap=564588c5cff04fa990aab644400475f9. (accessed 27 Oct 2020).

[DoN] Department of the Navy (US). 2005. Marine resources assessment for the Northeast operating areas: Atlantic City, Narragansett Bay, and Boston--Report PDF. Department of the Navy, US Fleet Forces Command, Norfolk, VA, USA.

[DoN] Department of the Navy (US). 2008. Request for Regulations and Letters of Authorization for the Incidental Harassment of Marine Mammals Resulting from Navy Training Activities Conducted within the Northwest Training Range Complex. 323 p.

[GARFO] Greater Atlantic Regional Fisheries Office. 2021. Whale Watching and Wildlife Viewing in New England and the Mid-Atlantic (Marine Life Viewing Guidelines). Available online at https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-viewing-guidelines/whale-watching-and-wildlife-viewing-new (website last updated on 04/28/2021).

[HESS] High Energy Seismic Survey. 1999. High Energy Seismic Survey Review Process and Interim Operational Guidelines for Marine Surveys Offshore Southern California. Prepared for the California State Lands Commission and the United States Minerals Management Service Pacific Outer Continental Shelf Region by the High Energy Seismic Survey Team, Camarillo, CA, USA. 98 p. https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB2001100103.xhtml.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2011a. 2010 Annual Report to the Inter-Agency Agreement M10PG00075/0001: A Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the western North Atlantic Ocean. https://nefsc.noaa.gov/psb/AMAPPS/docs/Final_2010AnnualReportAMAPPS_19Apr2011.pdf.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2011b. 2011 Annual Report to the Inter-Agency Agreement M10PG00075/0001: A Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the western North Atlantic Ocean. https://nefsc.noaa.gov/psb/AMAPPS/docs/NMFS_AMAPPS_2011_annual_report_final_BOEM.pdf.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2012. 2012 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean. https://nefsc.noaa.gov/psb/AMAPPS/docs/NMFS_AMAPPS_2012_annual_report_FINAL.pdf.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2014a. 2013 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean. https://nefsc.noaa.gov/psb/AMAPPS/docs/NMFS_AMAPPS_2013_annual_report_FINAL3.pdf.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2014b. 2014 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean. https://nefsc.noaa.gov/psb/AMAPPS/docs/NMFS_AMAPPS_2014_annual_report_Final.pdf.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2015. 2015 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean – AMAPPS II. https://doi.org/10.25923/kxrc-g028.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2016. 2016 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean – AMAPPS II. https://doi.org/10.25923/gbap-g480.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2018. 2017 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean – AMAPPS II. https://doi.org/10.25923/q4ae-aa65.

[NEFSC] Northeast Fisheries Science Center and [SEFSC] Southeast Fisheries Science Center. 2019. 2018 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean – AMAPPS II. https://repository.library.noaa.gov/view/noaa/22040.

[NMFS] National Marine Fisheries Service (US). 1991. Final Recovery Plan for the Humpback Whale (Megaptera novaeangliae). Report by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD, USA. 105 p. https://repository.library.noaa.gov/view/noaa/15993.

[NMFS] National Marine Fisheries Service (US). 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. US Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59. 167 p. https://www.fisheries.noaa.gov/webdam/download/75962998.

[NOAA] National Oceanic and Atmospheric Administration (US). 2005. Notice of Public Scoping and Intent to Prepare an Environmental Impact Statement. Federal Register 70(7): 1871-1875. https://www.govinfo.gov/content/pkg/FR-2005-01-11/pdf/05-525.pdf.

[NYSERDA] New York State Energy Research and Development Authority. 2017. New York State Offshore Wind Master Plan Marine Mammals and Sea Turtles Study Final Report. Prepared by Ecology and Environment Engineering, P.C. NYSERDA Report 17-25L.

[USFWS] US Fish and Wildlife Service. 2019. West Indian manatee Trichechus manatus. [accessed 17 Oct 2019]. https://www.fws.gov/southeast/wildlife/mammals/manatee.

Abend, A.G. and T.D. Smith. 1999. Review of the distribution of the long-finned pilot whale (Globicephala melas) in the North Atlantic and Mediterranean. In: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, and Northeast Fisheries Science Center. Volume 117. NOAA Technical Memorandum NMFS-NE-117. 1-22 p. http://www.nefsc.noaa.gov/nefsc/publications/tm/tm117/tm117.pdf.

American Cetacean Society. 2018. Pilot Whale © Copyright 2018 by the American Cetacean Society. https://www.acsonline.org/index.php?option=com_content&view=article&id=65:pilot-whale&catid=20:site-content.

Baird, R.W. and P.J. Stacey. 1991. Status of Risso's dolphin, Grampus griseus, in Canada. Canadian Field-Naturalist 105(2): 233-242.

Barco, S., W. McLellan, J. Allen, R. Asmutis-Silvia, R. Mallon-Day, E. Fougeres, D. Pabst, J. Robbins, R. Seton, et al. 2002. Population identity of humpback whales. Journal of Cetacean Research and Management 4: 135-141.

Barlas, M.E. 1999. The distribution and abundance of harbor seals (Phoca vitulina concolor) and gray seals (Halichoerus grypus) in southern New England, winter 1998-summer 1999. PhD Thesis. Boston University.

Barlow, J.P. 1988. Harbor porpoise, Phocoena phocoena, abundance estimation for California, Oregon, and Washington. I: Ship surveys. Fishery Bulletin 86(3): 417-432. https://www.st.nmfs.noaa.gov/spo/FishBull/863/barlow.pdf.

Barlow, J.P. and P.J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78(2): 535-546. https://doi.org/10.1890/0012-9658(1997)078[0535:ANBIAT]2.0.CO;2.

Baumgartner, M.F., S.M. Van Parijs, F.W. Wenzel, C.J. Tremblay, H.C. Esch, and A.M. Warde. 2008. Low frequency vocalizations attributed to sei whales (Balaenoptera borealis). Journal of the Acoustical Society of America 124(2): 1339-1349. https://doi.org/10.1121/1.2945155.

Bel'kovich, V.M. 1960. Some biological observations on the white whale from the aircraft. Zoologicheskii Zhurnal 39(9): 1414-1422.

Bellmann, M.A., A. May, T. Wendt, S. Gerlach, P. Remmers, and J. Brinkmann. 2020. Unterwasserschall während des Impulsrammverfahrens: Einflussfaktoren auf Rammschall und technische Möglichkeiten zur Einhaltung von Lärmschutzwerten. Report by ITAP GmbH, Oldenburg, Germany. https://www.itap.de/media/erfahrungsbericht_rammschall_era-bericht_.pdf

Bergström, L., F. Sundqvist, and U. Bergström. 2013. Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community. Marine Ecology Progress Series 485: 199-210. https://doi.org/10.3354/meps10344.

Biedron, I., N. Mihnovets, A. Warde, J. Michalec, C.W. Clark, C. Diamond, B. Estabrook, B. Howard, C. McCarthy, et al. 2009. Determining the seasonal distribution of cetaceans in New York coastal waters using passive acoustic monitoring. Abstracts, Eighteenth Biennial Conference on the Biology of Marine Mammals. 12-16 Oct 2009, Quebec City, Canada. p. 34.

Bonner, W.N. 1971. Grey seal Halichoerus grypus fabricus. In Ridgway, S.H. and H.J. Harrison (eds.). Handbook of Marine Mammals. Academic Press, London.

Bowers-Altman, J. and NJ Division of Fish and Wildlife. 2009. Species Status Review of Marine Mammals: Final Report. Report by the NJ Division of Fish and Wildlife, Endangered and Nongame Species Program. https://www.state.nj.us/dep/fgw/ensp/pdf/marine_mammal_status_rprt.pdf.

Brown, D.M., J. Robbins, P.L. Sieswerda, R. Schoelkopf, and E.C.M. Parsons. 2017. Humpback whale (Megaptera novaeangliae) sightings in the New York-New Jersey harbor estuary. Marine Mammal Science 34(1): 250-257. https://doi.org/10.1111/mms.12450.

Brown, M.W., D. Fenton, K. Smedbol, C. Merriman, K. Robichaud-Leblanc, and J.D. Conway. 2009. Recovery Strategy for the North Atlantic Right Whale (Eubalaena glacialis) in Atlantic Canadian Waters [Final]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada. 66 p.

Caldwell, D.K., and M.C. Caldwell. 1966. Observations on the distribution, coloration, behavior and audible sound production of the spotted dolphin, Stenella plagiodon (Cope). Los Angeles County Museum Contribution to Science 104: 1-28.

Charif, R.A., D.K. Mellinger, K.J. Dunsmore, K.M. Fristrup, and C.W. Clark. 2002. Estimated source levels on fin whale (Balaenoptera physalus) vocalizations: Adjustment for surface interference. Marine Mammal Science 18(1): 81-98. https://doi.org/10.1111/j.1748-7692.2002.tb01020.x.

Clark, C.W. and G.C. Gagnon. 2002. Low-frequency vocal behaviors of baleen whales in the North Atlantic: Insights from IUSS detections, locations and tracking from 1992 to 1996. U.S. Navy Journal of Underwater Acoustics 52(3): 609-640.

Clark, C.W. and P.J. Clapham. 2004. Acoustic monitoring on a humpback whale (Megaptera novaeangliae) feeding ground shows continual singing into late spring. The Royal Society of London. Volume 271(1543). pp. 1051-1058. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1691688/pdf/15293859.pdf.

Clark, C.W. and W.T. Ellison. 2004. Potential use of low-frequency sounds by baleen whales for probing the environment: Evidence from models and empirical measurements. In Thomas, J.A., C. Moss, and M. Vater (eds.). Echolocation in Bats and Dolphins. The University of Chicago Press, Chicago. pp. 564-582.

Cole, T., A. Glass, P.K. Hamilton, P. Duley, M. Niemeyer, C. Christman, R.M. Pace, III, and T. Frasier. 2009. Potential mating ground for North Atlantic right whales off the northeast USA. 18th Biennial Conference on the Biology of Marine Mammals, 12-16 Oct 2009, Quebec, Canada.

Copping, A., N. Sather, L. Hanna, J. Whiting, G. Zydlewski, G. Staines, A.B. Gill, I. Hutchison, A. O'Hagan, et al. 2016. Annex IV 2016 state of the science report: Environmental effects of marine renewable energy development around the world. Report by Pacific Northwest National Laboratory for US Department of Energy (the Annex IV Operating Agent) and other partnering nations under the International Energy Agency (IEA) Ocean Energy Systems Initiative (OES). 224 p. https://tethys.pnnl.gov/sites/default/files/publications/Annex-IV-2016-State-of-the-Science-Report_LR_0.pdf.

Curtice, C., J. Cleary, E. Shumchenia, and P.N. Halpin. 2019. Marine-life Data and Analysis Team (MDAT) Technical Report on the Methods and Development of Marine-life Data to Support Regional Ocean planning and Management. Report for the Marine-life Data and Analysis Team (MDAT). http://seamap.env.duke.edu/models/MDAT/MDAT-Technical-Report.pdf.

Davies, J.L. 1957. The Geography of the Gray Seal. Journal of Mammalogy 38(3): 297-310. https://doi.org/10.2307/1376229.

Davis, G.E., M.F. Baumgartner, P.J. Corkeron, J. Bell, C. Berchok, J.M. Bonnell, J.B. Thornton, S. Brault, G.A. Buchanan, D.M. Cholewiak, C.W. Clark, J. Delarue, L.T. Hatch, H.Klinck, S.D. Kraus, B. Martin, D.K. Mellinger, H. Moors-Murphy, S. Nieukirk, D.P. Nowacek, S.E. Parks, D. Parry, N. Pegg, A.J. Read, A.N. Rice, D. Risch, A. Scott, M.S. Soldevilla, K.M. Stafford, J.E. Stanistreet, E. Summers, S. Todd, and S.M. Van Parijs. 2020. Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. Glob Change Biol. 00:1-29. https://doi.org/10.1111/gcb.15191.

Davis, G.E., M.F. Baumgartner, J.M. Bonnell, J. Bell, C. Berchok, J. Bort Thornton, S. Brault, G. Buchanan, R.A. Charif, et al. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (Eubalaena glacialis) from 2004 to 2014. Scientific Reports 7(1): 1-12. https://doi.org/10.1038/s41598-017-13359-3.

deHart, P.A.P. 2002. The distribution and abundance of harbor seals (Phoca vitulina concolor) in the Woods Hole region. M.A. Thesis. Boston University. 88 p.

DiGiovanni, R., K. Durham, J. Wocial, R.D.V.M. Pisciotta, R.D.V.M. Hanush, A. Chaillet, A. Sabrosky, and R. Scott. 2005a. Post Release Monitoring of a male Risso's dolphin (Grampus griseus) rehabilitated and released in New York waters. Abstract from the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, CA .

DiGiovanni, R.A., Jr., K.F. Durham, J.N. Wocial, R.D. Pisciotta, R. Hanush, A.M. Chaillet, A.D. Hallett, A.M. Sabrosky, and R.A. Scott. 2005b. Rehabilitation and Post Release Monitoring of a Male Risso's Dolphin (Grampus griseus) Released in New York Waters [abstract]. Abstract from the 16th Biennial Conference on the Biology of Marine Mammals. 12-16 Dec 2005, San Diego, CA, USA.

Doksæter, L., E. Olsen, L. Nøttestad, and A. Fernö. 2008. Distribution and feeding ecology of dolphins along the Mid-Atlantic Ridge between Iceland and the Azores. Deep Sea Research Part II 55(1): 243-253. https://doi.org/10.1016/j.dsr2.2007.09.009.

Donovan, G.P. 1991. A review of IWC stock boundaries. Reports of the International Whaling Commission 13(Special Issue): 39-68.Doughty CE, Roman J, Faurby S, Wolf A, Haque A, Bakker ES, Malhi Y, Dunning JB Jr, Svenning JC. Global nutrient transport in a world of giants. Proc Natl Acad Sci U S A. 2016 Jan 26;113(4):868-73. doi: 10.1073/pnas.1502549112. Epub 2015 Oct 26. PMID: 26504209; PMCID: PMC4743783.

Dow Piniak, W.E., S.A. Eckert, C.A. Harms, and E.M. Stringer. 2012. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): Assessing the potential effect of anthropogenic noise. US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2012-00156. 35 p.

Dunlop, R.A., M.J. Noad, R.D. McCauley, L. Scott-Hayward, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2017. Determining the behavioural dose–response relationship of marine mammals to air gun noise and source proximity. Journal of Experimental Biology 220(16): 2878-2886. https://jeb.biologists.org/content/220/16/2878.

Ellison, W.T., B.L. Southall, C.W. Clark, and A.S. Frankel. 2012. A New Context-Based Approach to Assess Marine Mammal Behavioral Responses to Anthropogenic Sounds. Conservation Biology 26(1): 21-28. https://doi.org/10.1111/j.1523-1739.2011.01803.x.

Ellison, W.T., C.W. Clark, D.A. Mann, B.L. Southall, and D.J. Tollit. 2016a. A risk assessment framework to assess the biological significance of noise exposure on marine mammals. Poster presented at the 21st Conference on the Biology of Marine Mammals, San Francisco. http://sea-inc.net/wp-content/uploads/2016/01/EWG-Framework_SMM-poster.jpg.

Ellison, W.T., R.G. Racca, C.W. Clark, B. Streever, A.S. Frankel, E. Fleishman, R.P. Angliss, J. Berger, D.R. Ketten, et al. 2016b. Modeling the aggregated exposure and responses of bowhead whales Balaena mysticetus to multiple sources of anthropogenic underwater sound. Endangered Species Research 30: 95-108. https://doi.org/10.3354/esr00727.

Ellison, W.T., B.L. Southall, A.S. Frankel, K. Vigness-Raposa, and C.W. Clark. 2018. An Acoustic Scene Perspective on Spatial, Temporal, and Spectral [short note]. Aquatic Mammals 44(3): 239-243. https://doi.org/10.1578/AM.44.3.2018.239.

Fritts, T. H., A. B. Irvine, R. D. Jennings, L. A. Collum, W. Hoffman and M. A. McGehee. 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C., FWS/OBS-82/65, 455 pp.

Garrison, L.P., A.A. Hohn, and Hansen L.J. 2017b. Seasonal movements of Atlantic common bottlenose dolphin stocks based on tag telemetry data. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division 75 Virginia Beach Dr., Miami, FL 33140: PRBD Contribution # PRBD-2017-02, XX pp.

Gedamke, J. 2004. Minke whale song, spacing, and acoustic communication on the Great Barrier Reef, Australia. PhD thesis, University of California, Santa Cruz.

Geo-Marine. 2009a. Marine mammal monitoring during geophysical surveys in support of the construction of a meteorological data collection facility for the Bluewater Delaware Offshore Wind Park (MMS Lease Block 6325): October 2009. Final summary report by Geo-Marine for Bluewater Wind, LLC.

Geo-Marine. 2009b. Marine mammal monitoring during geophysical surveys in support of the construction of a meteorological data collection facility for the Bluewater Delaware Offshore Wind

Park (MMS Lease Block 6936): August 2009. Final summary report by Geo-Marine for Bluewater Wind, LLC.

Geo-Marine. 2010. Ocean/Wind Power Ecological Baseline Studies: January 2008 – December 2009. Final Report. Volume III: Marine Mammal and Sea Turtle Studies. Report by Geo-Marine, Inc. for the New Jersey Department of Environmental Protection, Office of Science. https://tethys.pnnl.gov/sites/default/files/publications/Ocean-Wind-Power-Baseline-Volume3.pdf.

Gilbert, J.R., G.T. Waring, K.M. Wynne, and N. Guldager. 2005. Changes in abundance of harbor seals in Maine, 1981–2001. Marine Mammal Science 21(3): 519-535. https://doi.org/10.1111/j.1748-7692.2005.tb01246.x.

