Ocean Wind
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Appendix P – Essential Fish Habitat Assessment

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Ocean Wind Offshore Wind Farm

Essential Fish Habitat Assessment

March 2021

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List of Acronyms

AC	Alternating Current
ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management
CBRA	Cable Burial Risk Assessment
COP	Construction and Operations Plan
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
FLIDAR	Floating Light Detecting and Ranging
IPF	Impact producing factor
MAFMC	Mid-Atlantic Fishery Management Council
MARMAP	Marine Resources Monitoring, Assessment, and Prediction Program
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NEFSC	Northeast Fisheries Science Center
NJDEP	New Jersey Department of Environmental Projection
NJ WEA	New Jersey Wind Energy Area
Nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Ocean Wind	Ocean Wind LLC
Orsted	Orsted Wind Power North America LLC
PJM	PJM Interconnection L.L.C
Ppt	parts per thousand
Project	Ocean Wind Offshore Wind Farm Project
ROV	remotely operated vehicles
SAV	Submerged Aquatic Vegetation
SFA	Sustainable Fisheries Act
TJBs	transition joint bays
TL	total length
USFWS	United States Fish and Wildlife Service
YOY	young-of-the-year

1. Introduction

Multiple federal, state, and local entities are responsible for governing and managing coastal and marine natural resources. The primary federal law governing marine fisheries management in United States Federal waters is the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), established in 1976. In the greater Atlantic region, the Atlantic States Marine Fisheries Commission (ASMFC) manages certain fisheries and the sustainable use of other shared coastal resources. The MSFCMA was later amended in 1996 to include the Sustainable Fisheries Act (SFA), which recognized that fisheries depend on marine, nearshore, and estuarine habitats for at least part of their lifecycles. To enhance fisheries and protect marine ecosystems, the SFA requires the identification of essential fish habitat (EFH). EFH is defined as waters and substrate necessary for spawning, breeding, feeding or growth to maturity (NMFS 2007, 16 U.S.C. 1802(10)). The National Marine Fisheries Service (NMFS) is charged by the SFA to coordinate with other federal agencies to avoid, minimize, mitigate, or offset adverse effects on EFH that could result from proposed activities.

This report presents an EFH Assessment for the proposed construction, operation, and maintenance, and decommissioning of the Ocean Wind Offshore Wind Farm Project (Project), located approximately 13 nautical miles (nm) offshore of Atlantic City, New Jersey. The contents of this EFH assessment are intended to meet the requirements of the NMFS to comply with the MSFCMA by describing the proposed action and an analysis of potential adverse effects of the proposed action on EFH and managed species.

2. Project Description

Ocean Wind LLC (Ocean Wind), a subsidiary of Orsted Wind Power North America LLC (Orsted) is developing the Ocean Wind Offshore Wind Farm Project (Project) to generate renewable power off the coast of New Jersey and transfer the electricity to load centers within New Jersey and the Mid-Atlantic region. The Project will include turbines and all infrastructure required to transmit power generated by the turbines to connection points with the regional electric transmission system operated by PJM Interconnection L.L.C. (PJM) electric transmission system or power pool. Grid connections will be made at BL England and Oyster Creek. The New Jersey Wind Energy Area (NJ WEA) was separated into two lease areas (OCS-A 0498 and OCS-A 0499). BOEM approved the assignment of the original Lease Area OCS-A 0498 to Ocean Wind LLC on May 10, 2016.

The Project will also include onshore and offshore infrastructure required for operation and maintenance. The Project includes up to 98 wind turbine generators, up to three offshore substations, array cables linking the individual turbines to the offshore substations, substation interconnector cables linking the substations to each other, offshore and onshore export cables linking the offshore and onshore substations, two onshore substations, and connections to the existing electrical grid in New Jersey. The wind turbine generators and offshore substations, array cables and substation interconnector cables will be located in Federal waters approximately 13 nm southeast of Atlantic City. The offshore export cables will be buried below the seabed within Federal and State waters. The offshore export cable will connect with the onshore export cable at the onshore transition joint bays (TJBs) at the landfall location(s). The onshore export cables, substations and grid connections will be located in Ocean, Atlantic, and Cape May Counties, New Jersey. The Project location is depicted in **Figure 1**. The Project would be installed beginning in 2023 and commissioned and operational in 2024. The Wind Farm Area, located within the Lease Area, is approximately 68,450 acres, and is located approximately 13 nm southeast of Atlantic City. For the purposes of this Assessment the Project Area is defined as the Wind Farm Area, the offshore export cable corridors, and the inshore export cable corridors. The Wind Farm Area and the boundaries of the Project are depicted on **Figure 1**.

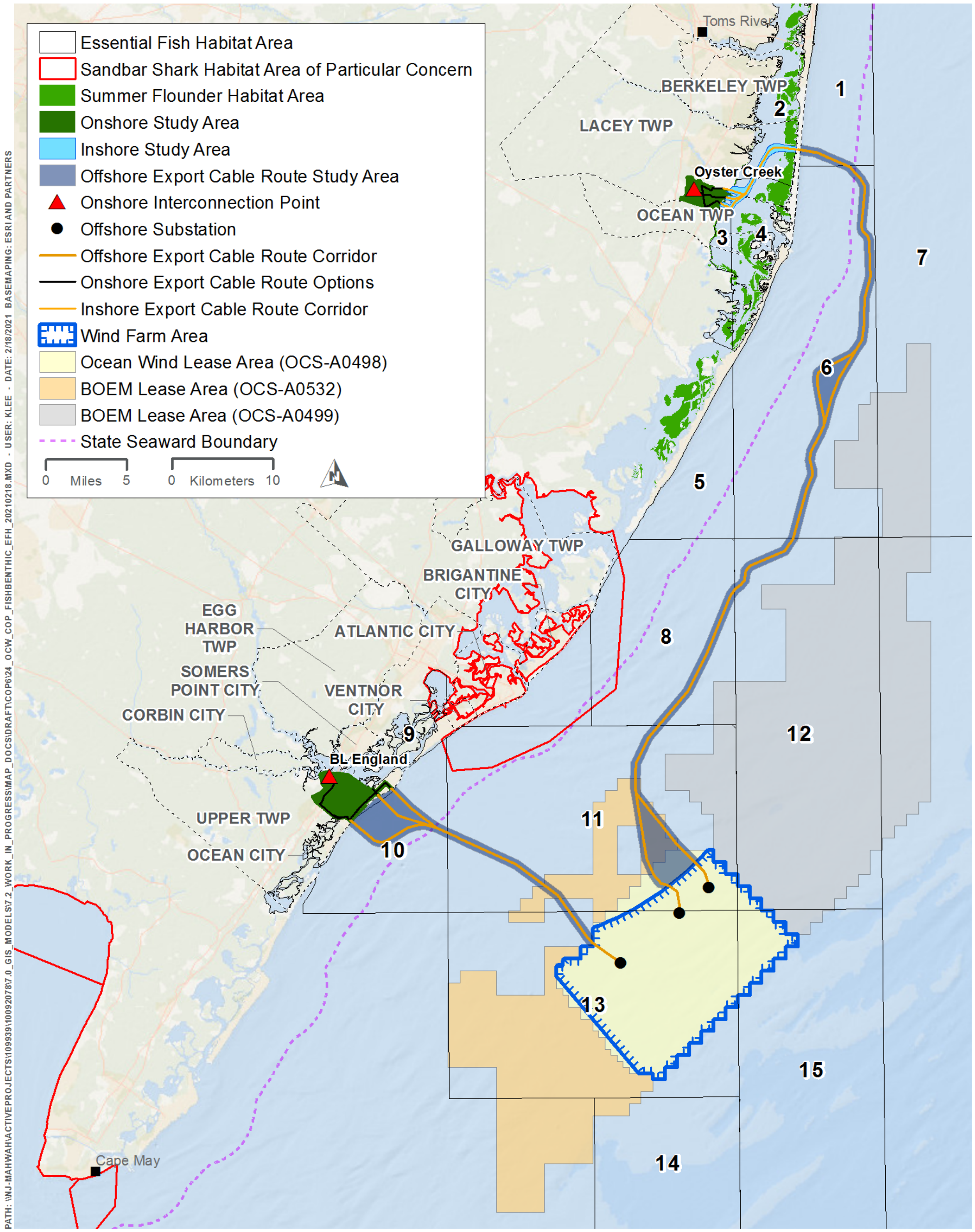

Figure 1 – Project Location.

This section provides a Project description summary. Attachments 1 through 3 provide additional Project description information including applicant proposed mitigation measures (APMs). Maximum design envelope parameters are provided in Volume I, Section 6 of this Construction and Operations Plan (COP). The focus of this assessment will be the offshore and inshore infrastructure that would have a potential impact on EFH.

The key components of the Project for offshore infrastructure are as follows:

- Up to 98 offshore wind turbines;
- Up to three offshore Alternating Current (AC) substations;
- Array cables – linking the individual turbines to offshore substations;
- Substation interconnector cables – linking the substations to each other;
- Offshore export cables.

The monopile with transition piece, or alternatively a one piece foundation where the transition piece is part of the monopile, will be used for wind turbines. Monopile foundations typically consist of a single steel tubular section, consisting of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout. The transition piece may include boat landing features, ladders, a crane, and other ancillary components as well as a connection to the turbine tower. The transition piece will be painted and marked per relevant regulatory guidance and may be installed separately following the monopile installation.

Up to three offshore substations may be required to collect the electricity generated by the offshore turbines. The voltage will be 'stepped up' to a higher voltage by transformers on the substation before transmission to shore. Offshore substations will consist of a main platform attached to the seabed by means of a foundation, and may include a helicopter platform. The main platform may have one or more decks and will include the equipment required to switch and transform electricity to higher voltage and provide compensation. The offshore substations may also include equipment and facilities for operating, maintaining, and controlling the substation and access to the substation by vessels and helicopters. Equipment for wind monitoring will be included. Housing accommodations, storage, workshop, and logistics facilities for operating and maintaining the offshore wind turbines may also be included.

Cables carrying the electrical current produced by the turbines will link the turbines to an offshore substation. Several turbines will typically be grouped together on the same cable 'string' connecting those turbines to the substation. Multiple cable strings will connect back to each offshore substation. The array cables will consist of a number of conductor cores, usually made from copper or aluminum surrounded by layers of insulating material as well as material to armor or protect the cable from external damage. The array cables will be installed below the seabed where possible. The target burial depth for array cables may vary based on existing conditions and potential risks, such as trawling and vessel anchors.

Substation interconnector cables will connect the offshore substations to each other. Up to two cables will be installed with each cable linking two substations. The substation interconnector cables will consist of a number of conductor cores, usually made from copper or aluminum surrounded by layers of insulating material as well as material to armor or protect the cable from external damage. As described for the array cables, the substation interconnector cables will be buried below the seabed whenever possible. The target burial depths will be determined through a post-approval Cable Burial Risk Assessment, and where burial cannot occur, sufficient depth cannot be achieved, or protection is required due to interconnector cables crossing other cables or pipelines, additional armoring or other cable protection methods may be used.

Offshore export cables will carry electrical power from the offshore substation to the onshore TJB, where the offshore export cable will be joined to the onshore export cable. Offshore export cables will be installed below the seabed and buried onshore up to the TJB. The Project will include two interconnection points; at BL England and Oyster Creek, as depicted on **Figure 1**. As described for the array cables, the offshore export cables will be buried below the seabed where possible. The target burial depths will be determined following detailed design and Cable Burial Risk Assessment, and where burial cannot occur, sufficient depth cannot be achieved, or protection is required due to the export cable crossing other cables or pipelines, additional armoring or other cable protection methods may be used. The offshore export cable corridors are also inclusive of the inshore area (e.g., Barnegat Bay).

2.1 Construction of Offshore Infrastructure

Construction of the offshore components of the project include the following:

- Site preparation activities
  - Pre-construction surveys
  - Unexploded ordnance clearance
  - Boulder clearance
  - Pre-lay grapnel run
  - Sandwave clearance (if needed)
  - Seabed preparation (if needed)
- Foundation installation
- Scour protection placement
- Turbine installation
  - Pre-assembly
  - Wind turbine generator installation
  - Wind turbine generator commissioning
- Offshore substation installation
- Array cable installation
  - First end pull
  - Second end pull
  - Cable protection
- Substation interconnection cable installation
- Offshore export cable installation
- Landfall

Additional information is provided in Attachment 1.

2.2 Operations and Maintenance

The Project is anticipated to have an operational life of 35 years. Per the Lease, the operations term of the Project is 25 years and will commence on the date of COP approval. It is anticipated that Ocean Wind will request to extend the operations term in accordance with applicable regulations in 30 CFR § 585.235.

Maintenance activities will include both preventive and corrective maintenance for the turbine and substation foundations, wind turbines, and cables. Preventive maintenance will be undertaken in accordance with scheduled services whereas corrective maintenance covers unexpected or emergency repairs, component replacements, retrofit programs and breakdowns.

Ocean Wind will conduct inspections of foundations, bathymetry, scour protection, and cable burial. For the first three years of the Project, surveys will be conducted twice a year. In subsequent years, annual surveys are expected. Sonar, remotely operated vehicles (ROVs), drones, and divers may be required.

During operation, an onshore operations and maintenance facility in Atlantic City will be used. The operations and maintenance Facility, which may serve multiple projects and has independent utility, is not considered to be a part of the Project.

2.3 Decommissioning

The dismantling and removal of the turbine components (e.g., blades, nacelle, tower) will largely be a "reverse installation" process subject to the same constraints as the original construction phase. Using today's technology, dismantling the turbine components requires a jack-up vessel to ensure adequate control of the demolition process and to manage the high lifts and high crane hook loads.

It is anticipated that the monopile foundations will be cut below the seabed level in accordance with standard practices at the time of demolition. The exact depth will depend on seabed conditions (e.g., dynamics, site characteristics) and developing industry best practices. The cutting process is likely to be via mechanical cutting, water-jet cutting, or other common industry practices.