Gill, A.B., I. Gloyne-Philips, J. Kimber, and P. Sigray. 2014. Marine renewable energy, electromagnetic (EM) fields and EM-sensitive animals. In Shields, M. and A. Payne (eds.). Humanity and the Sea: Marine Renewable Energy Technology and Environmental Interactions. Springer. pp. 61-79.

Gowans, S. and H. Whitehead. 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. Canadian Journal of Zoology 73(9): 1599-1608. https://doi.org/10.1139/z95-190.

Hain, J.H.W., M.J. Ratnaswamy, R.D. Kenney, and H.E. Winn. 1992. The fin whale, Balaenoptera physalus, in waters of the northeastern United States continental shelf. Reports of the International Whaling Commission 42: 653-669.

Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Marine Mammal Science 18(4): 920-939. https://doi.org/10.1111/j.1748-7692.2002.tb01082.x.

Hart Crowser, I.P.E. and Illingworth and Rodkin, Inc. 2009. Acoustic Monitoring and In-site Exposures of Juvenile Coho Salmon to Pile-driving Noise at the Port of Anchorage Marine Terminal Redevelopment Project, Knik Arm, Anchorage, Alaska. Report by Hart Crowser, Inc./Pentec Environmental and Illingworth and Rodkin, Inc. for URS Corporation for US Department of Transportation, Maritime Administration; Port of Anchorage; and Integrated Concepts and Research Corporation. https://www.fisheries.noaa.gov/resource/document/acoustic-monitoring-and-situ-exposures-juvenile-coho-salmon-pile-driving-noise.

Hatch, J.M. and C.D. Orphanides. 2017. Estimates of cetacean and pinniped bycatch in the 2015 New England sink and mid-Atlantic Gillnet fisheries. Northeast Fish Sci Cent Ref Doc 17-18: 21.

Hatch, L.T., C.W. Clark, S.M. Van Parijs, A.S. Frankel, and D.W. Ponirakis. 2012. Quantifying loss of acoustic communication space for right whales in and around a U.S. National Marine Sanctuary. Conservation Biology 26(6): 983-994. https://doi.org/10.1111/j.1523-1739.2012.01908.x.

Haug, T., M. Hammill, and D. Olafsdóttir. 2013. Introduction. In Grey seals in the North Atlantic and the Baltic. Volume 6. NAMMCO Scientific Publications. pp. 7-12. https://doi.org/10.7557/3.2717.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2017. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2016 (second edition). NOAA Technical Memorandum NMFS-NE-241, Woods Hole, MA, USA. 274 p.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2018a. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2017 (first edition). NOAA Technical Memorandum NMFS-NE-245, Woods Hole, MA, USA. 371 p.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2018b. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2017 (second edition). NOAA Technical Memorandum NMFS-NE-245, Woods Hole, MA, USA. 371 p. https://www.nefsc.noaa.gov/publications/tm/tm245/.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2019. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2018. NOAA Technical Memorandum NMFS-NE-258, Woods Hole, MA, USA. 298 p. https://doi.org/10.25923/9rrd-tx13.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J. Turek. 2021. Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2021. NOAA Technical Memorandum, Woods Hole, MA, USA.

Hayes et al. 2023

HDR. 2019. Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028. 281 p. https://espis.boem.gov/final%20reports/BOEM_2019-028.pdf.

Herzing, D. L. 1997. The natural history of tree-ranging Atlantic spotted dolphins (Stenella frontalis): Age classes, color phases and female reproduction. Marine Mammal Science 13: 40-59.

Hoover, K., S. Sadove, and P. Forestell. 1999. Trends of harbor seal, Phoca vitulina, abundance from aerial surveys in New York waters: 1985-1999 [abstract]. Proceedings of the 13th Biennial Conference on the Biology of Marine. 28 Nov to 3 Dec 1999, Wailea, HI.

Horwood, J.W. 1989. Biology and exploitation of the minke whale. CRC press.

Hotchkin, C.F. and S.E. Parks. 2013. The Lombard effect and other noise-induced vocal modifications: Insight from mammalian communication systems. Biological Reviews 88(4): 809-824. https://doi.org/10.1111/brv.12026.

Houghton, J., J. Starkes, J. Stutes, M. Havey, J.A. Reyff, and D. Erikson. 2010. Acoustic monitoring of in situ exposures of juvenile coho salmon to pile-driving noise at the port of Anchorage Marine Terminal redevelopment project, Knik Arm, Alaska. Alaska Marine Sciences Symposium, Anchorage.

Jacobs, S.R. and J.M. Terhune. 2000. Harbor seal (Phoca vitulina) numbers along the New Brunswick coast of the Bay of Fundy in the fall in relation to aquaculture. Northeastern Naturalist 7(3): 289-296. https://doi.org/10.1656/1092-6194(2000)007[0289:HSPVNA]2.0.CO;2.

Jefferson, T.A., M.A. Webber, and R.L. Pitman. 2008. Marine Mammals of the World, A Comprehensive Guide to their Identification. Elsevier, Amsterdam.

Jefferson, T.A., C.R. Weir, R.C. Anderson, L.T. Ballance, R.D. Kenney, and J.J. Kiszka. 2014. Global distribution of Risso's dolphin Grampus griseus: A review and critical evaluation. Mammal Review 44(1): 56-68. https://doi.org/10.1111/mam.12008.

Kastelein, R.A., P.J. Wensveen, L. Hoek, W.C. Verboom, and J.M. Terhune. 2009. Underwater detection of tonal signals between 0.125 and 100 kHz by harbor seals (Phoca vitulina). Journal of the Acoustical Society of America 125(2): 1222-1229. https://doi.org/10.1121/1.3050283.

Katona, S.K. and J.A. Beard. 1990. Population size, migrations and feeding aggregations of the humpback whale (Megaptera novaeangliae) in the western North Atlantic Ocean. Report of the International Whaling Commission 12(Special Issue): 295-306.

Katona, S.K., V. Rough, and D.T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316 p.

Kenney, M.K. 1994. Harbor seal population trends and habitat use in Maine. M.Sc. Thesis. University of Maine, Orono, ME. 55 p.

Kenney, R.D., M.A.M. Hyman, and H.E. Winn. 1985. Calculation of standing stocks and energetic requirements of the cetaceans of the northeast United States Outer Continental Shelf. NOAA technical memorandum NMFS-F/NEC-41. https://repository.library.noaa.gov/view/noaa/5641.

Kenney, R.D. 1990. Bottlenose dolphins off the north-eastern United States. In Leatherwood, S. and R.R. Reeves (eds.). The Bottlenose Dolphin. Academic Press, San Diego, CA, USA.

Kenney, R.D., G.P. Scott, T.J. Thompson, and H.E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. Journal of Northwest Atlantic Fishery Science 22: 155-171.

Kenney, R.D. and K.J. Vigness-Raposa. 2010. Marine mammals and sea turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound, and nearby waters: An analysis of existing data for the Rhode Island Ocean Special Area Management Plan. (Chapter 10) In RICRMC (Rhode Island Coastal Resources Management Council) Ocean Special Area Management Plan (SAMP). Appendix A: Technical Reports for the Rhode Island Ocean Special Area Management Plan. Volume 2. pp. 705-1042. http://seagrant.gso.uri.edu/oceansamp/pdf/appendix/full_volume2_osamp_4.26.13.pdf.

Kleĭnenberg, S.E.e., A.V. Yablokov, B.M. Bel’kovich, and M.N. Tarasevich. 1964. Beluga (Delphinapterus leucas): Investigation of the species [Belukha; opyt monograficheskogo issledovaniya vida)]. Israel

Program for Scientific Translation (1st translated edition 1 Jan 1969), Jerusalem. 376 p. http://hdl.handle.net/2027/uc1.31822014463194.

Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean. Journal of Cetacean Research and Management 2(Special Issue): 193-208.

Knowlton, A.R., J. Beaudin Ring, B. Russell, and New England Aquarium. 2002. Right whale sightings and survey effort in the Mid Atlantic Region: Migratory corridor, time frame, and proximity to port entrances. Report for the NMFS Ship Strike Working Group. 25 p.

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.K. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, et al. 2005. North Atlantic Right Whales in Crisis. Science 309(5734): 561-562. https://science.sciencemag.org/content/309/5734/561.

Kraus, S.D., S. Leiter, K. Stone, B. Wikgren, C.A. Mayo, P. Hughes, R.D. Kenney, C.W. Clark, A.N. Rice, et al. 2016. Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2016-054, Sterling, Virginia. 117 + appendices p. https://www.boem.gov/RI-MA-Whales-Turtles.

LaBrecque, E., C. Curtice, J. Harrison, S.M. Van Parijs, and P.N. Halpin. 2015. 2. Biologically Important Areas for cetaceans within U.S. waters - East Coast region. Aquatic Mammals 41(1): 17-29. http://dx.doi.org/10.1578/AM.41.1.2015.1.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1): 35-75. https://doi.org/10.1111/j.1748-7692.2001.tb00980.x.

Lavigueur, L. and M.O. Hammill. 1993. Distribution and seasonal movements of grey seals, Halichoerus grypus, born in the Gulf of St. Lawrence and eastern Nova Scotia shore. Canadian Field-Naturalist 107(3): 329-340.

Lawson, J.W. and J.-F. Gosselin. 2018. Estimates of cetacean abundance from the 2016 NAISS aerial surveys of eastern Canadian waters, with a comparison to estimates from the 2007 TNASS. Document Number NAMMCO SC/25/AE/09. Report for the NAMMCO Secretariat. 40 p.

Leatherwood, S., D.K. Caldwell, and H.E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Technical Report NMFS Circ. 396.

Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, Halichoerus grypus, in the Northwest Atlantic. Canadian Field-Naturalist 115(4): 653-662.

Lesage, V. and M.O. Hammill. 2003. Proceedings of the workshop on the development of research priorities forthe Northwest Atlantic blue whale population, 20−21 November 2002. DFO Can. Sci. Advis. Sec. Proceed. Ser.Longhurst, A.R. 1998. Ecological geography of the sea. 2nd edition. Elsevier Academic Press.

Luksenburg, J. and E.C.M. Parsons. 2009. The effects of aircraft on cetaceans: implications for aerial whalewatching. 61st Meeting of the International Whaling Commission. 8 Jun to 6 Jul 2012, Panama City.

Malme, C.I., P.R. Miles, C.W. Clark, P.L. Tyack, and J.E. Bird. 1983. Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior. Final Report for the Period of 7 June 1982 - 31 July 1983. Report Number 5366. Report by Bolt Beranek and Newman Inc. for US Department of the Interior, Minerals Management Service, Alaska OCS Office, Cambridge, MA, USA. https://www.boem.gov/sites/default/files/boemnewsroom/Library/Publications/1983/rpt5366.pdf.

Malme, C.I., P.R. Miles, C.W. Clark, P.L. Tyack, and J.E. Bird. 1984. Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior. Phase II: January 1984 Migration. Report Number 5586. Report by Bolt Beranek and Newman Inc. for the US Department of the Interior, Minerals Management Service, Cambridge, MA, USA. https://www.boem.gov/sites/default/files/boemnewsroom/Library/Publications/1983/rpt5586.pdf.

Mansfield, A.W. 1966. The grey seal in eastern Canadian waters. Canadian Audubon Magazine 28: 161-166.

Marangoni LFB, Davies T, Smyth T, Rodríguez A, Hamann M, Duarte C, Pendoley K, Berge J, Maggi E, Levy O. Impacts of artificial light at night in marine ecosystems-A review. Glob Chang Biol. 2022 Sep;28(18):5346-5367. doi: 10.1111/gcb.16264. Epub 2022 Jun 14. PMID: 35583661; PMCID: PMC9540822.

Marine Mammal Stranding Center. 2020. 2019 Stranding Totals https://mmsc.org/strandings/stranding-stats.

Matthews, L.P., J.A. McCordic, and S.E. Parks. 2014. Remote acoustic monitoring of North Atlantic right whales (Eubalaena glacialis) reveals seasonal and diel variations in acoustic behavior. PLOS ONE 9(3). https://doi.org/10.1371/journal.pone.0091367.

Mayo, C.A., L. Ganley, C.A. Hudak, S. Brault, M.K. Marx, E. Burke, and M.W. Brown. 2018. Distribution, demography, and behavior of North Atlantic right whales (Eubalaena glacialis) in Cape Cod Bay, Massachusetts, 1998–2013. Marine Mammal Science 34(4): 979-996. https://doi.org/10.1111/mms.12511.

McDonald, M.A., J.A. Hildebrand, S.M. Wiggins, D. Thiele, D. Glasgow, and S.E. Moore. 2005. Sei whale sounds recorded in the Antarctic. Journal of the Acoustical Society of America 118(6): 3941-3945. https://doi.org/10.1121/1.2130944.

Mead, J.G. 1975. Preliminary report on the former net fisheries for Tursiops truncatus in the western North Atlantic. Journal of the Fisheries Board of Canada 32(7): 1155-1162.

Mead, J.G. and C.W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (Tursiops truncatus) of the Atlantic coast of North America-morphologic and ecologic considerations. International Biological Research Institute Reports 5: 31-43.

Meißner, K., H. Schabelon, J. Bellebaum, and H. Sordyl. 2006. Impacts of submarine cables on the marine environment: A literature review. Report by the Institute of Applied Ecology Ltd for the Federal Agency of Nature Conservation, Germany. 88 p.

Moore, M.J., A. Bogomolni, R.S. Bowman, C.T. Harry, A.R. Knowlton, S. Landry, D.S. Rotstein, and K. Touhey. 2006. Fatally entangled right whales can die extremely slowly. OCEANS 2006. 18-21 Sep 2006. IEEE, oston, MA, USA. pp. 1-3. https://doi.org/10.1109/OCEANS.2006.306792.

Morano, J.L., D.P. Salisbury, A.N. Rice, K.L. Conklin, K.L. Falk, and C.W. Clark. 2012. Seasonal changes in fin whale song in the western north Atlantic Ocean. Journal of the Acoustical Society of America 132(2): 1207-1212. https://doi.org/10.1121/1.4730890.

Mullin, K.D., and G.L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fishery Bulletin 101:603-613.

Mullin, K.D., and G.L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Marine Mammal Science 20(4):787-807.

Nedwell, J.R. and A.W. Turnpenny. 1998. The use of a generic frequency weighting scale in estimating environmental effect. Workshop on Seismics and Marine Mammals. 23–25 Jun 1998, London, UK.

Nedwell, J.R., A.W. Turnpenny, J. Lovell, S.J. Parvin, R. Workman, J.A.L. Spinks, and D. Howell. 2007. A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise. Document Number 534R1231 Report prepared by Subacoustech Ltd. for Chevron Ltd, TotalFinaElf Exploration UK PLC, Department of Business, Enterprise and Regulatory Reform, Shell UK Exploration and Production Ltd, The Industry Technology Facilitator, Joint Nature Conservation Committee, and The UK Ministry of Defence. 74 p. https://tethys.pnnl.gov/sites/default/files/publications/Nedwell-et-al-2007.pdf.

Newhall, A.E., Y.T. Lin, J.F. Lynch, and M.F. Baumgartner. 2009. Sei whale localization and vocalization frequency sweep rate estimation during the New Jersey Shallow Water 2006 experiment. Journal of the Acoustical Society of America 125(4): 2738-2738. https://doi.org/10.1121/1.4784544.

[NYSDEC] New York Department of Environmental Conservation (NYSDEC). 2013. Species Status Assessment – Harbor Porpoise. [11 April 2022]. https://www.dec.ny.gov/docs/wildlife_pdf/sgcnharbporpoise.pdf.

NOAA Fisheries. 2010. Final recovery plan for the sperm whale (Physeter macrocephalus). National Marine Fisheries Service, Silver Spring, MD, USA.

NOAA Fisheries. 2017. Marine Mammal Stock Assessment Reports by Species/Stock – Short-Beaked Common Dolphin. [accessed 11 April 2022]. https://media.fisheries.noaa.gov/dam-migration/part12_common.pdf.

NOAA Fisheries. 2018a. Common bottlenose dolphin (Tursiops truncatus) overview. [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin.

NOAA Fisheries. 2018b. Fin whale (Balaenoptera physalus) overview (accessed 20 August 2020). https://www.fisheries.noaa.gov/species/fin-whale.

NOAA Fisheries. 2018c. Harbor porpoise (Phocoena phocoena) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/harbor-porpoise.

NOAA Fisheries. 2018d. Humpback whale (Megaptera novaeangliae) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/humpback-whale.

NOAA Fisheries. 2018e. Long-finned pilot whale (Globicephala melas) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/long-finned-pilot-whale.

NOAA Fisheries. 2018f. Sei Whale (Balaenoptera borealis) overview [accessed 20 August 2020] https://www.fisheries.noaa.gov/species/sei-whale.

NOAA Fisheries. 2018g. 2016-2018 Humpback Whale Unusual Mortality Event along the Atlantic Coast, [accessed 20 August 2020]. https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2018-humpback-whale-unusual-mortality-event-along-atlantic-coast.

NOAA Fisheries. 2018h. Short-beaked common dolphin (Delphinus delphis) overview [accessed 20 August 2020] https://www.fisheries.noaa.gov/species/short-beaked-common-dolphin.

NOAA Fisheries. 2018j. Minke whale (Balaenoptera acutorostrata) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/minke-whale.

NOAA Fisheries. 2018k. Risso's dolphin (Grampus griseus) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/rissos-dolphin.

NOAA Fisheries. 2018l. Gray seal (Halichoerus grypus atlantica) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/gray-seal.