The scour protection placed around the base of each monopile will be left *in-situ* as the default option in order to preserve the marine life that may have established itself on this substrate during the period of operation. If it is necessary to remove the scour protection, then the removal will proceed according to the best practices applicable at the time of decommissioning.

The offshore substation will be decommissioned by dismantling and removing its topside and foundation (substructure). As with the turbine components, this operation will be a reverse installation process subject to the same constraints as the original construction phase.

Offshore cables will either be left *in-situ* or removed, or a combination of both, depending on the regulatory requirements at the time of decommissioning. It is anticipated that the array cables will be removed using controlled flow excavation or a grapnel to lift them from the seabed. Alternatively, depending on available technology, a ROV may be used to cut the cable so that it can be recovered to the vessel. The export cables will be left in situ or wholly/partially removed. Any cable ends will be weighed down and buried if the cables are to be left in-situ to ensure that the ends are not exposed or have the potential to become exposed post-decommissioning. Cables may be left in-situ in certain locations, such as pipeline crossings, to avoid unnecessary risk to the integrity of the third-party cable or pipeline.

3. Essential Fish Habitat Review

The NMFS, New England Fishery Management Council, Mid-Atlantic Fishery Management Council, and South Atlantic Management Council have defined EFH for key species in the Northeastern United States coastal waters. EFH designations have been described based on 10' x 10' squares of latitude and longitude along the coast. **Table 1** presents the 10' x 10' squares of latitude and longitude that were used to determine EFH species within the Project Area. The National Oceanic and Atmospheric Administration (NOAA) EFH mapper was also consulted to determine EFH within coastal waters of the Project Area.

Table 1 - 10’ x 10’ Squares of latitude and longitude used for determining EFH species within the Project Area.

Square Number	North	East	South	West	Square Description
1	40° 00.0' N	74° 00.0' W	39° 50.0' N	74° 10.0' W	Atlantic Ocean waters within the square affecting the following: east of Island Beach from Normandy Beach on the north, south past Chadwick Beach, NJ., Lavalette, NJ., Ortley Beach, NJ., Seaside Heights, NJ., and Seaside Park, NJ., Also, west within Barnegat Bay and east of mainland New Jersey from just north of the Forked River, north past Stouts Creek, Lanoka Harbor, NJ., Cedar Creek, Holly Park, NJ., Potter Creek, Bayville, NJ., Good Luck Pt. east of Ocean Gate, NJ., the Toms River east of Beachwood, NJ. and Toms River, NJ., north of Pine Beach, NJ., and south of Island Heights, NJ., then past Coates Pt., Bay Shore, NJ., Goose Creek, and Tilton Pt. and Applegate Cove, both east of Cedar Grove, NJ., to Silver Bay on the north.
2	39° 50.0' N	74° 00.0' W	39° 40.0' N	74° 10.0' W	Waters within the square east within the Atlantic Ocean and west within Barnegat Bay, affecting from just north of Surf City , NJ., north along the northern part of Long Beach past Harvey Cedars, NJ., Loveladies Harbor, NJ., Barnegat Light and Barnegat Inlet, the Sedge Islands to Island Beach including waters affecting Clam Island, Vol Sledge and High Bar, and along with the entrance to the Forked River on the mainland, Slope Sedge, Sandy Island, eastern Carvel Island and eastern Harvey Sedges.
3	40° 00.0' N	73° 50.0' W	39° 50.0' N	74° 00.0' W	Atlantic Ocean waters within the square one square east of Island Beach on Barnegat Bay within part of the Ambrose to Barnegat shipping traffic lane.
4	39° 50.0' N	73° 50.0' W	39° 40.0' N	74° 00.0' W	The waters within the square within the Atlantic Ocean one square east of the square affecting the northern part of Long Beach north up to Island Beach.
5	39° 40.0' N	73° 50.0' W	39° 30.0' N	74° 00.0' W	The waters within the square within the Atlantic Ocean one square east of the waters just touching Surf City, NJ.
6	39° 20.0' N	74° 30.0' W	39° 10.0' N	74° 40.0' W	The waters within the square within the Atlantic Ocean and within the New Jersey Inland Bay estuary affecting the following: south of Margate City, N. J. and south and east of Ocean City, N.J., and Peck Beach, within Great Egg Harbor Bay and Peck Bay. The following features are also affected by these waters: Risley Channel, Lone Cedar I., Broad Thorofare, Anchorage Pt., Rainbow Is., Somers Pt., Cowpens I., Shooting I., Golders Pt., and Beesleys Pt. These waters extend up into Great Egg Harbor Bay to the boundary of the mixing / seawater salinity zones, which extends from just west of Somers Pt., southwest across the Bay to east of the entrance to the Tuckahoe River. These waters also affect southwest of Peck Beach, along with Crook Horn Creek, Blackmon I., Devils I., Corson Inlet, Strathmore, N. J., Whale Beach, N. J., and Middle Thorofare.
7	39° 20.0' N	74° 20.0' W	39° 10.0' N	74° 30.0' W	The waters within the square within the Atlantic Ocean south and east of Ventnor City, N. J. The waters within this square just touch the coastline between Ventnor City, N. J. and Margate City, N. J.
8	39° 20.0' N	74° 10.0' W	39° 10.0' N	74° 20.0' W	The waters within the square within the Atlantic Ocean one square east of the square south and east of Ventnor City, N. J. which just touches the coastline between Ventnor City, N. J. and Margate City, N. J.
9	39° 20.0' N	74° 00.0' W	39° 10.0' N	74° 10.0' W	The waters within the square within the Atlantic Ocean two squares east of the square south and east of Ventnor City, N. J. which just touches the coastline between Ventnor City, N. J. and Margate City, N. J.
10	39° 30.0' N	74° 00.0' W	39° 20.0' N	74° 10.0' W	Atlantic Ocean waters within the square one square east of the square affecting the following: waters within Little Egg Harbor Inlet and waters south and east of this inlet. Features affected within this square include Little Beach, Pullen I., Brigantine Inlet, Brigantine Shoal, Great Thorofare, and surrounding marshes. There is a large area with numerous research buoys towards the northwest corner of the square just outside of the inlet.

For the purposes of this Assessment the Project Area is defined as the Wind Farm Area, offshore export cable corridors, and inshore export cable corridors. The Atlantic Ocean, Barnegat Bay and Great Egg Harbor Bay have a diverse fish and invertebrate community that can be classified according to habitat requirements and location. Finfish diversity and abundance is largely dependent on environmental characteristics including but not limited to factors such as depth, salinity, substrate, currents, season, and temperature. The community is made up of pelagic, demersal, and highly migratory species. Pelagic species spend the majority of their lives within the water column, migrating between different depths based on prey availability, temperature, and light penetration. Demersal species spend the majority of their lives at or near the bottom. Highly migratory species travel long distances and often cross domestic and international boundaries and include fish such as tuna, swordfish, billfish, and sharks. These species are managed and protected by NOAA Fisheries. The New Jersey Division of Fish and Wildlife also manages marine fish species.

3.1 Project Area Benthic Habitat

3.1.1 Wind Farm Area and Offshore Export Cable Corridors

The Mid-Atlantic Ocean Data Portal and the Nature Conservancy (Greene *et al*. 2010) have characterized species, habitats, and ecosystems of the Lease Area and offshore export cable corridors. According to these sources, the benthic habitat within the Wind Farm Area is made up of substrate ranging from fine (0.125 - 0.25 mm) to coarse (0.5 – 1 mm) sands at depths of 25-45 meters.

In 2017, Ocean Wind conducted benthic habitat surveys associated with two Floating Light Detecting and Ranging (FLIDAR) locations within the Wind Farm Area. Samples were collected using a 0.1 m^2 Day grab sampler and ground-truthed with a camera. Sediments were characterized as sandy with shell fragments and tube worms and sand dollars as being the dominant fauna. The benthic community at each FLIDAR location is typical of sandy bottom habitats and included Annelida, Arthropoda, Mollusca, and Echinodermata (Alpine 2017). Based on seabed imagery and sampling, there was no evidence of sensitive benthic habitats, as defined by BOEM (2013), such as exposed hard bottoms, algal beds, or the presence of anthozoan species. Additionally, there is no critical habitat for fish mapped by the United States Fish and Wildlife (USFWS) Service or NMFS.

Offshore benthic habitat of New Jersey has been studied by various entities. Byrnes and Hammer (2001) conducted a study to evaluate the feasibility of sand borrowing and documented a sandy benthic habitat dominated by polychaete worms and Atlantic nut clams. Boesch (1979) categorized offshore benthic habitat a few miles offshore of Atlantic City as inner shelf coarse substrate with dynamic, uniformly coarse sand containing a benthic community dependent on changes in subtle bottom topography, particularly ridges and swales. Communities were dominated by mollusks (*Tellina agilis*), crustaceans (*Tanaissus liljeborgi*), polychaetes, and the sand dollar (*Echinarachnius parma*).

As part of a New Jersey Department of Environmental Protection (NJDEP) study, Geo-Marine, Inc. reviewed available data for benthic invertebrate (epifauna) taxa that occur along the New Jersey inner shelf within the Lease Area and offshore export cable corridors. Common macrofauna include species from several taxa including echinoderms (e.g., sea stars, sea urchins, and sand dollars), cnidarians (e.g., sea anemones and corals), mollusks (e.g., bivalves, cephalopods, and gastropods), bryozoans, sponges, amphipods, and crustaceans (NJDEP 2010). The mid-shelf is dominated by sand dollars and surf clams from about 40 to 70 m (131 feet to 230 feet) with various other epifauna (e.g., rock crabs, hermit crabs, cancer crabs, horseshoe crabs, spider crabs, and lobsters) are found throughout the shelf (NJDEP 2010). Within the near-shore area common crustaceans include hermit crabs (*Pagurus* spp.), Atlantic rock crab (*Cancer irrotatus*) and sevenspine bay shrimp (*Crangon septemspinosa*) (NJDEP 2010).

Within the Project Area, Guida *et al*. (2017) used the CMECS habitat classification system and identified the following benthic assemblages: small surface-burrowing fauna, small tube-building fauna, clam beds and sand dollar beds. Amphipods were present but not a core assemblage. Records of shellfish species of concern in the NJ WEA include sea scallop, surf clam and ocean quahog. Ocean quahog was not found in the Ocean Wind Lease Area. Sea scallops occurred in the Ocean Wind Lease Area and the adjacent OCS-A 0499 but were more commonly encountered in OCS-A 0499. In most cases they were sampled only in small numbers and are not considered to be abundant within the Project Area. Since the locations of trawl samples were attributed at the mid-point of the trawl track, which may lie outside the WEA limits, it is not certain whether the sea scallops near the WEA boundary were actually caught inside or outside the WEA in some cases. Current sea scallop EFH does not intersect the NJ WEA (Guida *et al*. 2017).

The U.S. Environmental Protection Agency's National Coastal Assessment program is the most spatially and temporally comprehensive survey conducted on New Jersey benthic communities (Ramey, Kennish, & Petrecca, 2011). The sampling program was designed to take into account episodic natural upwelling, offshore wastewater discharges, and state management zones. Samples were collected with a Van Veen grab from Sandy Hook to Cape May at 153 stations along the Atlantic Coastline in August and September 2007 and 2009. In total over 110,000 individuals belonging to 273 species/taxa were identified. In a review of 19 studies on benthic soft-sediment fauna Ramey, Kennish, & Petrecca (2011) identified 540 benthic macrofaunal species/taxa in New Jersey Coastal Waters (Ramey, Kennish, & Petrecca, 2011). Dominant taxonomic groups included polychaete and oligochaete worms (*Prionospio pygmaeus, Tharyx sp. A, Aricidea catherinae, Grania longiducta, Peosidrilus coeloprostatus*), amphipods (*Protohaustorius deichmannae*), and the bivalve (*Nucula proxima*). These benthic and epibenthic species are a vital food source for fish species.

3.1.2 Estuarine Portion of the Offshore Export Cable Corridor

Benthic communities in back bays such as Barnegat Bay and Great Egg Harbor differ from that of the open ocean because these areas are protected from the wave action and currents that occur in the open ocean. Reduced wave and current action influence substrate sediment type, which, along with other environmental factors such as water quality, dictate benthic communities. The Mid-Atlantic Ocean Data Portal and the Nature Conservancy (Greene *et al*. 2010) have characterized species, habitats, and ecosystems of the Estuarine Project Area, in particular the Barnegat Bay and Great Egg Harbor estuaries. According to these sources, the majority of the benthic habitat within Barnegat Bay is made up of very fine (0.06 – 0.125 mm) and fine (0.125 – 0.25 mm) sands at depths of less than 10 meters. The Great Egg Harbor estuary is mapped as mostly medium sand (0.25 - 0.5 mm) and depths of less than 10 meters.

Taghon *et al*. (2017) studied the benthic community of Barnegat Bay using Van Veen grab samples that were analyzed to the lowest practical taxonomic unit (species in most cases). The benthic surveys were conducted in 2012, 2013 and 2014. During each survey 97 stations were randomly selected in Barnegat Bay – Little Egg Harbor estuary. Taghon *et al*. (2017) found that benthic invertebrates were abundant, and the community was, in general, highly diverse. Spatial variability based on sediment size was observed. These data were then compared, where possible, to historical data collected from 1965 – 2010 and show few changes in abundance and species composition. Scott and Bruce (1999) conducted sampling in and around Great Egg Harbor Inlet as part of the assessment of offshore borrow pits and nearshore placement. Sampling was conducted on soft sandy bottoms and hard rocky intertidal areas. The most abundant taxa included common surf-zone clam

(*Donax variabilis*), haustorid amphipod (*Amphiporeia virginiana*), mole crab (*Emerita talpoida*), and polychaete (*Scolelepis squamata*).

In addition to benthic and marine communities, freshwater and tidal wetland communities exist within the Barnegat Bay and Great Egg Harbor inshore areas of the Export Cable Corridor. These communities include vegetated dune communities, saline low marsh, and high marsh, and *Phragmites* dominated coastal wetlands, among other communities mapped by the NJDEP. Based on NJDEP's wetland mapping, approximately 0.13 acres of *Phragmites* dominated coastal wetlands and 0.06 acres of saline low marsh may be temporarily impacted at BL England (from cable installation on indicative routes). At Oyster Creek, less than 0.01 acres of impacts may occur to saline high marsh (from cable installation on indicative routes). These wetland communities are assumed to be areas that lie below mean high water.