NOAA Fisheries. 2018m. North Atlantic right whale (Eubalaena glacialis) overview [accessed 20 August 2020]. https://www.fisheries.noaa.gov/species/north-atlantic-right-whale.

NOAA Fisheries. 2020a. Short-beaked Common Dolphin (Delphinus delphis) [accessed 27 October 2020]. https://www.fisheries.noaa.gov/species/short-beaked-common-dolphin.

NOAA Fisheries. 2020b. North Atlantic Right Whale (Eubalaena glacialis) [accessed 27 October 2020]. https://www.fisheries.noaa.gov/species/north-atlantic-right-whale.

NOAA Fisheries. 2020c. Common Bottlenose Dolphin (Tursiops truncatus) [accessed 27 October 2020]. https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin.

NOAA Fisheries. 2020e. 2017–2020 North Atlantic Right Whale Unusual Mortality Event Office of Protected Resources [accessed 20 August 2020]. https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2020-north-atlantic-right-whale-unusual-mortality-event.

NOAA Fisheries. 2020f. Marine Mammal Stock Assessment Reports by Species/Stock – Gray Seal. [accessed 11 April 2022]. https://media.fisheries.noaa.gov/dam-migration/part12_common.pdf.

NOAA Fisheries. 2022. Atlantic Spotted Dolphin. [accessed 11 April 2022]. https://www.fisheries.noaa.gov/species/atlantic-spotted-dolphin.

Noren, D.P., A.H. Johnson, D. Rehder, and A. Larson. 2009. Close approaches by vessels elicit surface active behaviors by southern resident killer whales. Endangered Species Research 8(3): 179-192.

Normandeau Associates, Inc., T.C. Tricas, and A.B. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. Final Report to US Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region. OCS Study BOEMRE 2011-09, Camarillo, CA. https://espis.boem.gov/final%20reports/5115.pdf.

Northridge, S.P., M.L. Tasker, A. Webb, K. Camphuysen, and M. Leopold. 1997. White-beaked Lagenorhynchus albirostris and Atlantic white-sided dolphin L. acutus distributions in northwest European and US North Atlantic waters. Report of the International Whaling Commission 47: 797-805. https://archive.iwc.int/?r=52&k=4bf9610eaa

Nowacek, D.P., L.H. Thorne, D.W. Johnston, and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2): 81-115. https://doi.org/10.1111/j.1365-2907.2007.00104.x.

Orphanides, C.D. 2019. Estimates of cetacean and pinniped bycatch in the 2016 New England sink and mid-Atlantic Gillnet fisheries. Northeast Fish Sci Cent Ref Doc. 19-04: 12.

Palka, D.L. 2012. Cetacean abundance estimates in U.S. northwestern Atlantic Ocean waters from summer 2011 line transect survey. In: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center (ed.). US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. https://www.nefsc.noaa.gov/publications/crd/crd1229/crd1229.pdf

Palka, D.L., S. Chavez-Rosales, E. Josephson, D.M. Cholewiak, H.L. Haas, L.P. Garrison, M. Jones, D. Sigourney, G.T. Waring, et al. 2017. Atlantic Marine Assessment Program for Protected Species: 2010-2014. US Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. OCS Study BOEM 2017-071, Washington, DC. 211 p. https://espis.boem.gov/final%20reports/5638.pdf.

Palsbøll, P.J., J. Allen, M. Bérube´, P.J. Clapham, T.P. Feddersen, P.S. Hammond, R.R. Hudson, H. Jørgensen, S. Katona, et al. 1997. Genetic tagging of humpback whales. Nature 388(6644): 767-769. https://doi.org/10.1038/42005.

Parks, S.E., P.K. Hamilton, S.D. Kraus, and P.L. Tyack. 2005. The gunshot sound produced by male North Atlantic right whales (Eubalaena glacialis) and its potential function in reproductive advertisement. Marine Mammal Science 21(3): 458-475. https://doi.org/10.1111/j.1748-7692.2005.tb01244.x.

Parks, S.E. and P.L. Tyack. 2005. Sound production by North Atlantic right whales (Eubalaena glacialis) in surface active groups. Journal of the Acoustical Society of America 117(5): 3297-3306. https://doi.org/10.1121/1.1882946.

Parks, S.E., M. Johnson, D.P. Nowacek, and P.L. Tyack. 2011. Individual right whales call louder in increased environmental noise. Biology Letters 7: 33-35. https://doi.org/10.1098/rsbl.2010.0451.

Patenaude, N.J., W.J. Richardson, M.A. Smultea, W.R. Koski, G.W. Miller, B. Würsig, and C.R. Greene, Jr. 2002. Aircraft sound and disturbance to bowhead and beluga whales during spring migration in the alaskan Beaufort sea. Marine Mammal Science 18(2): 309-335. https://doi.org/10.1111/j.1748-7692.2002.tb01040.x.

Payne, P.M., L.A. Selzer, and A.R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. Report to National Marine Fisheries Service, Woods Hole, MA.

Payne, P.M. and L.A. Selzer. 1989. The distribution, abundance, and selected prey of the harbor seal, Phoca vitulina concolor, in southern New England. Marine Mammal Science 5(2): 173-192. https://doi.org/10.1111/j.1748-7692.1989.tb00331.x.

Payne, P.M. and D.W. Heinemann. 1990. A distributional assessment of cetaceans in the shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to National Marine Fisheries Science Center, Woods Hole, MA. 108 p.

Payne, P.M. and D.W. Heinemann. 1993. The distribution of pilot whales (Globicephala spp.) in shelf/shelf edge and slope waters of the north-eastern United States, 1978-1988. Report of the International Whaling Commission 14(Special Issue): 51-68.

Pendleton, D.E., A.J. Pershing, M.W. Brown, C.A. Mayo, R.D. Kenney, N.R. Record, and T.V.N. Cole. 2009. Regional-scale mean copepod concentration indicates relative abundance of North Atlantic right whales. Marine Ecology Progress Series 378: 211-225. https://doi.org/10.3354/meps07832.

Perrin, W.F., E.D. Mitchell, J.G. Mead, D.K. Caldwell, M.C. Caldwell, P.J.H. van Bree and W.H. Dawbin. 1987. Revision of the spotted dolphins, Stenella spp. Marine Mammal Science 3(2): 99-170.

Pershing, A.J., L.B. Christensen, N.R. Record, G.D. Sherwood, and P.B. Stetson. 2010. The Impact of Whaling on the Ocean Carbon Cycle: Why Bigger Was Better. PLOS ONE 5(8): e12444. https://doi.org/10.1371/journal.pone.0012444.

Pettis, H.M., R.M. Pace, III, R.S. Schick, and P.K. Hamilton. 2017. North Atlantic Right Whale Consortium 2017 Annual Report Card. Report to the North Atlantic Right Whale Consortium. https://www.narwc.org/uploads/1/1/6/6/116623219/2017_report_cardfinal.pdf.

Popper, A.N. 1980. Sound emission and detection by delphinids. Cetacean Behavior, (ed. L.M. Herman), pp. 1–52, John Wiley & Sons, New York.

Potter, C.W. 1979. The marine fauna. Symposium on Endangered and Threatened Plants and Animals of Virginia. 19-20 May 1978, Blacksburg, VA, USA. pp. 595-602.

Potter, C.W. 1984. Marine mammals of Maryland. In Norden, A.W., D.C. Forester, and G.H. Fenwick (eds.). Threatened and endangered plants and animals of Maryland. Maryland Natural Heritage Program Publication 84-1, Annapolis, MA, USA. pp. 442-453.

Rankin, S. and J.P. Barlow. 2005. Source of the North Pacific "boing" sound attributed to minke whales. Journal of the Acoustical Society of America 118(5): 3346-3351. https://doi.org/10.1121/1.2046747.

Rankin, S. and J.P. Barlow. 2007. Vocalizations of the sei whale Balaenoptera borealis off the Hawaiian Islands. Bioacoustics 16(2): 137-145. https://doi.org/10.1080/09524622.2007.9753572.

Reeves, R.R. 1992. The Sierra Club handbook of seals and sirenians. Sierra Club Books, San Francisco, CA.

Reeves, R.R. and A.J. Read. 2003. Bottlenose dolphin, harbor porpoise, sperm whale and other toothed cetaceans. In Feldhamer, G.A., B.C. Thomspon, and J.A. Chapman (eds.). Wild Mammals of North America: Biology, Management and Conservation. 2nd edition. John Hopkins University Press, Baltimore, MD. pp. 397-424.

Richardson, D.T. 1976. Assessment of harbor and gray seal populations in Maine 1974-1975. Final report for Marine Mammal Commission, Washington, DC.

Richardson, D.T. and V. Rough. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington.

Richardson, W.J., M.A. Fraker, B. Würsig, and R.S. Wells. 1985a. Behaviour of Bowhead Whales Balaena mysticetus summering in the Beaufort Sea: Reactions to industrial activities. Biological Conservation 32(3): 195-230. https://doi.org/10.1016/0006-3207(85)90111-9.

Richardson, W.J., R.S. Wells, and B. Würsig. 1985b. Disturbance responses of bowheads, 1980-84. In Richardson, W.J. (ed.). Behavior, disturbance responses and distribution of bowhead whales Balaena mysticetus in the eastern Beaufort Sea, 1980-84. Report by LGL Ecological Research Associates, Inc. and US Minerals  Managment Service. OCS Study MMS 85-0034. pp. 89-196.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA, USA. 576 p. https://doi.org/10.1016/C2009-0-02253-3.

Richardson, W.J. and B. Würsig. 1997. Influences of man-made noise and other human actions on cetacean behaviour. Marine and Freshwater Behaviour and Physiology 29(1-4): 183-209. https://doi.org/10.1080/10236249709379006.

Risch, D., C.W. Clark, P.J. Dugan, M. Popescu, U. Siebert, and S.M. Van Parijs. 2013. Minke whale acoustic behavior and multi-year seasonal and diel vocalization patterns in Massachusetts Bay, USA. Marine Ecology Progress Series 489: 279-295. https://doi.org/10.3354/meps10426.

Risch, D., M. Castellote, C.W. Clark, G.E. Davis, P.J. Dugan, L.E.W. Hodge, A. Kumar, K. Lucke, D.K. Mellinger, et al. 2014. Seasonal migrations of North Atlantic minke whales: Novel insights from large-scale passive acoustic monitoring networks. Movement Ecology 2(24). https://doi.org/10.1186/s40462-014-0024-3.

Roberts, J.J., B.D. Best, L. Mannocci, P.N. Halpin, D.L. Palka, L.P. Garrison, K.D. Mullin, T.V.N. Cole, and W.M. McLellan. 2015. Density Model for Seals (Phocidae) Along the U.S. East Coast, Preliminary Results. Version 3.2. Marine Geospatial Ecology Lab, Duke University, Durham, NC.

Roberts, J.J., B.D. Best, L. Mannocci, E. Fujioka, P.N. Halpin, D.L. Palka, L.P. Garrison, K.D. Mullin, T.V.N. Cole, et al. 2016a. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports 6. https://doi.org/10.1038/srep22615.

Roberts, J.J., L. Mannocci, and P.N. Halpin. 2016b. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2015-2016 (Base Year). Version 1.0. Report by the Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic Durham, NC, USA.

Roberts, J.J., L. Mannocci, and P.N. Halpin. 2017. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2016-2017 (Opt. Year 1). Version 1.4. Report by Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic, Durham, NC, USA.

Roberts, J.J., L. Mannocci, R.S. Schick, and P.N. Halpin. 2018. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2017-2018 (Opt. Year 2). Version 1.2. Report by the Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic Durham, NC, USA.

Roberts, J.J., R.S. Schick, and P.N. Halpin. 2020. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018-2020 (Opt. Year 3). Version 1.4. Report by the Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic Durham, NC, USA.

Roberts J.J., R.S. Schick, R.N. Halpin, 2021. Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2020 (Option Year 4). Version 2.2. Report by the Duke University Marine Geospatial Ecology Lab for Naval Facilities Engineering Command, Atlantic Durham, NC, USA.

Roman, J. and J.J. McCarthy. 2010. The whale pump: Marine mammals enhance primary productivity in a coastal basin. PLOS ONE 5(10): e13255. https://doi.org/10.1371/journal.pone.0013255.

Roman, J., J.A. Estes, L. Morissette, C. Smith, D.P. Costa, J. McCarthy, J.B. Nation, S. Nicol, A. Pershing, et al. 2014. Whales as marine ecosystem engineers. Frontiers in Ecology and the Environment 12(7): 377-385. https://doi.org/10.1890/130220.

Rone, B.K. and R.M. Pace, III. 2012. A simple photograph-based approach for discriminating between free-ranging long-finned (Globicephala melas) and short-finned (G. macrorhynchus) pilot whales off the east coast of the United States. Marine Mammal Science 28(2): 254-275. https://doi.org/10.1111/j.1748-7692.2011.00488.x.

Rosenfeld, M., M. George, and J.M. Terhune. 1988. Evidence of autumnal harbour seal, Phoca vitulina, movement from Canada to the United States. Canadian Field-Naturalist 102(3): 527-529.

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to the Marine Mammal Commission. 28 p. https://www.nefsc.noaa.gov/psb/docs/Rough - 1995 - Seals in Nantucket Sound, Massachusetts, winter an.pdf.

Rowlett, R.A. 1980. Observations of marine birds and mammals in the northern Chesapeake Bight. Document Number FWS/OBS-80/04. Report by US Fish and Wildlife Service, Washington, DC, USA.

Russell, D.J.F., G.D. Hastie, D. Thompson, V.M. Janik, P.S. Hammond, L.A.S. Scott-Hayward, J. Matthiopoulos, E.L. Jones, and B.J. McConnell. 2016. Avoidance of wind farms by harbour seals is limited to pile-driving activities. Journal of Applied Ecology 53(6): 1642-1652. https://doi.org/10.1111/1365-2664.12678.

Sabinsky, P.F., O.N. Larsen, M. Wahlberg, and J. Tougaard. 2017. Temporal and spatial variation in harbor seal (Phoca vitulina L.) roar calls from southern Scandinavia. Journal of the Acoustical Society of America 141(3): 1824–1834. https://doi.org/10.1121/1.4977999.

Schilling, M.R., I. Seipt, M.T. Weinrich, S.E. Frohock, A.E. Kuhlberg, and P.J. Clapham. 1992. Behavior of individually-identified sei whales Balaenoptera borealis during an episodic influx into the southern Gulf of Maine in 1986. Fisheries Bulletin 90(4): 749-755. https://spo.nmfs.noaa.gov/content/behavior-individually-identified-sei-whales-balaenoptera-borealis-during-episodic-influx

Schneider, D.C. and P.M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. Journal of Mammalogy 64(3): 518-520. https://doi.org/10.2307/1380370.

Schoeman RP, Patterson-Abrolat C and Plön S (2020) A Global Review of Vessel Collisions With Marine Animals. Front. Mar. Sci. 7:292. doi: 10.3389/fmars.2020.00292

Schroeder, C.L. 2000. Population status and distribution of the harbor seal in Rhode Island waters. M.S. Thesis. University of Rhode Island, Narragansett, RI. 197 p.

Schwartz, F.J. 1962. Summer occurrence of an immature little piked whale,Balaenoptera acutorostrata, in Chesapeake Bay, Maryland. Chesapeake Science 3(3): 206-209. https://doi.org/10.2307/1350996.

Scott, M.D., R.S. Wells, and A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. (Chapter 11) In Leatherwood, S. and R.R. Reeves (eds.). The Bottlenose Dolphin. Volume 235. Academic Press, San Diego, CA, USA. pp. 235-244.

Scott, T.M. and S.S. Sadove. 1997. Sperm whale, Physeter macrocephalus, sightings in the shallow shelf waters off Long Island, New York. Marine Mammal Science 13(2): 317-321. https://doi.org/10.1111/j.1748-7692.1997.tb00636.x.

Selzer, L.A. and P.M. Payne. 1988. The distribution of white-sided (Lagenorhynchus acutus) and common dolphins (Delphinus delphis) vs. environmental features of the continental shelf of the northeastern United States. Marine Mammal Science 4(2): 141-153. https://doi.org/10.1111/j.1748-7692.1988.tb00194.x.

Sergeant, D.E., A.W. Mansfield, and B. Beck. 1970. Inshore Records of Cetacea for Eastern Canada, 1949–68. Journal of the Fisheries Research Board of Canada 27(11): 1903-1915. https://doi.org/10.1139/f70-216.

Sergeant, D.E. 1977. Stocks of fin whales (Balaenoptera physalus L.) in the North Atlantic Ocean. Reports of the International Whaling Commission 27: 460-473.

Sieswerda, P.L., C.A. Spagnoli, and D.S. Rosenthal. 2015. Notes on a new feeding ground for humpback whales in the Western New York Bight. Southeast and Mid-Atlantic Marine Mammal Symposium. 27-29 Mar 2015, Virginia Beach, VI.

Slocum, C.J., R. Schoelkopf, S. Tulevech, M. Stevens, S. Evert, and M. Moyer. 1999. Seal populations wintering in New Jersey (USA) have increased in abundance and diversity [abstract]. Proceedings of the 13th Biennial Conference on the Biology of Marine. 28 Nov to 3 Dec 1999, Wailea, HI.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, et al. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33(4): 411-521.

Southall, B.L., D.P. Nowaceck, P.J.O. Miller, and P.L. Tyack. 2016. Experimental field studies to measure behavioral responses of cetaceans to sonar. Endangered Species Research 31: 293-315. https://doi.org/10.3354/esr00764.

Southall, B.L., J.J. Finneran, C.J. Reichmuth, P.E. Nachtigall, D.R. Ketten, A.E. Bowles, W.T. Ellison, D.P. Nowacek, and P.L. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45(2): 125-232. https://doi.org/10.1578/AM.45.2.2019.125.

Spalding, M.D., H.E. Fox, G.R. Allen, N. Davidson, Z.A. Ferdaña, M. Finlayson, B.S. Halpern, M.A. Jorge, A. Lombana, et al. 2007. Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience 57(7): 573-583. https://doi.org/10.1641/B570707.

Stenberg, C., J.G. Støttrup, M. van Deurs, C.W. Berg, G.E. Dinesen, H. Mosegaard, T.M. Grome, and S.B. Leonhard. 2015. Long-term effects of an offshore wind farm in the North Sea on fish communities. Marine Ecology Progress Series 528: 257-265. https://doi.org/10.3354/meps11261.

Sutcliffe, M.H. and P.F. Brodie. 1977. Whale distributions in Nova Scotia waters. Fisheries and Marine Service Technical Report No. 722. Vi, 83 p. http://www.dfompo.gc.ca/Library/18300.pdf.

Swingle, M., S. Barco, T. Pitchford, W. McLellan, and D. Pabst. 2006. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Marine Mammal Science 9: 309-315.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. Mclellan, and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in nearshore waters of Virginia. Marine Mammal Science 9(3): 309-315. https://doi.org/10.1111/j.1748-7692.1993.tb00458.x.

Todd, Victoria L. G., Ian B. Todd, Jane C. Gardiner, Erica C. N. Morrin, Nicola A. MacPherson, Nancy A. DiMarzio, Frank Thomsen. 2015. A review of impacts of marine dredging activities on marine mammals. ICES Journal of Marine Science, Volume 72, Issue 2, January/February 2015, Pages 328–340, https://doi.org/10.1093/icesjms/fsu187.

Tollit, D.J., P.M. Thompson, and S.P.R. Greenstreet. 1997. Prey selection by harbour seals, Phoca vitulina, in relation to variations in prey abundance. Canadian Journal of Zoology 75(9): 1508-1518. https://doi.org/10.1139/z97-774.

Tyler, D.E. 2008. Robust Statistics: Theory and Methods. Journal of the American Statistical Association 103(482): 888-889. https://doi.org/10.1198/jasa.2008.s239.

Ulmer, F.A.J. 1981. New Jersey's dolphins and porpoises. New Jersey Audubon Society Occasional Paper 137.

Vanderlaan, A. S. M., and Taggart, C. T. (2007). Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Mar. Mamm. Sci.* 23, 144–156. doi: 10.1111/j.1748-7692.2006.00098.x

Viricel, A., and P.E. Rosel. 2014. Hierarchical population structure and habitat differences in a highly mobile marine species: the Atlantic spotted dolphin. Molecular Ecology 23: 5018–5035.

Vester, H., K. Hammerschmidt, M. Timme, and S. Hallerberg. 2014. Bag-of-calls analysis reveals group-specific vocal repertoire in long-finned pilot whales. Quantitative Methods.

Villadsgaard, A., M. Wahlberg, and J. Tougaard. 2007. Echolocation signals of wild harbour porpoises, Phocoena phocoena. Journal of Experimental Biology 210: 56-64. http://jeb.biologists.org/content/jexbio/210/1/56.full.pdf.

Vu, E.T., D. Risch, C.W. Clark, S. Gaylord, L.T. Hatch, M.A. Thompson, D.N. Wiley, and S.M. Van Parijs. 2012. Humpback whale (Megaptera novaeangliae) song occurs extensively on feeding grounds in the Northwest Atlantic Ocean. Aquatic Biology 14(2): 175-183. https://doi.org/10.3354/ab00390.

Wahlberg, M. 2002. The acoustic behaviour of diving sperm whales observed with a hydrophone array. Journal of Experimental Marine Biology and Ecology, 281(1–2), 53–62. https://doi.org/10.1016/S0022-0981(02)00411-2.

Wahlberg, M. and H. Westerberg. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. Marine Ecology Progress Series 288: 295-309. https://www.int-res.com/abstracts/meps/v288/p295-309/.

Wang, C., Lyons, S. B., Corbett, J. J., and Firestone, J. (2007). *Using ship Speed and Mass do Describe Potential Collision Severity with Whales: an Application of the Ship Traffic, Energy and Environment Model (STEEM) [Report by the University of Delaware]*. Available online at: https://tethys.pnnl.gov/publications/using-ship-speed-and-mass-describe-potential-collision-severity-whales

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2007. NOAA Technical Memorandum NMFS-NE-205, Woods Hole, MA, USA. 415 p. https://repository.library.noaa.gov/view/noaa/3567.

Waring, G.T., D.L. Palka, and P.G.H. Evans. 2009. North Atlantic Marine Mammals. In Perrin, W.F., B. Würsig, and J.G.M. Thewissen (eds.). Encyclopedia of Marine Mammals. 2nd edition. Academic Press, London. pp. 773-781. https://doi.org/10.1016/B978-0-12-373553-9.00181-4

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2015. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2014. NOAA Technical Memorandum NMFS-NE-232, Woods Hole, MA, USA. 361 p. https://repository.library.noaa.gov/view/noaa/5043.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2015. NOAA Technical Memorandum NMFS-NE-238, Woods Hole, MA, USA. 501 p. https://repository.library.noaa.gov/view/noaa/11985.

Watkins, W.A., P.L. Tyack, K.E. Moore, and J.E. Bird. 1987. The 20-Hz signals of finback whales (Balaenoptera physalus). Journal of the Acoustical Society of America 82(6): 1901–1912. https://doi.org/10.1121/1.395685.

Whitman, A.A. and P.M. Payne. 1990. Age of harbour seals, Phoca vitulina concolor, wintering in southern New England. Canadian Field-Naturalist 104(4): 579-582.

Whitt, A.D., K. Dudzinski, and J.R. Laliberté. 2013. North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management. Endangered Species Research 20(1): 59-69. https://doi.org/10.3354/esr00486.

Wilson, S.C. 1978. Social Organization and Behavior of Harbor Seals, Phoca Vitulina Concolor', in Maine. Final Report to US Marine Mammal Commission in Fulfillment of Contract MM6AC013. 103 p.

Winn, H.E., E.A. Scott, and R.D. Kenney. 1985. Aerial surveys for right whales in the Great South Channel, Spring 1984. Report by Graduate School of Oceanography, University of Rhode Island for the US Marine Mammal Commission.

Winn, H.E., C.A. Price, and P.W. Sorensen. 1986. The distributional ecology of the right whale Eubalaena glacialis in the western North Atlantic. Report to the International Whaling Commission 10(Special Issue): 129-138.

Wood, J.D., B.L. Southall, and D.J. Tollit. 2012. PG&E offshore 3-D Seismic Survey Project Environmental Impact Report–Marine Mammal Technical Draft Report. Report by SMRU Ltd. 121 p. https://www.coastal.ca.gov/energy/seismic/mm-technical-report-EIR.pdf.

Würsig, B., S.K. Lynn, T.A. Jefferson, and K.D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1): 41-50. http://www.aquaticmammalsjournal.org/share/AquaticMammalsIssueArchives/1998/AquaticMammals_24-01/24-01_Wursig.pdf.

### 4.8 Sea Turtles

[BOEM] Bureau of Ocean Energy Management. 2012a. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia.

[BOEM] Bureau of Ocean Energy Management. 2012b. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017. Final Programmatic Environmental Impact Statement. US Department of the Interior. BOEM 2012-030. https://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing/Five_Year_Program/2012-2017_Five_Year_Program/2012-2017_Final_PEIS.pdf.

[BOEM] Bureau of Ocean Energy Management. 2014. Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Area Final Programmatic Environmental Impact Statement. http://www.boem.gov/BOEM-2014-001-v1/.

BOEM. Bureau of Ocean Energy Management. 2014. Appendix I: Sea Turtle Hearing and Sensitivity to Acoustic Impacts in Atlantic G&G Programmatic EIS. BOEM 2014-001.

[NMFS] National Marine Fisheries Service (US) and [USFWS] US Fish and Wildlife Service. 2013. Hawksbill Sea Turtle (Eretmochelys Imbricata) 5-Year Review: Summary and Evaluation. Report for US Department of Commerce, US Department of the Interior, National Oceanic and Atmospheric

Administration, National Marine Fisheries Service, and US Fish and Wildlife Service, Silver Spring, MD. https://repository.library.noaa.gov/view/noaa/17041.

[NMFS] National Marine Fisheries Service (US) and [USFWS] US Fish and Wildlife Service. 2015. Status Review of the Green Turtle (Chelonia mydas) under the Endangered Species Act. https://www.fisheries.noaa.gov/resource/document/status-review-green-turtle-chelonia-mydas-under-endangered-species-act.

[NMFS] National Marine Fisheries Service (US) and [USFWS] US Fish and Wildlife Service. 2014. Olive Ridley Sea Turtle (Lepidochelys Olivacea) 5-Year Review: Summary and Evaluation. https://repository.library.noaa.gov/view/noaa/17036.

[NMFS] National Marine Fisheries Service (US) and [USFWS] US Fish and Wildlife Service. 2015. Kemp's Ridley Sea Turtle (Lepidochelys Kempii) 5-Year Review: Summary and Evaluation. https://repository.library.noaa.gov/view/noaa/17048.

[NOAA] National Oceanic and Atmospheric Administration. 2018. Marine Life Viewing Guidelines. https://www.fisheries.noaa.gov/topic/marine-life-viewing-guidelines.

[NOAA] National Oceanic and Atmospheric Administration Fisheries. 2022. Green turtle. https://www.fisheries.noaa.gov/species/green-turtle

[NYSERDA] New York State Energy Research and Development Authority. 2017. New York State Offshore Wind Master Plan Marine Mammals and Sea Turtles Study Final Report. Prepared by Ecology and Environment Engineering, P.C. NYSERDA Report 17-25L.

[TEWG] Turtle Expert Working Group. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555. 116 p. https://repository.library.noaa.gov/view/noaa/8608.

[USCG] US Coast Guard. 2006. Final Environmental Impact Statement for the Compass Port LLC Deepwater Port License Application. Volume 1 of 2. Document Number USCG 2004-17659.

[USFWS] US Fish and Wildlife Service. 2018. Leatherback Sea Turtle (Dermochelys coriacea) [accessed 7 Feb 2021]. https://www.fws.gov/northflorida/SeaTurtles/Turtle Factsheets/leatherback-sea-turtle.htm.

Ambrose, R.F. and T.W. Anderson. 1990. Influence of an artificial reef on the surrounding infaunal community. Marine Biology 107: 41-52. https://doi.org/10.1007/BF01313240.

Arena, P.T., L.K.B. Jordan, and R.E. Spieler. 2007. Fish assemblages on sunken vessels and natural reefs in southeast Florida, USA. In Relini, G. and J. Ryland (eds.). Biodiversity in Enclosed Seas and Artificial Marine Habitats. Volume 193. Springer Netherlands, Dordrecht. pp. 157-171. https://doi.org/10.1007/978-1-4020-6156-1_14.

Baldi, G., Furii, G., Del Vecchio, M., Salvemini, P., Vallini, C., Angelini, V., ... & Casale, P. (2023). Growth rates and age at maturity of Mediterranean loggerhead sea turtles estimated from a single-population foraging ground. *Marine Biology*, *170*(4), 36.

Barnette, M. C. (2017). Potential impacts of artificial reef development on sea turtle conservation in Florida.

Bell, C.D.L., J. Parsons, T.J. Austin, A.C. Broderick, G. Ebanks-Petrie, and B.J. Godley. 2005. Some of them came home: The Cayman Turtle Farm headstarting project for the green turtle Chelonia mydas. Oryx 39(2): 137-148. https://doi.org/10.1017/S0030605305000372.

Bellman, M.A., A. May, T. Wendt, S. Gerlach, P. Remmers, and J. Brinkmann. 2020. Underwater noise during percussive pile driving: Influencing factors on pile-driving noise and technical possibilities to comply with noise mitigation values. Report edited by the itap GmbH for the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie) and supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit).

Bellmann, M.A. 2014. Overview of existing noise mitigation systems for reducing pile-driving noise. Inter-noise2014. Melbourne, Australia. https://www.acoustics.asn.au/conference_proceedings/INTERNOISE2014/papers/p358.pdf.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. (Chapter 8) In Lutz, P.L. and J.A. Musick (eds.). The Biology of Sea Turtles. Volume 1. CRC press, Boca Raton, FL. pp. 199-231.

Bochert, R., & Zettler, M. L. (2006). Effect of electromagnetic fields on marine organisms. In *Offshore wind energy: research on environmental impacts* (pp. 223-234). Berlin, Heidelberg: Springer Berlin Heidelberg.

Bohnsack, J.A. 1989. Are high densities of fishes at artificial reefs the result of habitat limitation or behavioral preference? Bulletin of Marine Science 44(2): 631-645.

Bohnsack, J.A., D.E. Harper, D.B. McClellan, and M. Hulsbeck. 1994. Effects of reef size on colonization and assemblage structure of fishes at artificial reefs off southeastern Florida, USA. Bulletin of Marine Science 55(2-3): 796-823.

Bouchard, S.S. and K.A. Bjorndal. 2000. Sea turtles as biological transporters of nutrients and energy from marine to terrestrial ecosystems. Ecology 81(8): 2305-2313.

Bräutigam, A. and K.L. Eckert. 2006. Turning the tide: Exploitation, trade and management of marine turtles in the Lesser Antilles, Central America, Colombia and Venezuela. A Traffic Report Commissioned by the Cites Secretariat. https://www.traffic.org/site/assets/files/5086/traffic_species_reptiles10.pdf.

Broadbent, H. A., Grasty, S. E., Hardy, R. F., Lamont, M. M., Hart, K. M., Lembke, C., ... & Murawski, S. (2020). West Florida Shelf pipeline serves as sea turtle benthic habitat based on in situ towed camera observations. *Aquatic Biology*, *29*, 17-31.

Burke, V.J., E.A. Standora, and S.J. Morreale. 1993. Diet of Juvenile Kemp's Ridley and Loggerhead Sea Turtles from Long Island, New York. Copeia 1993(4): 1176-1180. https://www.jstor.org/stable/144710.

Carballo, J.L., C. Olabarria, and T.G. Osuna. 2002. Analysis of Four Macroalgal Assemblages along the Pacific Mexican Coast during and after the 1997–98 El Niño. Ecosystems 5(8): 0749-0760. https://doi.org/10.1007/s10021-002-0144-2.

Casale, P., M. Affronte, G. Insacco, D. Freggi, C. Vallini, P. Pino d'Astore, R. Basso, G. Paolillo, G. Abbate, et al. 2010. Sea turtle strandings reveal high anthropogenic mortality in Italian waters. Aquatic Conserv: Mar Freshw Ecosyst 20(6): 611-620. https://doi.org/10.1002/aqc.1133.

Conant, R. 1975. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. The Peterson Field Guide Series. Houghton Mifflin Harcourt.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, et al. 2009. Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act. Report by the Loggerhead Biological Review Team for NMFS. 222 p. ftp://ftp.library.noaa.gov/noaa_documents.lib/NMFS/OfcProtectedResources/Status_Review/SR_loggerheadturtle_2009-ACCESSIBLE.pdf.

da Silva ACCD da, Castilhos JC de, Lopez GG, Barata PCR. 2007. Nesting biology and conservation of the olive ridley sea turtle (Lepidochelys olivacea) in Brazil, 1991/1992 to 2002/2003. Journal of the Marine Biological Association of the United Kingdom. 87(4):1047–1056. doi:10.1017/S0025315407056378.

DiMatteo, A., Roberts, J.J., Jones, D., Garrison, L., Hart, K.M., Kenney, R.D., Khan, C., McLellan, W.A., Lomac-MacNair, K., Palka, D., Rickard, M.E., Roberts, K., Zoidis, A.M., and Sparks, L. (2023). Sea turtle density surface models along the United States Atlantic coast; Version 1. Prepared for Naval Undersea Warfare Center Division Newport, Department of the Navy, by Duke University Marine Geospatial Ecology Laboratory. Technical Report in Preparation.

Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle Caretta caretta (Linnaeus 1758). US Fish and Wildlife Services. Biological Report 88 (44). 110 p. https://apps.dtic.mil/dtic/tr/fulltext/u2/a322813.pdf.

Eckert, K.L., B.P. Wallace, J.G. Frazier, and S.A. Eckert. 2012. Synopsis of the Biological Data on the Leatherback Sea Turtle (Dermochelys Coriacea). Biological Technical Publication. Createspace Independent Pub.

Eckert, S.A. 2002. Swim speed and movement patterns of gravid leatherback sea turtles (Dermochelys coriacea) at St. Croix, US Virgin Islands. Journal of Experimental Biology 205: 3689-3697. https://jeb.biologists.org/content/205/23/3689.

Epperly, S.P., S.S. Heppell, R.M. Richards, M.A. Castro Martínez, A.L. Sarti Martínez, L.J. Peña, and D.J. Shaver. 2013. Mortality rates of Kemp's ridley sea turtles in the neritic waters of the United States. 33rd Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Symposium. 8 Feb 2013. NOAA Technical Memorandum NMFS-SEFSC-645, Baltimore, MD, USA. https://repository.library.noaa.gov/view/noaa/4403.

Finneran, J.J., E.E. Henderson, D.S. Houser, K. Jenkins, S. Kotecki, and J. Mulsow. 2017. Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III). Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 p. https://apps.dtic.mil/dtic/tr/fulltext/u2/a561707.pdf.

Friedlander, A.M., E. Ballesteros, M. Fay, and E. Sala. 2014. Marine Communities on Oil Platforms in Gabon, West Africa: High Biodiversity Oases in a Low Biodiversity Environment. PLOS ONE 9(8). https://doi.org/10.1371/journal.pone.0103709.