3.1.3 Submerged Aquatic Vegetation

The offshore export cable is unlikely to cross any potential submerged aquatic vegetation (SAV) as SAV growth is limited by water depth (light penetration) and wave/current energy (Long Island Sound Study 2003). Therefore, this section will only describe SAV growth within estuarine waters of the Offshore Export Cable Corridor.

SAV serves several functions in estuarine ecosystems in New Jersey like that of Barnegat Bay (Oyster Creek area). SAV provides a substantial amount of primary production for the Barnegat Bay estuary, and serve as critically important spawning, nursery, and feeding habitat for benthic and finfish communities. SAV also serves to stabilize the benthic habitat by attenuating waves and currents and minimizing substrate erosion. In the coastal waters and back bays of New Jersey, SAV species diversity peaks in the late spring and is highly dependent on solar radiation and water temperature. Dominant vascular and algal species within Barnegat Bay include *Ulva lactuca, Gracilaria tikvahiae, Codium fragile, Zostera marina, Ceramium fastigiatum*, and *Agardhiella subulata* (Kennish 2001).

SAV along the New Jersey coast has been studied by various public and private entities over the last 40 years. Barnegat Bay and the Oyster Creek area have been extensively studied, the coastal areas south of Little Egg Harbor (near the BL England Generating Station) have been less extensively studied. The NJDEP has mapped SAV habitat along the New Jersey coast from Sandy Hook to Cape May. The majority of this mapping took place from 1979 to 1987, with a 2011 update to Little Egg Harbor Bay (NJDEP 2018). NJDEP stipulates that historical SAV areas must be considered current SAV habitat and are subject to NJDEP regulation.

Other research has been conducted that can supplement NJDEP data and provide an updated map of SAV habitat particularly in Barnegat Bay. Bologna *et al*. (2000), Lathrop *et al*. (2004), and Lathrop and Haag (2011) extensively studied the locations of seagrasses in Barnegat Bay. The Bologna study was conducted in Little Egg Harbor assessing eel grass (*Zostera marina*) and widgeon grass (*Ruppia maritime*) distribution during 1999. The study compares past SAV distribution maps (Good *et al*. 1978, Macomber and Allen 1979, and McLain and McHale 1997) to current findings and indicates drastic declines in SAV coverage within Barnegat Bay and around Oyster Creek over a period of 25 years. Lathrop's findings agree with Bologna's as they note an approximately 60% decline in seagrass density from 2003 to 2009 based on the use of aerial imaging to assess seagrass habitat in Barnegat Bay.

In fall of 2019 Ocean Wind conducted aerial SAV mapping surveys in Barnegat Bay and Great Egg Harbor. The survey was conducted to incorporate methodologies from previous studies (Lathrop and Haag 2011) and existing agency guidelines (Colarusso and Verkade 2016) with the main goal to inform project design and quantify potential areas of impacts. The survey was conducted via aerial photography in October 2019 over the proposed inshore export cable route in Barnegat Bay in the Oyster Creek study area along with Great Egg Harbor in the BL England study area. The areas of SAV documented in the Phase 1 Survey were used to inform the more intensive Phase 2 Survey effort.

A Phase 2 in-water drop camera SAV survey was conducted in October 2020 and included a field reconnaissance of Barnegat Bay[1] where disturbance is anticipated to occur. The Phase 2 SAV survey was conducted to identify the presence, spatial extent, density, and species composition of SAV beds within the proposed export cable routes at the four potential landfall locations. The inshore reconnaissance area surveyed in 2020 included transects parallel to the shoreline as well as 50 meters on either side of the indicative cable routes (Appendix E). Survey protocols were coordinated with NJDEP, BOEM and NMFS. SAV was documented in 41.7 percent of the survey locations. Of the three landfall areas on the western shoreline of the bay, the Holtec Property had the lowest percent cover of SAV, with SAV present at only a single survey station close to the shoreline. Based on review of the photographs collected during the field survey and the SAV samples collected, observed SAV consisted almost entirely of eelgrass (*Zostera marina*) with the exception of a single location at the Holtec Property which contained widgeon grass (*Ruppia maritima*). Results of the 2019 SAV aerial survey are shown on **Figure 2** and **Figure 3.** The results of the SAV aerial survey conducted in 2019 and in-water survey conducted in 2020 are provided in Appendix E.

[1] A Phase 2 SAV survey was not conducted in Great Egg Harbor as the inshore route option was no longer being considered.