Gallaway, B.J., S.T. Szedlmayer, and W.J. Gazey. 2009. A life history review for red snapper in the Gulf of Mexico with an evaluation of the importance of offshore petroleum platforms and other artificial reefs. Reviews in Fisheries Science 17(1): 48-67.

Gallaway, B.J., C.W. Caillouet, Jr., P.T. Plotkin, W.J. Gazey, J.G. Cole, and S.W. Raborn. 2013. Kemp's Ridley Stock Assessment Project. Report by LGL Ecological Research Associates, Inc., Marine Fisheries Scientist Conservation Volunteer, Texas Sea Grant, and W.J. Gazey Research for the Gulf States Marine Fisheries Commission. https://www.gsmfc.org/publications/Miscellaneous/Kemp Ridley Stock Assessment Report Final June 27 2013.pdf.

Geo-Marine. 2010. Ocean/Wind Power Ecological Baseline Studies: January 2008 – December 2009. Final Report. Volume III: Marine Mammal and Sea Turtle Studies. Report by Geo-Marine, Inc. for the New Jersey Department of Environmental Protection, Office of Science. https://tethys.pnnl.gov/sites/default/files/publications/Ocean-Wind-Power-Baseline-Volume3.pdf

Gitschlag, G.R., B.A. Herczeg, and T.R. Barcak. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf and Caribbean Research 9(4): 247-262.

Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg. 2010. The Northwest Atlantic Marine Ecoregional Assessment: Species, habitats and ecosystems. Phase One. Report by the Nature Conservancy, Eastern US Division, Boston, MA.

Groombridge, B. and R.A. Luxmoore. 1989. The green turtle and hawksbill (Reptilia: Cheloniidae): World status, exploitation and trade. Secretariat of the Convention on International Trade in Engangererd Species of Wild Fauna and Flora. http://archive.org/details/greenturtlehawks89groo.

Hannan, L.B., J.D. Roth, L.M. Ehrhart, and J.F. Weishampel. 2007. Dune vegetation fertilization by nesting sea turtles. Ecology 88: 1053-1058.

Hawkes, L.A., A.C. Broderick, M.S. Coyne, M.H. Godfrey, and B.J. Godley. 2007. Only some like it hot—quantifying the environmental niche of the loggerhead sea turtle. Diversity and Distributions 13(4): 447-457. https://doi.org/10.1111/j.1472-4642.2007.00354.x.

Insacco, G. and F. Spadola. 2010. First record of Kemp's ridley sea turtle, Lepidochelys kempii (Garman, 1880) (Cheloniidae), from the Italian waters (Mediterranean Sea). Acta Herpetologica 5(1). https://doi.org/10.13128/Acta_Herpetol-8540.

James, M. C., Myers, R. A., & Ottensmeyer, C. A. (2005). Behaviour of leatherback sea turtles, Dermochelys coriacea, during the migratory cycle. *Proceedings of the Royal Society B: Biological Sciences*, *272*(1572), 1547-1555.

Johnson, A. 2018. The Effects of Increased Turbidity and Suspended Sediment on ESA-Listed Species from Projects Occurring in the Greater Atlantic Region. Greater AtlanticRegion Policy Series. Document Number 18-02. Report by NOAA Fisheries, Greater Atlantic Regional FisheriesOffice, Gloucester, MA, USA. 106 p. https://www.greateratlantic.fisheries.noaa.gov/policyseries/index.php/GARPS/article/view/8/8.

Kraus, S.D., S. Leiter, K. Stone, B. Wikgren, C.A. Mayo, P. Hughes, R.D. Kenney, C.W. Clark, A.N. Rice, et al. 2016. Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2016-054, Sterling, Virginia. 117 + appendices p. https://www.boem.gov/RI-MA-Whales-Turtles/.

Lohmann KJ, Hester JT, Lohmann CMF (1999) Long-distance navigation in sea turtles. Ethol Ecol Evol 11:1-23

Lohmann KJ, Cain SD, Dodge SA, Lohmann CMF (2001) Regional magnetic fields as navigational markers for sea turtles. Science 294:364-366

Lowe, C.G., K.M. Anthony, E.T. Jarvis, L.F. Bellquist, and M.S. Love. 2009. Site fidelity and movement patterns of groundfish associated with offshore petroleum platforms in the Santa Barbara Channel. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 1(1): 71-89.

Lyn, H., A. Coleman, M. Broadway, J. Klaus, S. Finerty, D. Shannon, and M. Solangi. 2012. Displacement and Site Fidelity of Rehabilitated Immature Kemp's Ridley Sea Turtles (Lepidochelys kempii). Marine Turtle Newsletter 135: 10-13. http://www.seaturtle.org/mtn/archives/mtn135/mtn135p10.shtml.

Mansfield, K. L., Wyneken, J., & Luo, J. (2021). First Atlantic satellite tracks of 'lost years' green turtles support the importance of the Sargasso Sea as a sea turtle nursery. *Proceedings of the Royal Society B*, *288*(1950), 20210057.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, et al. 2000a. Marine seismic surveys: A study of environmental implications. Australian

Petroleum Production Exploration Association (APPEA) Journal 40(1): 692-708. https://doi.org/10.1071/AJ99048.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, et al. 2000b. Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Report Number R99-15. Prepared for Australian Petroleum Production Exploration Association by Centre for Maine Science and Technology, Western Australia. 198 p. https://cmst.curtin.edu.au/wp-content/uploads/sites/4/2016/05/McCauley-et-al-Seismic-effects-2000.pdf.

McMichael, E., A. Norem, R.R. Carthy, and T. Summers. 2006. Summary of 2003 cold stun turtles in St Joseph Bay, Florida. 23rd Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-536. 17-21 Mar 2003, Kuala Lumpur, Malaysia. pp. 184-186. https://repository.library.noaa.gov/view/noaa/4418.

McNeill, J. B., Avens, L., Hall, A. G., Fujisaki, I., & Iverson, A. R. (2020). Foraging and overwintering behavior of loggerhead sea turtles Caretta caretta in the western North Atlantic. *Marine Ecology Progress Series*, *641*, 209-225.

Meißner, K., H. Schabelon, J. Bellebaum, and H. Sordyl. 2006. Impacts of submarine cables on the marine environment: A literature review. Report by the Institute of Applied Ecology Ltd for the Federal Agency of Nature Conservation, Germany. 88 p.

Nedwell, J.R., J. Langworthy, and D. Howell. 2003. Assessment of Sub-Sea Acoustic Noise and Vibration from Offshore Wind Turbines and Its Impact on Marine Wildlife; Initial Measurements of Underwater Noise during Construction of Offshore Windfarms, And Comparison with Background Noise. Document Number 544 R 0424 Report Number 544 R 0424. Report by Subacoustech Ltd. for the Crown Estates Office. 68 p. http://www.subacoustech.com/wp-content/uploads/544R0424.pdf.

NOAA Fisheries. 2020. Loggerhead Turtle [accessed 27 Oct 2020]. https://www.fisheries.noaa.gov/species/loggerhead-turtle.

Normandeau Associates Inc. and APEM Inc. 2018. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Summer 2018 Taxonomic Analysis Summary Report. Report by Normandeau Associates Inc. and APEM Inc. for New York State Energy Research and Development Authority. https://remote.normandeau.com/docs/NYSERDA_Summer_2018_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates Inc. and APEM Inc. 2019a. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Spring 2019 Taxonomic Analysis Summary Report. Report by Normandeau Associates Inc. and APEM Inc. for New York State Energy Research and Development Authority. https://remote.normandeau.com/docs/NYSERDA_Spring_2019_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates Inc. and APEM Inc. 2019b. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Summer 2016–Spring 2018 Fourth Interim Report. Second annual report by Normandeau Associates Inc. and APEM Ltd. for New York State Energy Research. 149 p. https://remote.normandeau.com/docs/NYSERDA_2016-2018_4th_Semi-Annual_report.pdf.

Normandeau Associates Inc. and APEM Inc. 2019c. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Fall 2018 Taxonomic Analysis Summary Report. Report by Normandeau Associates Inc. and APEM Inc. for New York State Energy Research and Development Authority.
https://remote.normandeau.com/docs/NYSERDA_Fall_2018_Taxonomic_Analysis_Summary_Report.pdf.

Normandeau Associates Inc. and APEM Inc. 2020. Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Winter 2018-2019 Taxonomic Analysis Summary Report. Report by Normandeau Associates Inc. and APEM Inc. for New York State Energy Research and Development Authority.
https://remote.normandeau.com/docs/NYSERDA_Winter_2018_19_Taxonomic_Analysis_Summary_Report.pdf

Nuttall, S.M., and L.D. Wood. 2012. A comparison of hawksbill sea turtle site occupancy between natural and artificial reefs in Palm Beach County, FL, USA. In Jones, T.T., and B.P. Wallace, compilers, Proceedings of the thirty-first annual symposium on sea turtle biology and conservation, NOAA Technical Memorandum NMFS-SEFSC-631, pp. 152-153.

Patterson, W. 2010. The effect of unpublished artificial reefs deployed on the Northwest Florida Shelf. Final Report. Florida Fish and Wildlife Conservation Commission Grant Number FWC08267. 38 pp.

Petersen, J.K. and T. Malm. 2006. Offshore Windmill Farms: Threats to or Possibilities for the Marine Environment. Volume 35. Document Number 2 Report Number 0044-7447. Ambio Special Report. Royal Swedish Academy of Sciences. 75-80 p. https://doi.org/10.1579/0044-7447(2006)35[75:OWFTTO]2.0.CO;2

Piniak, W. E. D. (2012). *Acoustic ecology of sea turtles: Implications for conservation* (Doctoral dissertation, Duke University).

Piniak, W. E. D., Mann, D. A., Eckert, S. A., & Harms, C. A. (2012). Amphibious hearing in sea turtles. In *The effects of noise on aquatic life* (pp. 83-87). Springer New York.

Piniak, W. E., Mann, D. A., Harms, C. A., Jones, T. T., & Eckert, S. A. (2016). Hearing in the juvenile green sea turtle (Chelonia mydas): a comparison of underwater and aerial hearing using auditory evoked potentials. *PLoS One*, *11*(10), e0159711.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, et al. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014. SpringerBriefs in Oceanography. ASA Press and Springer. https://doi.org/10.1007/978-3-319-06659-2

Rostal, D.C. 2007. Reproductive physiology of the ridley sea turtle. (Chapter 7) In Plotkin, P.T. (ed.). Biology and conservation of ridley sea turtles. Johns Hopkins University Press. pp. 151–165.

Sammarco, P.W., A. Lirette, Y. Tung, G. Boland, M. Genazzio, and J. Sinclair. 2014. Coral communities on artificial reefs in the Gulf of Mexico: standing vs. toppled oil platforms. ICES Journal of Marine Science 71(2): 417-426.

Shaver, D.J., B.A. Schroeder, R.A. Byles, P.M. Burchfield, J. Peña, R. Márquez, and H.J. Martinez. 2005. Movements and Home Ranges of Adult Male Kemp's Ridley Sea Turtles (Lepidochelys kempii) in the Gulf of Mexico Investigated by Satellite Telemetry. Chelonian Conservation and Biology 4(4): 817-827.

Shaver, D.J. and T. Wibbels. 2007. Head-starting the Kemp’s ridley sea turtle. (Chapter 14) In Plotkin, P.T. (ed.). Biology and conservation of ridley sea turtles. Johns Hopkins University Press. pp. 297-323.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal Distributions and Abundances of Loggerhead and Leatherback Sea Turtles in Waters of the Northeastern United States. Herpetological Monographs 6: 43-67. http://www.jstor.org/stable/1466961.

Smolowitz, R.J., S.H. Patel, H.L. Haas, and S.A. Miller. 2015. Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (Caretta caretta) behavior on foraging grounds off the mid-Atlantic United States. Journal of Experimental Marine Biology and Ecology 471: 84-91. https://doi.org/10.1016/j.jembe.2015.05.016.

Stoneburner, D.L. 1982. Satellite telemetry of loggerhead sea turtle movement in the Georgia bight. Copeia 1982(2): 400-408.

Wilson, E.G., K.L. Miller, D. Allison, and M. Magliocca. 2010. Why Healthy Oceans Need Sea Turtles: The Importance of Sea Turtles to Marine Ecosystems. Report by Oceana. 17 p. https://oceana.org/reports/why-healthy-oceans-need-sea-turtles-importance-sea-turtles-marine-ecosystems.

Winton, M.V., G. Fay, H.L. Haas, M.D. Arendt, S.G. Barco, M.C. James, C. Sasso, and R.J. Smolowitz. 2018. Estimating the distribution and relative density of satellite-tagged loggerhead sea turtles using geostatistical mixed effects models. Marine Ecology Progress Series 586: 217-232. https://doi.org/10.3354/meps12396.

Witherington, B.E. 1997. The problem of photopollution for sea turtles and other nocturnal animals. Behavioral approaches to conservation in the wild: 303-328.

Witt, M.J., R. Penrose, and B.J. Godley. 2007. Spatio-temporal patterns of juvenile marine turtle occurrence in waters of the European continental shelf. Marine Biology 151(3): 873-885. https://doi.org/10.1007/s00227-006-0532-9.

### 4.9 Summary of Protected Species

Conserve Wildlife Foundation of New Jersey. 2021. Species Field Guide Search Results. [accessed 25 March 2021]. http://www.conservewildlifenj.org/species/fieldguide/search/all/.

NJDEP. 2020. Wildlife Species of Special Concern in New Jersey. [accessed 25 March 2021]. https://www.nj.gov/dep/fgw/spclspp.htm#:~:text=The%20term%20%22Species%20of%20Special,their%20becoming%20a%20Threatened%20species.

USFWS. 2020. Species Status Codes. [accessed 25 March 2021]. https://www.fws.gov/endangered/about/listing-status-codes.html#:~:text=Under%20Review%20(UR)%20%2D%20Species,published%20in%20the%20Federal%20Register.

USFWS. 2021. Endangered Species. [accessed 25 March 2021]. https://www.fws.gov/endangered/about/listing-status-codes.html.

### 5.0 Visual Resources

Brodie, Joseph F. and B. Frei. 2020. Initial Visibility Modeling Study for Offshore Wind for New Jersey's Atlantic Shores Offshore Wind Project. Center for Ocean Observing Leadership School of Environmental and Biological Sciences Rutgers. New Brunswick, New Jersey.

Capitol Airspace Group, 2021. *Atlantic Shores Offshore Wind Project Aircraft Detection Lighting System (ADLS) Efficacy Analysis.* Alexandria, VA.

Federal Aviation Administration (FAA). 2020. Obstruction Marking and Lighting. Advisory Circular AC 70/7460-1M. DOT/FAA/AR-TN 05/50. U.S. Department of Transportation, Washington, D.C.

Robert G. Sullivan, Leslie B. Kirchler, Jackson Cothren & Snow L. Winters (2013) Research Articles: Offshore Wind Turbine Visibility and Visual Impact Threshold Distances, Environmental Practice, 15:1, 33-49. [accessed 11 January 2021]. https://www.tandfonline.com/doi/abs/10.1017/S1466046612000464.

Smardon, R.C., J.F. Palmer, A. Knopf, K. Grinde, J.E. Henderson and L.D. Peyman-Dove. 1988. *Visual Resources Assessment Procedure for U.S. Army Corps of Engineers*. Instruction Report EL-88-1. Department of the Army, U.S. Army Corps of Engineers. Washington, D.C.

### 6.1 Aboveground Historic Properties

Advisory Council on Historic Preservation (ACHP). 2004. 36 CFR 800 – Protection of Historic Properties - Special Requirements for Protecting National Historic Landmarks (36 CFR 800.10). [accessed 11 January 2021]. https://www.achp.gov/sites/default/files/regulations/2017-02/regs-rev04.pdf.

Bureau of Ocean Energy Management (BOEM). 2020a. Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP). May 2020. United States Department of the Interior. Washington, D.C. [accessed 11 January 2021]. https://www.boem.gov/sites/default/files/documents/about-boem/Archaeology%20and%20Historic%20Property%20Guidelines.pdf.

BOEM. 2020b. OCS EIS/EA, BOEM 2020-025, Vineyard Wind 1 Offshore Wind Energy Project, Supplement to the Draft Environmental Impact Statement, June 2020. United States Department of the Interior, Washington, D.C. [accessed 11 January 2021]. https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf.

Code of Federal Regulations (CFR). 2019. 36 CFR 800 – Protection of Historic Properties [incorporating amendments effective August 5, 2004. https://www.govinfo.gov/content/pkg/CFR-2019-title36-vol1/pdf/CFR-2019-title36-vol1-part60.pdf.

Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR). 2021. Visual Impact Assessment, Atlantic Shores Offshore Wind, LLC, New Jersey, US. March 2021.

New Jersey State Historic Preservation Office (NJHPO). 2008. *Standards for Architectural Survey Reports.* New Jersey Administrative Code. New Jersey Department of Environmental Protection. Trenton, NJ. Effective February 2, 2008. [accessed 25 September 2020]. https://www.nj.gov/dep/hpo/2protection/register_historic_places09_29_08.pdf.

### 6.2 Terrestrial Archaeological Resources

Atlantic County Department of Regional Planning and Economic Development (Atlantic County Planning). 2000. *Atlantic County Master Plan*. Atlantic County Department of Regional Planning and Economic Development. Northfield, NJ.

Bache, A.D. 1864. *Absecom Inlet New Jersey; From a Trigonometrical Survey, under the direction of A.D. Bach, Superintendent of the SURVEY OF THE COAST OF THE UNITED STATES*. 1:20,000 scale. Accessed 9 November 2021. Available at http://mapmaker.rutgers.edu/.