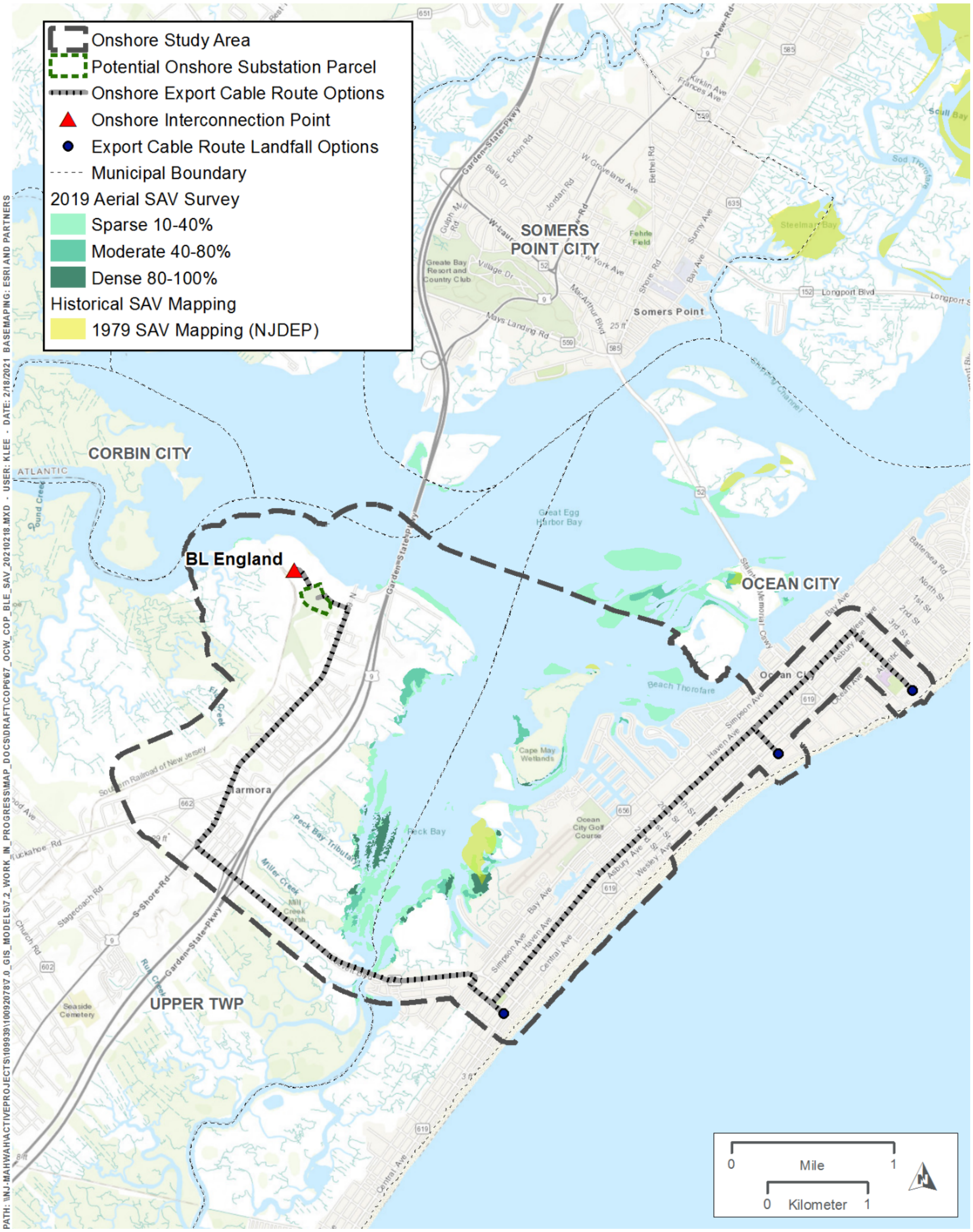

Figure 2 – Results of the 2019 SAV Aerial Survey of Great Egg Harbor Bay.

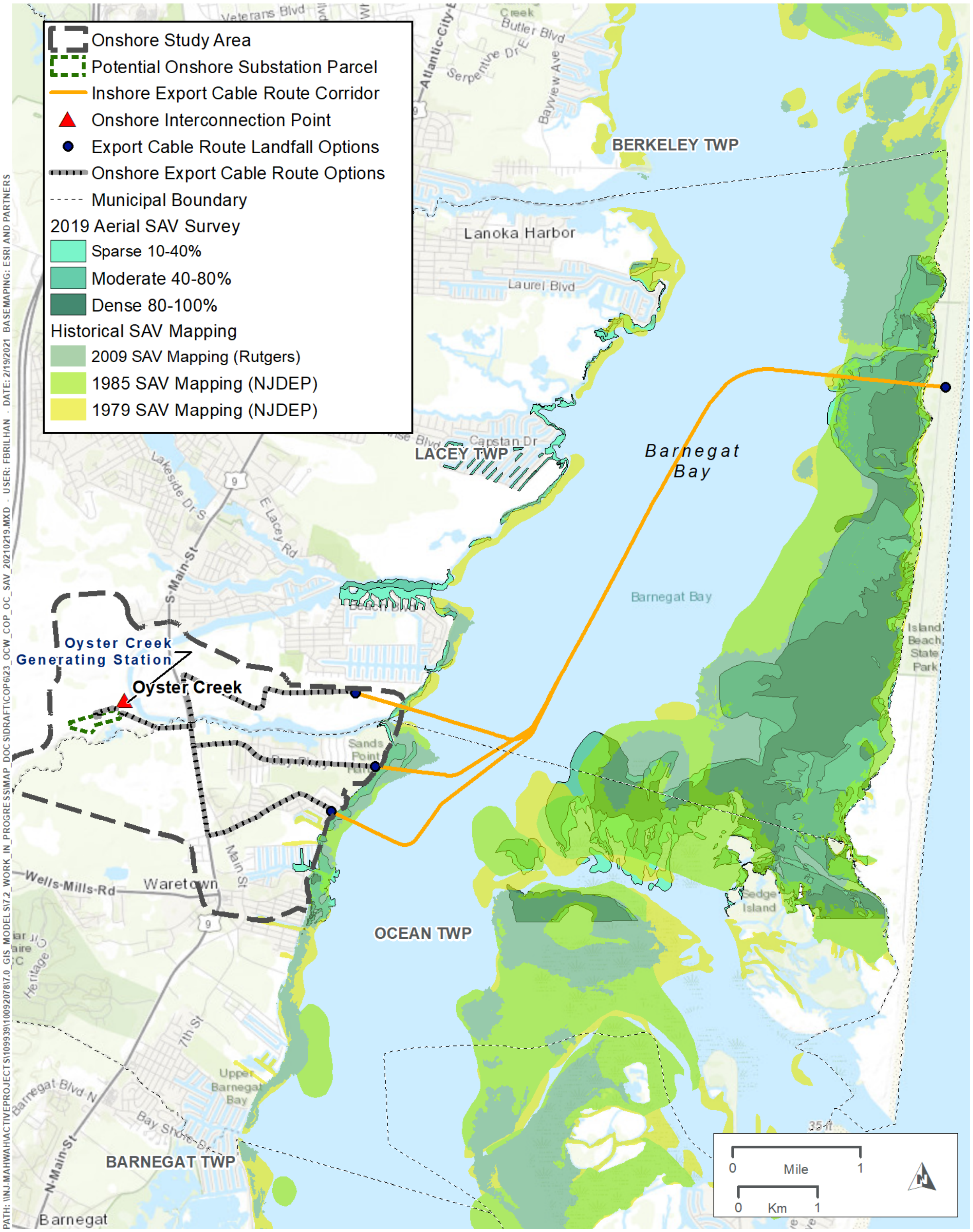

Figure 3 – Results of the 2019 Aerial Survey of Barnegat Bay.

3.2 Project Area Pelagic Habitat

3.2.1 Wind Farm Area and Offshore Export Cable Corridor

Phytoplankton are microscopic, single-celled organisms that use sunlight and chlorophyll to photosynthesize, serving as the base for the marine food chain. Phytoplankton distribution is patchy and dependent on water temperature, light, and nutrient concentration. It is denser in nearshore areas where there is input of nutrients such as dissolved nitrogen, phosphorus, and silica from land sources. In general, in continental shelf and slope waters, the concentration of chlorophyll a (the means of measuring phytoplankton concentration) decreases with distance from shore and with increasing water depth. Phytoplankton within the coastal waters are typically dominated by chromophytic algae with diatoms being the major phytoplankton taxa present (NJDEP 2010).

Zooplankton form an essential link connecting fishes, birds, marine mammals, other large marine species, and the primary producers (phytoplankton and marine bacteria) of the marine food web. They are aquatic animals ranging from the smallest protozoans to jellyfish. Zooplankton species are capable of moving sizable distances, performing vertical migrations in the water column. However, horizontal distribution is mostly governed by ocean currents and physical, chemical, and biological conditions. The major zooplankton groups include chaetognaths, copepods, gelatinous zooplankton, ichthyoplankton, amphipods, cladocerans, euphausiids, heteropods mostly of the copepods *Pseudocalanus* sp. and *Centropages typicus*, and *pteropod Limacina retroversa*. Seasonal water changes off the coast of New Jersey regulate zooplankton productivity, species composition, and spatial distribution. In general, zooplankton display a strong seasonal pattern with a spring enhancement of biomass within the upper 656 ft (200 m) of the water column. Typically, maximum abundance occurs during spring between April and May on the outer shelf (dominated by *Pseudocalanus* sp. and *Calanus finmarchicus*) as well as late summer between August and September on the inner shelf (dominated *by C. typicus* and *Ternora longicornis*). The lowest abundance begins in November and reaches a minimum in February (NJDEP 2010).