Beers FW. 1872. Topographical map of Atlantic County, New Jersey: from recent and actual surveys. In state atlas of New Jersey: based on state geological surveys and from additional surveys. New York, NY: Beers, Comstock, and Cline. Library of Congress, Geography and Map Division; [accessed 16 October 2020]. https://lccn.loc.gov/2012586901.

Beers F.W. 1873. Atlas of Monmouth Co. New Jersey From Recent and Actual Surveys and Records. Beers, Comstock & Cline. New York, New York.

Boyer, C.S. 1931. Early Forges & Furnaces in New Jersey. University of Pennsylvania Press.

Braun D.P. 1974. Explanatory models for the evolution of coastal adaptation in prehistoric eastern New England. Am. Antiq. 39(4):582-596.

Bureau of Ocean Energy Management (BOEM). 2020. *Guidelines for Providing Archaeological and Historical Property Information Pursuant to 30 CFR Part 585*. United States Department of the Interior. Washington, D.C.

Chelser O, editor. 1982. New Jersey's archaeological resources: A review of research problems and survey priorities the Paleo-Indian period to the present. Trenton, NJ: Office of New Jersey Heritage, Department of Environmental Protection.

Chelser O, editor. 1984. Historic preservation planning in New Jersey: selected papers on the identification, evaluation, and protection of cultural resources. Trenton, NJ: Office of New Jersey Heritage, Department of Environmental Protection.

Chesler O, Richardson D. 1980. Annotated bibliography of cultural resource reports submitted to the New Jersey State historic preservation officer through December 31, 1979. Trenton, NJ: Office of New Jersey Heritage, Department of Environmental Protection.

Cook GH, Smock JC, and Vermeule CC. 1888. A topographical map of Egg Harbor and vicinity including the Atlantic shore from Barnegat to Great Egg Harbor. New York, NY: Julius Bien. David Rumsey Historical Map Collection; [accessed 16 October 2020].

Cunningham, J.T. 1997. Railroad in New Jersey. Afton Publishing Co., Inc. Andover, New Jersey.

Custer, J. F. 2001. *Classification Guide for Arrowheads and Spearpoints of Eastern Pennsylvania and the Central Middle Atlantic*. Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

Ellis, F. 1885. History of Monmouth County, New Jersey. R.T. Peck & Co. Philadelphia, Pennsylvania.

Environmental Design and Research (EDR). 2021a. Phase IA Terrestrial Archaeological Resources Assessment, Atlantic Shores Offshore Wind Project - Onshore Interconnection Facilities, Monmouth and Atlantic County, New Jersey. Report prepared by EDR for Atlantic Shores Offshore Wind. Syracuse, NY.

EDR. 2021b. Phase IA Terrestrial Archaeological Resources Assessment, Atlantic Shores Offshore Wind Project - Operations and Maintenance Facility, Atlantic City, Atlantic County, New Jersey. Report prepared by EDR for Atlantic Shores Offshore Wind. Syracuse, NY.

Gordon T. 1828. A map of the state of New Jersey: with part of the adjoining states. Trenton, NJ: T. Gordon. MIT Libraries, MIT GeoWeb; [accessed 22 October 2020]. https://geodata.mit.edu/catalog/princeton-9k41zg570.

Greater Egg Harbor Township Historical Society. 2020. Website. [accessed 22 October 2020]. https://www.gehthsmuseum.org/.

Grossman-Bailey, I. 2001. *"The People Who Lived By The Ocean": Native American Resource Use and Settlement In The Outer Coastal Plain of New Jersey*. Doctoral Thesis, Temple University.

Hall, John. F. 1900. History of Atlantic City and County, New Jersey. Daily Union Printing Company. Atlantic City, NJ.

Historic Aerials. 2020. Historic Aerials Viewer. Nationwide Environmental Title Research, LLC. [accessed 11 January 2021]. https://www.historicaerials.com/viewer.

Hopkins, G.M. 1860. Topographical Map of the State of New Jersey: Together with the Vicinities of New York and Philadelphia, and with Most of the State of Delaware: From the State Geological Survey and U.S. Coast Survey, and from Surveys. H.G. Bond.

Howell, G.W. 1878. The State of New Jersey 1877. From U.S. Coast Survey Records, N.J. Geological and Topographical Surveys and Various Local Surveys to Date. Woolman & Rose, Philadelphia, Pennsylvania.

Howell Heritage and Historical Society. 2020. [accessed 11 January 2021]. https://howellheritagehistoricalsociety.org/.

Meredith AB, Hood VP. 1921. Geography and history of New Jersey. Boston, MA: Ginn and Company.

Morrison RH. 1950. Outline history of New Jersey. New Brunswick, NJ: Rutgers University Press.

Mounier RA, Cresson J, Martin JW. 1993. New evidence of Paleoindian biface fluting from the outer coastal plain of New Jersey at 28-OC-100. Archaeol. East. N. Am. 21(Fall 1993):1-23.

National Park Service. 2018. Geology of the Atlantic coastal plain. Washington, D.C.: National Park Service; [accessed 22 October 2020]. https://www.nps.gov/articles/coastalplain.htm.

New Jersey Department of Environmental Protection (NJDEP). 2021. 1930s Aerial Photography of New Jersey. [accessed 2021 Sept 28]. https://img.nj.gov/imagerywms/BlackWhite1930.

New Jersey Historic Preservation Office (NJHPO). 2000. Guidelines for Preparing Cultural Resources Management Archaeological Reports Submitted to the Historic Preservation Office.

NJHPO. 2008. Guidelines for Phase I Archaeological Investigations: Identification of Archaeological Resources.

NJHPO. 2020. New Jersey and National Registers of Historic Places: Atlantic County. New Jersey Historic Preservation Office; [Updated June 25, 2020].

Pagoulatos P. 2003. Early Archaic settlement patterns of New Jersey. Archaeol. East. N. Am. 31(2003):15-43.

Pagoulatos P. 2004. Paleoindian site location in New Jersey. Archaeol. East. N. Am. 32(2004):123-149.

Parsons, F.W., ed. 1928. New Jersey Life, Industries and Resources of a Great State. New Jersey State Chamber of Commerce. Newark, New Jersey.

Polistina, V. 2002. *Egg Harbor Township Master Plan*. Prepared by Mott, Polistina & Associates, LLC. Egg Harbor Township, NJ.

Salter, E. 1890. History of Monmouth and Ocean Counties. E. Gardner & Son, Bayonne, New Jersey.

Sanborn Fire Insurance Map. 1886/1891/1903 editions. Egg Harbor City, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 22 October 2020]. https://www.loc.gov/collections/sanborn-maps/?fa=location:new+jersey%7Clocation:atlantic+county.

Sanborn Fire Insurance Map. 1889/1890/1905/1921 editions. Manasquan, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 11 January 2021]. https://www.loc.gov/collections/sanborn-maps/?q=Manasquan,+NJ.+Sanborn+Fire+Insurance+Map.

Sanborn Fire Insurance Map. 1890/1905 editions. Sea Girt, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 11 January 2021]. https://www.loc.gov/collections/sanborn-maps/?q=Sea+Girt,+NJ.+Sanborn+Fire+Insurance+Map.

Sanborn Fire Insurance Map. 1906/1921/1943 editions. Atlantic City, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 22 October 2020]. https://www.loc.gov/collections/sanborn-maps/?fa=location:new+jersey%7Clocation:atlantic+county.

Sanborn Fire Insurance Map. 1906/1911/1924 editions. Pleasantville, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 22 October 2020]. https://www.loc.gov/collections/sanborn-maps/?fa=location:new+jersey%7Clocation:atlantic+county.

Sanborn Fire Insurance Map. 1930 edition. Wall Township, NJ. Sanborn Fire Insurance Map Company, New York, NY. [accessed 11 January 2021]. https://www.loc.gov/collections/sanborn-maps/?q=Wall+Township,+NJ.+Sanborn+Fire+Insurance+Map.

Schrabisch M. 1915. Indian habitations in Sussex County in New Jersey. Union Hill, NJ: Dispatch Printing Company. Geological Survey of New Jersey. Bulletin 13.

Schrabisch M. 1917. Archaeology of Warren and Hunterdon Counties. Trenton, NJ: MacCrellish & Quigley Co. Department of Conservation and Development. Bulletin 18.

Spier L. 1915. Indian remains near Plainfield, Union Co., and along the Lower Delaware Valley. Union Hill, NJ: Dispatch Printing Company. Geological Survey of New Jersey. Bulletin 13.

Stanford, D.J., and B.A. Bradley. 2012. Across Atlantic ice: the origin of America's Clovis culture. Berkeley, CA: University of California Press.

Stanzeski AJ. 1996. Agate Basin and Dalton in a new home: 28 BU 214 in New Jersey. Archaeol East N. Am. 24(1996):59-79.

Stanzeski A. 1998. Four Paleoindian and early Archaic sites in southern New Jersey. Archaeol. East. N. Am. 26(1998):41-53.

Stanzeski AJ. 2005. Atlantic City site 28AT105: a Paleoindian site on the present day coast of New Jersey. Archaeol. East. N. Am. 33(2005):57-77.

Stewart, R. M., K. W. Carr, and P. A. Raber. 2015. *The Nature and Pace of Change in American Indian Cultures, Pennsylvania, 4000 to 3000 B.P.* Pennsylvania State University Press, State College.

Tuck JA. 1978. Regional cultural development 3000 to 300 B.C. In: Smithsonian Handbook of North American Indians. Washington, D.C.: Smithsonian Institution Press. Vol 15 Northeast, p. 28-43.

United States Geological Survey (USGS). 1890. Great Egg Harbor, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October, 2020]. https://ngmdb.usgs.gov/topoview/

USGS. 1893. Great Egg Harbor, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October 2020]. https://ngmdb.usgs.gov/topoview/.

USGS. 1894. Atlantic City, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October 2020]. https://ngmdb.usgs.gov/topoview/.

USGS. 1901. Asbury Park, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 11 January 2021]. https://ngmdb.usgs.gov/topoview/.

USGS. 1918. Great Egg Harbor, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October 2020]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1941. Atlantic City, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October 2020]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1943. Pleasantville, NJ. Topographic Quadrangle Map. 1:62,500-scale. Washington, D.C.: USGS; [accessed 22 October 2020]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1953. Point Pleasant, NJ. Topographic Quadrangle Map. 1:24,000-scale. Washington, D.C.: USGS; [accessed 11 January 2021]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1954. Asbury Park, NJ. Topographic Quadrangle Map. 1:24,000-scale. Washington, D.C.: USGS; [accessed 11 January 2021]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1954. Lakewood, NJ. Topographic Quadrangle Map. 1:24,000-scale. Washington, D.C.: USGS; [accessed 11 January 2021]. https://ngmdb.usgs.gov/topoview/ .

USGS. 1954. Farmingdale, NJ. Topographic Quadrangle Map. 1:24,000-scale. Washington, D.C.: USGS; [accessed 11 January 2021]. https://ngmdb.usgs.gov/topoview/ .

Veit R, Lattanzi GD, Bello CA. 2004. More precious than gold: a preliminary study of the varieties and distribution of pre-contact copper artifacts in New Jersey. Archaeol. East. N. Am. 32(2004):73-88.

Willis LLT, editor. 1915. Early history of Atlantic County New Jersey: record of the first year's work of Atlantic County's historical society. Kutztown, PA: Kutztown Publishing Company.

Wilson, C.W., Jr. 1974. Allaire Village. National Register of Historic Places Registration Form. National Park Service, U.S. Department of the Interior, Washington, D.C.

Wiser, S. and E. Walberg. 2008. *Comprehensive Master Plan Update, City of Pleasantville, Atlantic County, N.J.* Remington, Vernick & Walberg Engineers, Pleasantville, NJ.

Wolverton, C. 1889. Atlas of Monmouth County, "Howell Township." Chester Wolverton, New York, New York.

## 6.3 Marine Archaeological Resources

Atlantic Shores Offshore Wind, LLC (ASOW). 2020. Marine High-Resolution Geophysical Survey Plan. Submitted to Bureau of Ocean Energy Management, January 8, 2020; revised version submitted February 24, 2020.

Buchholz MT. 2004. New Jersey Shipwrecks: 350 Years in the Graveyard of the Atlantic. Down the Shore Publishing, Harvey Cedars, New Jersey.

Bureau of Ocean Energy Management (BOEM). 2013. 2013 Shipwreck Database. Atlantic Ocean, Outer Continental Shelf Region.

Bureau of Ocean Energy Management (BOEM). 2020. Guidelines for Providing Archaeological and Historic Properties Information Pursuant to 30 CFR Part 585. [Accessed 01 August 2021] https://www.boem.gov/sites/default/files/documents/about-boem/Archaeology%20and%20Historic%20Property%20Guidelines.pdf.

Cathie. 2020. Atlantic Shore Offshore Wind Farm Geotechnical Interpretive Report, Doc. No.C1193-R07.

Carey, JS, Sheridan, RE, Ashley, GM and Uptegrove, J. 2005. Glacially-influenced late Pleistocene stratigraphy of a passive margin: New Jersey's record of the North American ice sheet. Marine Geology, 218, 155–173.

Duncan, C. S., J. A. Goff, J. A. Austin, C. S. Fulthorpe, 2000. Tracking the last sea-level cycle: seafloor morphology and shallow stratigraphy of the latest Quaternary New Jersey middle continental shelf. Marine Geology, Volume 170, Issues 3–4, Pages 395-421, ISSN 0025-3227. [accessed 18 January, 2021]. https://doi.org/10.1016/S0025-3227(00)00082-7. http://www.sciencedirect.com/science/article/pii/S0025322700000827.

Emery K and Edwards RL. 1966. Archaeological Potential of the Atlantic Continental Shelf. American Antiquity 31:733-737.

R.C. Goodwin & Associates, Inc. (RCG&A). 2021a. Atlantic Shores Offshore Wind Project (Project Area) – Geoarchaeological Analyses. Technical Memorandum prepared for EDR, Inc.

RCG&A. 2021b. Marine Archaeological Resource Sensitivity Assessment - Geological and Cultural Contexts. Technical Memorandum prepared for EDR, Inc.

Lambeck, K, Esat, T, and Potter, EK. 2002. Links between climate and sea levels for the past three million years. Nature 419, 199–206 (2002). https://doi.org/10.1038/nature01089.

Marshall SB. 1982. Aboriginal Settlement in New Jersey During the Paleo-Indian Period, ca. 10,000 B.C. to 6,000 B. C. Electronic document. [accessed 18 May 2020]. https://www.nj.gov/dep/hpo/1identify/pg_10_AborigianalSettleNJMarshall.pdf#:~:text=ABORIGINAL%20SETTLEMENT%20IN%20NEW%20JERSEY%20DURING%20THE%20PALEO-INDIAN,and%20discuss%20Paleo-Indian%20site%20distribution,%20preservation,%20and%20protection.

National Oceanographic and Atmospheric Administration (NOAA/NOS). 1985. Bathymetric Chart of the Northeastern United States (Chart #BR1PT1). Electronic image. [accessed 14 July 2020]. https://historicalcharts.noaa.gov/historicals/search.

National Oceanographic and Atmospheric Administration (NOAA/NOS). 2018. Automated Shipwreck and Obstruction Information System (AWOIS): Section 5. Office of Coast Survey. Available at https://www.nauticalcharts.noaa.gov/index.html.

New Jersey Historic Preservation Office (NJHPO). 2008. Guidelines for Phase I Archaeological Investigations: Identification of Archaeological Resources. Website. [Accessed March 2022] https://www.nj.gov/dep/hpo/1identify/arkeoguide1.htm.

New York Archaeological Council (NYAC). 1994. Standards for Cultural Resources Investigations and the Curation of Archaeological Collections in New York State. New York State Historic Preservation Office, Waterford, NY.

Nordfjord S, Goff JA, Austin, Jr. JA and Gulick SP. 2006. Seismic facies of incised-valley fills, New Jersey Continental Shelf: Implications for erosion and preservation processes acting during latest Pleistocene-Holocene Transgression. Journal of Sedimentary Research 76:1284-1303.

2000. Approaches to New York (Nautical Chart #12300). National Ocean Survey. Electronic image. [accessed 13 July 2020]. https://historicalcharts.noaa.gov/historicals/search.

2018. Automated Shipwreck and Obstruction Information System (AWOIS): Section 5. Office of Coast Survey. [accessed 18 January 2021]. https://www.nauticalcharts.noaa.gov/index.html.

2020. Little Egg Inlet to Hereford Inlet (Chart #12318). NOAA Office of Coast Survey. Electronic Image. [accessed 18 January 2021]. https://charts.noaa.gov/OnLineViewer/12318.shtml.

(n.d.). Historical Map and Chart Collection. Office of Coast Survey. [accessed 18 January 2021]. https://historicalcharts.noaa.gov/historicals/search.

Pearson, C.E, S.R. James, Jr, M.C. Krivor, S.D. El Darragi, and L. Cunningham. 2003. Refining and Revising the Gulf of Mexico Outer Continental Shelf Region High-Probability Model for Historic Shipwrecks: Final report. Volume I: Executive Summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-060, 13 pp, 3 volumes.

Smith PC. 1996. Nearshore Ridges and Underlying Upper Pleistocene Sediments of the Inner Continental Shelf of New Jersey. Unpublished Master's thesis, Department of Geological Sciences, Rutgers University, New Brunswick, New Jersey.

TerraSond. 2020. TerraSond, Geophysical and Geohazard Survey, Atlantic Shores Wind, LLC. Project no. 2019-054.

TeraSond. 2020. TerraSond, Archaeological Assessment, Atlantic Shores Wind, LLC. Project No. 2019-054.