3.2.2 Estuarine Portion of the Export Cable Corridors

Extensive studies have been conducted on plankton in the Barnegat Bay-Little Egg Harbor Estuary to assess zooplankton and phytoplankton populations. Surveys were conducted to collect data on the zooplankton, including ichthyoplankton, gelatinous macrozooplankton, and copepods, decapods, and bivalves. The zooplankton community in Barnegat Bay is characterized by strong spatial and seasonal trends in abundance and diversity. Northern and southern regions of the bay show the most apparent spatial variability in their community assemblage and water quality characteristics. The northern bay was characterized by higher nitrogen and chlorophyll a, higher abundances of copepods, ctenophores, and barnacle larvae, and the lowest species diversity of zooplankton and ichthyoplankton in the bay. Alkalinity and phosphorus were higher in the southern bay, as was species diversity of both zooplankton and ichthyoplankton (Nickels and Howson 2016). Water quality conditions driven by urbanization and lack of flushing in northern Barnegat Bay appear to be steering these trends. Similar extensive studies on zooplankton and phytoplankton assemblages and populations in Great Egg Harbor Bay are not readily available. However, because of its proximity, it is assumed the data collected from the Barnegat Bay-Little Egg Harbor Estuary provides representative information on zooplankton and phytoplankton communities, where spatial and seasonal variability are anticipated to be similar.

Weather patterns appear to be directly and indirectly affecting zooplankton abundance in Barnegat Bay. Density-independent factors such as temperature strongly contribute to variability in biological systems seen on an interannual basis (Nickels and Howson 2016).

3.3 EFH Designations

The species with EFH designations within the Project Area and their associated life stages are provided in **Table 2** below. **Table 3** provides the EFH designations for shark species within the Project Area.

Table 2 - EFH-designated species within the Project Area.

Common Name	Scientific Name	EFH Habitat within Project Area				Habitat Association
		Egg	Larvae	Juvenile	Adult	
New England Finfish Species						
Atlantic cod	*Gadus morhua*	X	X		X	Eggs/Larvae: Pelagic Juvenile/Adults: Demersal/Structure Oriented
Atlantic herring	*Clupea harengus*		X	X	X	Pelagic
monkfish	*Lophius americanus*	X	X	X	X	Eggs/Larvae: Pelagic Juvenile/Adult: Demersal
ocean pout	*Macrozoarces amercanus*	X		X	X	Demersal
pollock	*Pollachius pollachius*		X			Pelagic
red hake	*Urophycis chuss*	X	X	X	X	Eggs/Larvae: Pelagic Juveniles and Adults: Demersal
silver hake	*Merluccius bilnearis*	X	X	X	X	Demersal/Pelagic
white hake	*Urophycis tenuis*				X	Demersal
windowpane flounder	*Scophthalmus aquosus*	X	X	X	X	Eggs: Pelagic Larvae/Juveniles/Adult: Demersal
winter flounder	*Pseudopleuronectes americanus*	X	X	X	X	Demersal
witch flounder	*Glyptocephalus cynoglossus*	X	X		X	Eggs/Larvae: Pelagic Juveniles/Adults: Demersal
yellowtail flounder	*Limanda ferruginea*	X	X	X	X	Eggs/Larvae: Pelagic Juveniles/Adults: Demersal
Mid-Atlantic Finfish Species						
Atlantic butterfish	*Peprilus triacanthus*	X	X	X	X	Pelagic
Atlantic mackerel	*Scomber scombrus*	X	X	X	X	Pelagic
black sea bass	*Centropristis striata*		X	X	X	Larvae: Pelagic/Structure Oriented Juveniles/Adults: Demersal/Structure Oriented
bluefish	*Pomatomus saltatrix*	X	X	X	X	Pelagic
scup	*Stenotomus chrysops*			X	X	Demersal
summer flounder*	*Paralichthys dentatus*	X	X	X	X	Demersal
Invertebrate Species						
Atlantic sea scallop	*Placopecten magellanicus*	X	X	X	X	Eggs/Juvenile/Adults: Demersal/Somewhat Structure Oriented Larvae: Demersal/Pelagic
longfin inshore squid	*Loligo pealeii*	X	X	X	X	Eggs: Demersal/Somewhat Structure Oriented Larvae/Juvenile/Adult: Pelagic

Common Name	Scientific Name	EFH Habitat within Project Area				Habitat Association
		Egg	Larvae	Juvenile	Adult	
northern shortfin squid	*Illex illecebrosus*			X		Pelagic
ocean quahog	*Artica islandica*			X	X	Demersal
surf clam	*Spisula solidissima*			X	X	Demersal
Highly Migratory Species						
bluefin tuna	*Thunnus thynnus*			X	X	Pelagic
yellowfin tuna	*Thunnus albacares*			X		Pelagic
skipjack tuna	*Katsuwonus pelamis*			X	X	Pelagic
swordfish	*Xiphias gladius*			X		Pelagic
Coastal Migratory Pelagic Species						
cobia	*Rachycentron canadum*	X	X	X	X	Pelagic
king mackerel	*Scomberomorus cavalla*	X	X	X	X	Pelagic
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X	Pelagic
Skate Species						
clearnose skate	*Raja eglanteria*			X	X	Demersal
little skate	*Leucoraja erinacea*			X	X	Demersal
winter skate	*Leucoraja ocellata*			X	X	Demersal
*Habitat areas of particular concern (HAPC) are identified for this species within SAV areas of the Project Area. Refer to Section 3.4.2.6 below for more information						

Table 3 - EFH for shark species within the Project Area.

Common name	Scientific name	EFH Habitat within Project Area			Habitat Association
		Neonate	Juvenile	Adult	
Atlantic angel shark	*Squatina dumeril*	X	X	X	Demersal
Atlantic sharpnose shark	*Rhizopriondon terraenovae*			X	Pelagic
basking shark	*Cetorhinus maximus*	X	X	X	Pelagic
blue shark	*Prionace glauca*	X	X	X	Pelagic
common thresher shark	*Alopias vulpinus*	X	X	X	Pelagic
dusky shark	*Carcharhinus obscurus*	X	X	X	Pelagic
sand tiger shark	*Carcharias taurus*	X	X		Pelagic

Common name	Scientific name	EFH Habitat within Project Area			Habitat Association
		Neonate	Juvenile	Adult	
sandbar shark	*Carcharhinus plumbeus*	X	X	X	Demersal
shortfin mako shark	*Isurus oxyrinchus*	X	X	X	Pelagic
smoothhound shark complex (Atlantic stock)	*Mustelus canis*	X	X	X	Demersal
spiny dogfish	*Squalus acanthias*		X	X	Pelagic/Epibenthic
tiger shark	*Galeocerdo cuvieri*		X	X	Pelagic
white shark	*Carcharodon carcharias*	X	X	X	Pelagic

3.4 Life History Characteristics of EFH-Designated Species

The life history habitat requirements of the 40 designated EFH species within the Project Area are summarized below.