Tiemann, Frank J. n.d. A History of South Atlantic City and the Early Days of Margate. The Margate Historical Society and Museum. Margate Public Library

TRC Environment Corporation (TRC). 2012. *Inventory and Analysis of Archaeological Site Occurrence on the Atlantic Outer Continental Shelf*. OCS Study, BOEM 2012-008 [accessed 18 January 2021].https://espis.boem.gov/final%20reports/5196.pdf.

Uchupi, E., N. Driscoll, R.D. Ballard, and S.T. Bolmer. 2001 Drainage of late Wisconsin glacial lakes and the morphology and late quaternary stratigraphy of the New Jersey – southern New England continental shelf and slope. In Marine Geology 172, pp. 117-145.

Waelbroeck, C, Labeyrie L, Michel M, Duplessy JC, McManus JF, Lambeck K, Balbon E, Labracherie M. 2002. Sea-level and deep water temperature changes derived from benthic foraminifera isotopic records. Quaternary Science Reviews. 21 (2002): 295-305.

## 7.1 Demographics, Employment, and Economics

IMPLAN model, 2019 Data, using inputs provided by the user and IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078. www.IMPLAN.com

NOAA Office For Coastal Management. 2020. *Economics: National Ocean Watch*. [accessed 14 October 2020]. https://coast.noaa.gov/digitalcoast/data/enow.html.

U.S. Bureau of Economic Analysis. 2017-2018. Regional Data, GDP & Personal Income, Tables CAGDP1 and SQGDP9. [accessed 14 October 2020]. https://apps.bea.gov/iTable/index_regional.cfm.

U.S. Bureau of Economic Analysis. 2017 and 2021. CAGDP1 County and MSA gross domestic product (GDP) summary. [accessed August 18, 2023]. https://apps.bea.gov/itable/?ReqID=70&step=1.

U.S. Bureau of Labor Statistics. 2021. State Unemployment Rates, seasonally adjusted. https://www.bls.gov/charts/state-employment-and-unemployment/state-unemployment-rates-map.htm

U.S. Census Bureau. 2000 & 2010. Decennial Census. Total Population, Table P001. [accessed 14 October 2020]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2010. U.S. Census Bureau QuickFacts. Population Density and Land Area (Sq. Mi.). [accessed 14 October 2020]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 1-Year Estimates, Table DP03. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey Supplemental Estimates. Industry for the Civilian Employed Population 16 Years and Over, Table K202403. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Per Capita Income, Table DP03. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Population, Age, and Sex, Table S0101. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Labor Force and Employment, Table S2301. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-Year Estimates. Land Area data from U.S. Census Bureau QuickFacts 2020. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Selected Housing Characteristics, Table DP04. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Total Population 1 Years and Over & Labor Force Participation Rate, Table DP03. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Vacant Status, Table B25004. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

U.S. Census Bureau. 2021. American Community Survey 5-year Estimates. Owner-Occupied Housing Units Value, Table B25075. [accessed 10 August 2023]. https://data.census.gov/cedsci/.

### 7.2 Environmental Justice

Council on Environmental Quality, 1997. Environmental Justice Guidance Under the National Environmental Policy Act. [accessed 14 October 2020]. https://ceq.doe.gov/docs/ceq-regulations-and-guidance/regs/ej/justice.pdf.

New York City Council. 2017. Local Law 2017/060: Identifying and addressing environmental justice issues. [accessed 2 November 2020]. https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=1805815&GUID=8901A89B-078E-4D47-88D8-EA3E48E715A1&Options=ID|Text|&Search=.

New York City Department of Health. 2020. Environment & Health Data Portal. [accessed 2 November 2020]. http://a816-dohbesp.nyc.gov/IndicatorPublic/publictracking.aspx.

New York State Department of Environmental Conservation. (2003). Commissioner Policy 29, Environmental Justice and Permitting. [accessed 2 November 2020]. https://www.dec.ny.gov/regulations/36951.html.

New York State Department of Environmental Conservation. 2020. Maps & Geospatial Information System (GIS) Tools for Environmental Justice. [accessed 2 November 2020]. https://www.dec.ny.gov/public/911.html.

State Of New Jersey 219th Legislature. 2020. New Jersey Senate, No. 232. [accessed 14 October 2020]. https://www.njleg.state.nj.us/bills/BillView.asp?BillNumber=S232.

Texas Commission on Environmental Quality. 2023. Title VI Compliance at TCEQ. [accessed 18 August 2023]. https://www.tceq.texas.gov/agency/decisions/participation/title-vi-compliance.

U.S. Environmental Protection Agency. 2015. Guidance on Considering Environmental Justice During the Development Of Regulatory Actions. [accessed 14 October 2020]. https://www.epa.gov/sites/production/files/2015-06/documents/considering-ej-in-rulemaking-guide-final.pdf.

U.S. Environmental Protection Agency. 2019. EJSCREEN: Environmental Justice Screening and Mapping Tool, EJSCREEN Data. [accessed 2 November 2020]. https://www.epa.gov/ejscreen/download-ejscreen-data.

Virginia Legislative Information System. 2020. 2020 Session SB 406. [accessed 17 August 2023]. https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+SB406S#:~:text=Virginia%20Environmental%20Justice%20Act.&text=Under%20the%20bill%2C%20state%20agencies,of%20the%20regulation%20or%20policy.

Virginia Legislative Information System. 2023. Code of Virginia Article 12 Virginia Environmental Justice Act - § 2.2-234. [accessed 17 August 2023]. https://law.lis.virginia.gov/vacodefull/title2.2/chapter2/article12/.

### 7.3 Recreation and Tourism

Carr-Harris, Andrew and Corey Lang. 2019. Sustainability and tourism: the effect of the United States' first offshore wind farm on the vacation rental mark. Resource and Energy Economics, Volume 57, August 2019, Pages 51-67.

Global Insight. 2008. An Assessment of the Potential Coasts and Benefits of Offshore Wind Turbines, A Report for the State of New Jersey. Global Insight Travel & Tourism. September 2008. pp. 102.

ICF Incorporated, L.L.C. 2012. Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2012-085, 35 pp.

Leonhard, S. B., Stenberg, C., Støttrup, J., Deurs, M. V., Christensen, A., & Pedersen, J. 2013. Fish benefits from offshore wind farm development. In Danish offshore wind - key environmental issues – a follow-up (pp. 31- 45). Danish Energy Agency. https://backend.orbit.dtu.dk/ws/portalfiles/portal/55080896/Havvindm_llebog.pdf

Lieberman Research Group. 2006. New Jersey Shore Opinions About Off-Shore Wind Turbines. Presentation to the New Jersey Commerce, Economic Growth & Tourism Commission and Brushfire, Inc. [published September 14, 2006; accessed 3 February 2021]. http://www.njcleanenergy.com/files/file/document.pdf.

Marine Trades Association of New Jersey (MTANJ). 2008. Recreational Boating in New Jersey: An Economic Impact Analysis. Prepared by HDR for the MTA NJ. [published April 2008; accessed 3 February 2021]. https://www.mtanj.org/ecoimpact.html.

National Marine Manufacturers Association (NMMA). 2018. Recreational Boating: An American Pastime & Economic Engine. [Accessed 18 August 2023]. https://www.mtanj.org/PDF/NMMAEcononomicSignificanceNJ.pdfNational Marine Manufacturers Association (NMMA). 2023. Recreational Boating: Impact in New York. [Accessed 18 August 2023]. https://www.nmma.org/statistics/publications/economic-impact-infographics

National Oceanic and Atmospheric Administration (NOAA). 2018. Fisheries Economics of the United States 2018. [Accessed February 2022] https://media.fisheries.noaa.gov/2021-11/FEUS-2018-final-508_0.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2019. Fisheries Office of Science and Technology, Commercial Landings Query. [accessed 18 June 2020]. https://foss.nmfs.noaa.gov/apexfoss/f?p=215:200

[NOAA MRIP] National Oceanic and Atmospheric Administration Marine Recreational Information Program. 2017. Recreational Fishing Data and Statistics Queries. [accessed November 2020]. https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index.

NJ Department of Environmental Protection (NJDEP). 2021. State, Local and Nonprofit Open Space of New Jersey (Land_owner_openspace). Edition 20200729. [published January 19, 2021, accessed 3 February 2021]. https://njogis-newjersey.opendata.arcgis.com/datasets/4a1f9d3075a04cd792a14f78b9697df3_65

New Jersey Board of Public Utilities (NJBPU) and the Interagency Taskforce on Offshore Wind, 2020. New Jersey Offshore Wind Strategic Plan (DRAFT July 2020). Prepared by Ramboll U.S. Corporation, Princeton, NJ.

New Jersey Division of Fish and Wildlife (NJDFW). 2021. New Jersey's Artificial Reefs. [Accessed February 2022] https://www.state.nj.us/dep/fgw/images/marine/reefsites.jpg

New Jersey Sea Grant Consortium (NJSGC). 2022. Recreational Fishing and Boating. [Accessed November 2022] https://njseagrant.org/extension/recreational-fishing/

[NYS] New York State. 2019. Parks, Recreation and Historic Preservation, 2019 Recreational Boating Report [Accessed 01 April 2022]. https://parks.ny.gov/documents/recreation/boating/RecreationalBoatingReport2019.pdf

New York State Department of Environmental Conservation (NYSDEC). 2022. Artificial Reef Locations. [Accessed February 2022] https://www.dec.ny.gov/outdoor/71702.html.

New York State Energy Research and Development Authority (NYSERDA). 2017a. "New York State Offshore Wind Master Plan Fish and Fisheries Study." 17–25. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/Master-Plan/17-25j-Fish-and-FisheriesStudy.pdf

New York State Energy Research and Development Authority (NYSERDA). 2021. "Offshore Wind Climate Adaptation and Resiliency Study," NYSERDA Report Number 21-04. Prepared by ICF International, Inc., Fairfax, VA. nyserda.ny.gov/publications.

Office of the New York State Comptroller (ONYSC). 2021. The Tourism Industry in New York City. [Accessed February 2022] https://www.osc.state.ny.us/reports/osdc/tourism-industry-new-york-city.

Parsons, G. Firestone, J., 2018. Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-013. 52 p.

Parson, George, Jeremy Firestone, Lingxiao Yan, and Jenna Toussaint, 2020. The effect of offshore wind power projects on recreational beach use on the east coast of the United States: Evidence from contingent-behavior data. Published in Energy Policy, Volume 144, September 2020, 111659.

Sea Grant New York (Sea Grant). 2004. Recreational Boating Expenditures in 2003 in New York State and Their Economic Impacts. [Accessed February 2022] https://seagrant.sunysb.edu/marina/pdfs/BoatingReport-FINAL.pdf.

Ten Brink, Talya S., and Tracey Dalton. 2018. "Perceptions of Commercial and Recreational Fishers on the Potential Ecological Impacts of the Block Island Wind Farm (US)." Frontiers in Marine Science 5. https://doi.org/10.3389/fmars.2018.00439

Tourism Economics. 2018. Economic Impact of Tourism in New Jersey, 2017. Prepared for the State of New Jersey. [published January 2018; accessed November 2020]. https://www.visitnj.org/sites/default/files/2017-nj-economic-impact.pdf.

Tourism Economics. 2021. Economic Impact of Tourism in New Jersey. [Accessed February 2022] https://visitnj.org/sites/default/files/2020-nj-economic-impact_5-6-20.pdf.pdf.

Tourism Economics. 2023. The New Jersey Visitor Economy 2022. [Accessed 18 August 2023]. https://visitnj.org/sites/default/files/2023-05/2022_Tourism_Economic_Impact_Study.pdf

### 7.4 Commercial Fisheries and For-Hire Recreational Fishing

Azavea. 2020. Fishing route analytics report. Report prepared for Last Tow, LLC. February 3, 2020.

Benjamin S, Lee MY, DePiper G. 2018. Visualizing Fishing Data as Rasters.  Woods Hole (MA): Northeast Fisheries Sciences Center. Ref Doc 18-12. [published December 2018; accessed 15 October 2020]. https://repository.library.noaa.gov/view/noaa/23030.

[BOEM] Bureau of Ocean Energy Management. 2020. Vineyard Wind 1 Offshore Wind Energy Project Supplement to the Draft Environmental Impact Statement. OCS EIS/EA BOEM 2020-025. [published June 2020; accessed 22 October 2020]. https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf.

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial wind lease issuance and site assessment activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts: environmental assessment.

https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/BOEM_RI_MA_EA_2012-070_719.pdfDePiper GS. 2014. Statistically assessing the precision of self-reported VTR fishing locations. Woods Hole (MA): Northeast Fisheries Sciences Center. NOAA Technical Memorandum NMFS-NE-229. [published June 2014; accessed 31 August 2020]. http://doi.org/10.7289/V53F4MJN

Fontenault J. 2018. Vessel Monitoring Systems (VMS) commercial fishing density Northeast and Mid-Atlantic Regions. [published April 2018; accessed 15 September 2020]. https://www.northeastoceandata.org/files/metadata/Themes/CommercialFishing/VMSCommercialFishingDensity.pdf

[GSSA] Garden State Seafood Association. Gillnet Fishing. Cape May (NJ): New Jersey Fishing Sponsored by the Garden State Seafood Association. [accessed 24 February 2021].

https://www.fishingnj.org/techgn.htm#:~:text=Species%20sought%20by%20gillnetters%20in,and%20chips%22)%20and%20shad.

Hutt CP, Silva G. 2015. The economics of Atlantic highly migratory species for-hire fishing trips, July-November 2013. National Oceanic and Atmospheric Administration Technical Memorandum. NMFS-OSF-4. [published November 2015; accessed 31 January 2021]. https://repository.library.noaa.gov/view/noaa/9064.

Hoffman EE, Powell EN, Klinck JN, Munrow DM, Mann R, Haidvogel DB, Narvael, DA, Zhang X, Kuykendall, KM. 2018. An Overview of factors affecting distribution of the Atlantic surfclam (*Spisula solidissima*), a continental shelf biomass dominant, During a Period of Climate Change. Journal of Shellfish Research, 37(4):821-831. [published October 2018; accessed February 2020]. http://www.bioone.org/doi/full/10.2983/035.037.0412.

Kirkpatrick AJ, Benjamin S, DePiper G, Murphy T, Steinbeck S, Demarest C. 2017. Socio-Economic impact of outer continental shelf wind energy development on fisheries in the U.S. Atlantic. OCS Study BOEM 2017-012. Prepared under BOEM Interagency Agreement No: M12PG00028 by National Oceanic and Atmospheric Administration National Marine Fisheries Service Northeast [published February 2017; accessed 15 September 2020]. https://espis.boem.gov/final%20reports/5580.pdf.

[MARCO] Mid-Atlantic Regional Council on the Ocean. 2016. Mid-Atlantic Ocean Data Portal. Williamsburg (VA). [accessed 1 December 2020]. https://portal.midatlanticocean.org/.

[NOAA] National Oceanic and Atmospheric Administration, Northeast Fisheries Science Center. 2014. Snapshots of human communities and fisheries in the Northeast. [accessed 2021 September 6]. https://apps-nefsc.fisheries.noaa.gov/read/socialsci/communitySnapshots.php.

New Jersey Department of Agriculture. New Jersey fishing and aquaculture: harvesting the Garden State's waters. [accessed 1 December 2020]. https://www.jerseyseafood.nj.gov/seafoodreport.pdf.

[NMFS] National Marine Fisheries Service. 2020. Atlantic Shores Wind Summary [dataset]. Report prepared for Atlantic Shores. 16 April 2022.

[NMFS] National Marine Fisheries Service. 2023. Descriptions of Selected Fishery Landings and Estimates of Vessel Revenue from Areas: A Planning-level Assessment. [published March 1; accessed 19 September 2023].
https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/com/OCS_A_0549_Atlantic_Shores_North_com.html

[NMFS] National Marine Fisheries Service. 2021b. Descriptions of Selected Fishery Landings and Estimates of Recreational Party and Charter Vessel Revenue from Areas: A Planning-level Assessment. [published March 1; accessed 1 September 2023].
https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/rec/OCS_A_0549_Atlantic_Shores_North_rec.html

[NOAA] National Oceanic and Atmospheric Administration. 2020. Annual commercial landings statistics [dataset]. [accessed 19 September 2023]. https://www.fisheries.noaa.gov/foss.

[NOAA MRIP] National Oceanic and Atmospheric Administration Marine Recreational Information Program. 2021. Recreational Fishing Data and Statistics Queries. [accessed 24 April 2022]. https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index.

[NROC] Northeast Regional Ocean Council. 2009. Northeast Ocean Data Portal. [accessed 1 December 2020]. www.northeastoceandata.org

SUBCOM. 2019. Coastal Consistency Review Application – HAVFRUE Cable System Project. [published June 2019; accessed 24 February 2021]. https://www.dos.ny.gov/opd/programs/pdfs/Consistency/F-2019-0606_ApplicationForPN.pdf.

[USCG] U. S. Coast Guard. 2020. The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. Final Report, 14 May 2020. USCG-2019-0131.

[USCG NAVCEN] U.S. Coast Guard Navigation Center. 2017. AIS Requirements. [accessed 28 April 2022] https://www.navcen.uscg.gov/?pageName=AISRequirementsRev

### 7.5 Land Use and Coastal Infrastructure

N/A.

### 7.6 Navigation and Vessel Traffic

[BWEA] British Wind Energy Association. (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm.

Azavea. (2020). Fishing Route Analytics Report. Report prepared for Last Tow, LLC. February 3.

U.S. Coast Guard (2015). The Atlantic Coast Port Access Route Study. Final Report, 08 July 2015. USCG-2011-0351.

U.S. Coast Guard. (2020). The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. Final Report, 14 May 2020. USCG-2019-0131.

### 7.7 Other Marine Uses and Military Activities

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia- Final Environmental Assessment. OCS EIS/EA BOEM 2012-003.

BOEM. 2017. Munitions and Explosives of Concern Survey Methodology and In-field Testing for Wind Energy Areas on the Atlantic Outer Continental Shelf. U.S. Department of Interior, Bureau of Ocean Energy Management. Sterling, Virginia.

BOEM. 2020a. Atlantic Outer Continental Shelf Aliquots with Sand Resources [dataset]. Sterling, (VA): U.S. Department of Interior, Bureau of Ocean Energy Management, Marine Minerals Program; [published 2020 February 19; accessed 1 December 2020]. https://www.marinecadastre.gov/data/.

BOEM. 2020b. Federal Outer Continental Shelf (OCS) Sand and Gravel Borrow Areas (Lease Areas). [dataset]. Sterling, (VA): U.S. Department of Interior, Bureau of Ocean Energy Management, Marine Minerals Program; [published 2020 February 19; accessed 1 December 2020]. https://www.marinecadastre.gov/data/.

Celestino M, Pyle J, Barry L, Hinks G. 2014. NJ Fisheries Surveys: Signals from our Research. Trenton (NJ): New Jersey Fish and Wildlife; [accessed 2020 December 1]; https://www.njfishandwildlife.com/pdf/2014/digmar6-11.pdf.

Commander, Navy Installations Command Notification (CNICN) [date unknown]. Mission Statement. [accessed 1 December 2020]. https://www.cnic.navy.mil/regions/cnrma/installations/nws_earle/about/mission_and_vision.html.

Department of Homeland Security. 2017. Station Manasquan [Squan] Beach, New Jersey. [accessed 1 December 2020]. https://media.defense.gov/2017/Jul/04/2001772994/-1/-1/0/SQUANBEACH.PDF.

Environmental Protection Agency (EPA). 2020. Ocean Disposal Site Designation. Washington D.C.: EPA Ocean Dumping Management Program; [updated 2020 September 11; accessed 1 December 2020]. https://www.epa.gov/ocean-dumping/ocean-disposal-site-designation.

[GOANG] Go Air National Guard. 2020. Atlantic City Air National Guard Base. [accessed 1 December 2020] https://www.goang.com/locations/new-jersey/atlantic-city-air-national-guard-base.html.

Joint Base McGuire-Dix-Lakehurst [date unknown]. About Us. [accessed 1 December 2020]. https://www.jbmdl.jb.mil/About-Us/About-Us/.

Secretary of Defense. 2003. Report of the Defense Science Board Task Force on Unexploded Ordnance. Washington D.C: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics; 20301-3140.

Marines. 2022. 6th Communication Battalion – Force Headquarters Group Marine Corps Forces Reserve. [accessed 23 February 2022]. https://www.marforres.marines.mil/Major-Subordinate-Commands/Force-Headquarters-Group/6th-Communication-Battalion/.

Military Installations. 2021. Fort Hamilton In-Depth Overview. [accessed 23 February 2021]. https://installations.militaryonesource.mil/in-depth-overview/fort-hamilton.

National Guard. 2020. Joint Operations Center coordinates NJ COVID-19 response. [published 27 April 2020; accessed 30 November 2020]. https://www.nationalguard.mil/News/Article/2165762/joint-operations-center-coordinates-nj-covid-19-response/.

[NAWCAD] Naval Air Warfare Center Air Division [date unknown]. NAWCAD Lakehurst. [accessed 1 December 2020]. https://www.navair.navy.mil/lakehurst/.

[NEFSC] Northeast Fisheries Science Center. 2020. 2019 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS II. Woods Hole (MA): NEFSC.

New Jersey Department of Military and Veterans Affairs. 2020. National Guard Training Center. Trenton (NJ); [accessed 30 November 2020]. https://www.nj.gov/military/admin/departments/ngtc/.

[NOAA] National Oceanic and Atmospheric Administration. 2015. North American Submarine Cable Association Submarine Cables. [dataset]. Charleston (SC): NOAA Office of Coastal Management; [published 2015 August; accessed 1 December 2020]. https://www.marinecadastre.gov/data/.

NOAA. 2017. Anchorage Areas [dataset]. Charleston (SC): NOAA Office for Coastal Management; [published 2017 September 20; updated 2022 August 9; accessed 2022 September 21]. https://marinecadastre.gov/data/.

NOAA. 2018a. Unexploded Ordinances. [dataset]. Charleston (SC): NOAA Office for Coastal Management; [published 2018 December 12; accessed 2020 December 1]. https://marinecadastre.gov/data/.

NOAA. 2018b. Ocean Disposal Sites. [dataset]. Charleston (SC): NOAA Office for Coastal Management; [published 2018 October 31; accessed 1 December 2020]. https://www.fisheries.noaa.gov/inport/item/54193.

NOAA. 2018c. NOAA Charted Submarine Cables. [dataset]. Charleston (SC): NOAA Office of Coastal Management; [published 2018 May 1; accessed 1 December 2020]. https://marinecadastre.gov/data/.

NOAA. 2019. Military Operating Area Boundary. [dataset]. Charleston (SC): NOAA Office of Coastal Management; [published 2019 February 2; accessed 1 December 2020]. https://www.marinecadastre.gov/data/.

NOAA. 2020a. Beach Nourishment Projects. [dataset]. Charleston (SC): NOAA Office of Coastal Management; [published 2020 June 23; accessed 1 December 2020]. https://marinecadastre.gov/data/.

NOAA. 2020b. InPort: Bottom Trawl Surveys. [updated 9 August 2022; accessed 18 August 2023]. https://www.fisheries.noaa.gov/inport/item/22557

NOAA. 2022. NOAA Northeast Sea Scallop Survey Results. [published 27 June 2022; accessed 18 August 2023]. https://www.fisheries.noaa.gov/feature-story/2022-noaa-northeast-sea-scallop-survey-results

NOAA. 2023. InPort: Atlantic Surfclam and Ocean Quahog Survey. [data set]. [updated 15 August 2023; accessed 18 August 2023]. https://www.fisheries.noaa.gov/inport/item/22565

[NYSDEC] New York State Department of Environmental Conservation. 2022a. Ocean Monitoring Projects: Nearshore Ocean Trawl Survey. [accessed 18 August 2023]. https://www.dec.ny.gov/lands/111178.html#:~:text=Nearshore%20Ocean%20Trawl%20Survey,-SoMAS%20and%20DEC&text=Establishing%20baseline%20information%20and%20long,for%20many%20important%20fish%20species.

NYSDEC. 2022b. Passive Acoustic Survey. [accessed 18 August 2023]. https://www.dec.ny.gov/lands/113828.html

NYSDEC. 2022c. Aerial Survey. [accessed 2022 September 21]. https://www.dec.ny.gov/lands/113818.html.

United States Army. 2019. About Picatinny. [updated 2020 March 19; accessed 1 December 2020]. https://www.pica.army.mil/Picatinny/about/default.aspx.

[USACE]. United States Army Corps of Engineers. 2019. New York and New Jersey Harbor Anchorages General Reevaluation Report and Environmental Assessment. Norfolk (VA): USACE Norfolk District.

USACE. 2022. NY District Coastal Storm Risk Reduction Projects and Studies Map; [accessed 2022 April 19]. https://www.nan.usace.army.mil/About/Hurricane-Sandy/Coastal-Storm-Risk-Reduction-Projects-and-Studies/

USACE. 2022. NY District Coastal Storm Risk Reduction Projects and Studies Map; [accessed 2022 April 19]. https://www.nan.usace.army.mil/About/Hurricane-Sandy/Coastal-Storm-Risk-Reduction-Projects-and-Studies/.

[USCG]. United States Coast Guard. Station Manasquan [Squan] Beach, New Jersey [date unknown (a)]. [1 December 2020]. https://media.defense.gov/2017/Jul/04/2001772994/-1/-1/0/SQUANBEACH.PDF.

USCG. Atlantic City, New Jersey [date unknown (b)]. [1 December 2020]. https://www.atlanticarea.uscg.mil/Our-Organization/District-5/District-Units/Air-Station-Atlantic-City/Missions/.

USCG. Mission [date unknown(c)]. [accessed 2020 December 1]. https://www.mycg.uscg.mil/Missions/#:~:text=The%20mission%20of%20the%20United,maritime%20safety%2C%20security%20and%20stewardship.

USCG. Training Center Cape May [date unknown (d)]. [accessed 1 December 2020]. https://www.forcecom.uscg.mil/Our-Organization/FORCECOM-UNITS/TraCen-Cape-May/.

USCG. Station Ocean City, Maryland [date unknown (e)]. [accessed 1 December 2020]. https://media.defense.gov/2017/Jul/04/2001772874/-1/-1/0/OCEANCITYMD.PDF.

[USGS] United States Geological Survey 2007. United States Coast Guard (USCG) Units. [dataset]. USGS Logistics Geospatial Integration Center; [published 10 January 2007; 1 December 2020]. https://www.sciencebase.gov/catalog/item/4f4e4783e4b07f02db483873.

United States Navy. Mission and Vision [date unknown]. [accessed 2020 November]. https://www.cnic.navy.mil/regions/cnrma/installations/nws_earle/about/mission_and_vision.html.

## 7.8 Aviation and Radar

Federal Aviation Administration (FAA). 2011. Aeronautical Information Manual, Section 5. Surveillance Systems. [accessed 23 March 2021]. https://tfmlearning.faa.gov/Publications/atpubs/AIM/Chap4/aim0405.html.

FAA. 2016. United States Standard for Performance Based Navigation (PBN) Instrument Procedure Design. AFS-400 8260.58A. [published March 2016; accessed 13 August 2020]. https://www.faa.gov/documentLibrary/media/Order/FAA_Order_8260.58A_Including_Change_1_and_2.pdf.

FAA. 2018a. Obstruction Evaluation/Airport Airspace Analysis Desk Reference Guide. IOE/AAA V_2018 2.0. [published 2020; accessed 23 March 2021]. https://oeaaa.faa.gov/oeaaa/downloads/external/content/deskReferenceGuides/Download%20Archives%20-%20Desk%20Reference%20Guide%20V_2018.2.0.pdf.

FAA. 2018b. United States Standard for Terminal Instrument Procedures (TERPS). AFS-400 8260.3DE. [published February 2018; accessed 2020 13 August 2020]. https://www.faa.gov/documentLibrary/media/Order/Order_8260.3D_vs3.pdf

FAA. 2019. Procedures for Handling Airspace Matters. AJV-O 7400.2M. [accessed 2021 23 March 2021]. https://www.faa.gov/air_traffic/publications/atpubs/pham_html/.

FAA. 2020. Advisory Circular: Obstruction Marking and Lighting. AJV-P13 AC 70/7460-1M. [published November 2020; accessed 23 March 2021]. https://www.faa.gov/documentLibrary/media/Advisory_Circular/Advisory_Circular_70_7460_1M.pdf

FAA. 2021a. Aeronautical Data. National Airspace System Resource (NASR). [accessed 23 March 2021]. https://www.faa.gov/air_traffic/flight_info/aeronav/Aero_Data/#:~:text=The%20Aeronautical%20Data%20Team%20is%20responsible%20for%20the,and%20status%20of%20all%20components%20of%20the%20NAS

FAA. 2021b. Airport Airspace Analysis. [accessed 23 March 2021]. https://www.faa.gov/airports/engineering/airspace_analysis/.

FAA. 2021c. U.S. Terminal Procedures Publication. [accessed 23 March 2021]. https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/dtpp/.

14 C.F.R. §77.9. 2010. Safe, Efficient Use, and Preservation of the Navigable Airspace. FR 35 (139), 42296-42308. [published July 2010; accessed 23 March 2021]. https://www.govinfo.gov/content/pkg/FR-2010-07-21/pdf/2010-17767.pdf.

### 7.9 Onshore Transportation and Traffic

N/A.

### 8.0 Onshore Transportation, Traffic, and Noise

[EPA] Environmental Protection Agency. 1971 Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances". US Environmental Protection Agency Office of Noise Abatement and Control; prepared by Bolt, Beranek, and Newman, December 31, 1971.

Bellman, M.A., A. May, T. Wendt, S. Gerlach, P. Remmers, and J. Brinkmann. 2020. Underwater noise during percussive pile driving: Influencing factors on pile-driving noise and technical possibilities to comply with noise mitigation values. Report edited by the itap GmbH for the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie) and supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit).

Pile Dynamics, Inc. 2010. GRLWEAP. [accessed January 2021]. https://www.pile.com/.

### 9.0 Public Health and Safety

[BOEM] Bureau of Ocean Energy Management. 2012. Commercial Wind Lease Issuance and Site Characterization Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment. OCS Study BOEM 2012-003. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. 366 pp. [published January 2012; accessed January 2021] https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Mid-Atlantic-Final-EA-2012.pdf.

Bureau of Transportation Statistics. 2020. Petroleum oil spills impacting navigable U.S. waterways. [accessed January 2021]. https://www.bts.gov/content/petroleum-oil-spills-impacting-navigable-us-waters.

Spiga I, Caldwell GS, Bruintjes R. 2016. Influence of Pile Driving on the Clearance Rate of the Blue Mussel, Mytilus edulis (L.). Meetings on Acoustics: Fourth International Conference on the Effects of Noise on Aquatic Life. Volume 27(1), 10–16 Jul 2016, Dublin, Ireland. https://doi.org/10.1121/2.0000277.

Sellheim K, Stachowicz JJ, Coates RC. 2010. Effects of a nonnative habitat-forming species on mobile and sessile epifaunal communities. Marine Ecology Progress Series. 398: 69-80.

[SMAST] University of Massachusetts Dartmouth, School of Marine Science and Technology . 2016. Average (2003-2012) Presence/Abundance from SMAST Survey Northeast United States [dataset]. North Dartmouth (MA): University of Massachusetts Dartmouth, SMAST; [published 2016 April; accessed 11 January 2021]. https://www.northeastoceandata.org/data-explorer/?habitat|biological.

Steimle FW, Zetlin C. 2000. Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. Highlands, New Jersey. Marine Fisheries Review 62(2).

Stevenson D, Chiarella L, Stephan D, Reid R, Wilhelm K, McCarthy J, Pentony M. 2004. Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat. NOAA Technical Memorandum NMFS-NE-181.

The Nature Conservancy. 2015. Northwest Atlantic Marine Ecosystem Assessment- Soft Sediments (Chapter 3) [dataset]. Arlington (VA): Conservation Gateway; [accessed 2020 December 16]. http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/marine/data/Pages/default.aspx.

Topham E, McMillan D. 2017. Sustainable decommissioning of an offshore wind farm. Renewable Energy. 102:470-480.

Tougaard J, Madsen PT, Wahlberg M. 2008. Underwater noise from construction and operation of offshore wind farms. Bioacoustics. 17(1-3):143-146.

Tougaard J, Carstensen J, Teilmann J. 2009a. Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (Phocoena phocoena). Journal of the Acoustical Society of America. 126(1):11-14.

Tougaard J, Carstensen J, Teilmann J, Skov H, Rasmussen P. 2009b. Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (Phocoena phocoena (L.)) (L). Journal of the Acoustical Society of America. 126(1):11-14.

Toupoint, N., L. Gilmore-Solomon, F. Bourque, B. Myrand, F. Pernet, F. Olivier, and R. Tremblay, 2012: Match/mismatch between the Mytilus edulis larval supply and seston quality: effect on recruitment. Ecology, 93, 1922-1934.

[URI] University of Rhode Island. 2020. Habitat Restoration-Species Gallery. Kingston (RI): University of Rhode Island; [accessed 1 December 2020]. https://www.edc.uri.edu/restoration/html/gallery/seagrass.htm.

[USDA] United States Department of Agriculture. 2021. National Invasive Species Information Center-Aquatic Invertebrates. [accessed 22 January 2021]. https://www.invasivespeciesinfo.gov/aquatic/invertebrates.

[USGS] United States Geological Survey. 2021. NAS-Nonindigenous Aquatic Species. [updated and accessed 22 January 2021]. https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=183.

Voynova, Y. G., M. J. Oliver, and J. H. Sharp. 2013: Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. J. Geophys. Res. Oceans, 118, 6437-6450. doi:10.1002/2013JC008793.

Wahlberg M, Westerberg H. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. Mar Ecol Prog Ser. 288:295-309.

West Point Partners, LLC. 2013. Application to the United States Army Corps of Engineers (New York District) for a Department of the Army Individual Permit. Volume 1 of 2. Fairfield (CT): West Point Partners, LLC.
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BC191AEEA-9CFF-4D39-9654-E21B59A3629A%7D.

Wilber, DH and Clarke, DG. 2001. Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management, 21: 4, 855-875.

Wilhelmsson D, Malm T, Öhman MC. 2006. The influence of offshore windpower on demersal fish. ICES Journal of Marine Science, 63: 775-784.

Woodruff DL, Schultz IR, Marshall KE, Ward JA, Cullinan VI. 2012. Effects of Electromagnetic Fields on Fish and Invertebrates, Task 2.1.3: Effects on Aquatic Organisms Fiscal Year 2011 Progress Report. Prepared for U.S. Department of Energy. Richland, Washington: Pacific Northwest National Laboratory.

Woodruff DL, Schultz IR, Marshall KE, Ward JA, Cullinan VI. 2013. Effects of Electromagnetic Fields on Fish and Invertebrates, Task 2.1.3: Effects on Aquatic Organisms, Fiscal Year 2012 Progress Report. PNNL-22154. Prepared for U.S. Department of Energy. Richland, Washington: Pacific Northwest National Laboratory.

Zykov MM, Bailey L, Deveau TJ, Racca RG. 2013. South Stream Pipeline – Russian Sector – Underwater Sound Analysis. Technical report by JASCO Applied Sciences for South Stream Transport B.V.

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