3.4.1 New England Finfish Species

3.4.1.1 Atlantic cod (Gadus morhua)

General: Atlantic cod is a benthopelagic, commercially important groundfish ranging from the coasts of Greenland to north of Cape Hatteras, North Carolina, in North America. The Project Area is designated EFH for the egg, larvae, and adult life-stages (**Table 2**).

Eggs: Atlantic cod eggs are pelagic, buoyant, spherical, and transparent with a diameter that ranges from 1.2-1.7 mm (Lough 2004). Hatching occurs after 8 to 60 days in varying temperatures, with temperature exerting the most influence on egg and hatchling size (Lough 2004). EFH for Atlantic cod includes pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, as well as the high salinity zones of bays and estuaries (NEFMC 2017).

Larvae: Larvae hatch at sizes between 3.3 and 5.7 mm and occur from near-surface to depths of 75 m, with movement to deeper waters with growth (Lough 2004). Yolk sac larvae are vulnerable to zooplankton predators and planktivorous fish species, such as Atlantic herring and Atlantic mackerel (Lough 2004). EFH for Atlantic cod larvae includes pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, as well as the high salinity zones of bays and estuaries (NEFMC 2017).

Adult: Adult Atlantic cod are found at depths of 40-150 meters (m) with water temperatures <10°C, and salinities between 29-34 parts per thousand (ppt) (Lough 2004). Atlantic cod sightings have been rarely reported in New Jersey and their presence has not been documented within inland bays (Stone *et al*. 1994). Atlantic cod in the Great South Channel area migrate during autumn to overwinter in southern New England and the Mid-Atlantic coast, returning in the spring (Lough 2004). Atlantic cod spawn near the ocean floor from winter to early spring. Larger females can produce 3 to 9 million transparent, buoyant, pelagic eggs when they spawn (Lough 2004). Smaller Atlantic cod feed primarily on crustaceans, while larger cod feed primarily on fish, which include silver hake, shad (*Alosa* sp.), mackerel (*Scombridae* sp.), Atlantic silverside (*Menidia menidia*), and herring (*Clupea* sp.). Adult cod predators include large sharks and spiny dogfish (Lough 2004).

Adult Atlantic cod essential habitat includes structurally complex hard bottom composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae (NEFMC 2017). Adult Atlantic cod are unlikely to occur in the Project Area since this life-stage prefers cobble habitats and not the sand substrate that dominates the Project Area. Atlantic cod are also uncommon along the southern New Jersey coast because it is near the southern end of their range in the western North Atlantic (Lough 2004).

3.4.1.2 Atlantic Herring (Clupea harengus)

General: Atlantic herring is a schooling, pelagic, commercially important coastal species that ranges from northern Labrador to North Carolina in the western Atlantic and, depending on feeding, spawning, and wintering, migrates extensively north-south (Collette and Klein-MacPhee 2002). Atlantic herring have been documented off the New Jersey coast in waters near Atlantic City (Fowler, Stevenson and Scott 2005). The Project Area is designated EFH for Atlantic herring juvenile and adult life-stages (**Table 2**).

Larvae: A very long larval stage (4-8 months) allows Atlantic herring to be transported long distances to inshore and estuarine waters where, in the spring, they become early stage juveniles through metamorphosis (NEFMC 2017). Atlantic herring larvae are observed between August and April, with peak abundances generally occurring from September through November (NEFMC 2017).

Juvenile: Atlantic herring juveniles are found in pelagic and bottom waters that range in depth from 15-135 m, at temperatures less than 10°C, and in salinities ranging from 26-32 ppt (Reid *et al*. 1999). At approximately 40-50 mm, Atlantic herring larvae metamorphose into juveniles and begin schooling. Juvenile Atlantic herring occur year-round in the inland bays of New Jersey and are most abundant from April to June (Stone *et al*. 1994). Juvenile Atlantic herring do not migrate seasonally, but instead move to overwintering habitats in southern New England and throughout the Middle Atlantic Bight during summer and fall where they stay in deep bays or near the bottom in offshore areas (Reid *et al*. 1999). Zooplankton, including predominantly groups of copepods, decapod larvae, barnacle larvae, cladocerans, and pelecypod larvae, are the primary prey of juvenile Atlantic herring (Sherman and Perkins 1971). Atlantic herring reach maturity at approximately three years of age and approximately 23 cm (O'Brien *et al*. 1993).

Adult: Adult Atlantic herring can be found in pelagic and bottom waters ranging in depth from 20-130 m, with temperatures less than 10°C, and salinities that are greater than 28 ppt (Reid *et al*. 1999). Adults can be found year round in the inland waters of New Jersey, with peak abundances occurring in January, November, and December (Stone *et al*. 1994). Adult Atlantic herring feed on copepods, euphausiids, decapods, and bivalve larvae and are preyed on by short-finned squid, numerous piscivorous fish (cod [*Gadus* spp.], monkfish [*Lophius* spp.], bluefish, silver hake, striped bass [*Morone saxatilis]*, mackerel, and tuna), elasmobranchs (sharks and rays), marine mammals, and seabirds (Sherman and Perkin 1971, Stevenson and Scott 2005, Bigelow and Schroeder 1953, Bowman *et al*. 2000).

3.4.1.3 Monkfish (Lophius americanus)

General: Monkfish can be found from Newfoundland to North Carolina, in the Gulf of Mexico, and along the coast of Brazil (Collette and Klein-MacPhee 2002). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: The spawning season for monkfish begins in early spring in the Carolinas and continues through early fall, with peak spawning occurring May through June, including in the Gulf of Maine (Steimle *et al*. 1999a).

Eggs (1.6-1.8 mm in diameter), which are buoyant and float close to the surface, occur in surface waters at depths ranging from 15 m to 1,000 m, in temperatures less than 18°C (Martin and Dewry 1978). Egg incubation time depends on the temperature and can range from 7 to 100 day at 15°C to 5°C, respectively (Steimle *et al*. 1999a). At approximately 2.5 to 4.5 mm total length (TL[2]), larvae hatch from eggs and spend 2-3 days in the egg veil (Steimle *et al*. 1999a).

Larvae: After release from the egg veil, larval monkfish are pelagic occurring at depths of 5 to 1,000 m, in water temperatures ranging from 6°C to 20°C (Steimle *et al*. 1999a). At approximately 5-10 cm TL, larval monkfish metamorphose into juveniles and bottom dwellers. However, the habitat(s) in which metamorphosis occurs is not well known (Bigelow and Schroeder 1953, Steimle *et al*. 1999a). Larval monkfish have been collected in Northeast Fisheries Science Center (NEFSC) Marine Resources Monitoring, Assessment, and Prediction (MARMAP) Program ichthyoplankton surveys along the coast of New Jersey, specifically in May, and appear in the New York Bight area in April and June through September (Steimle *et al*. 1999a). Zooplankton (i.e., copepods, crustacean larvae, and chaetognaths) are the primary prey item for larval monkfish (Steimle *et al*. 1999a).

Juvenile: Juvenile monkfish can be found in sub-tidal benthic habitats with depths between 50-400 m in the Mid-Atlantic, 20-400 m in the Gulf of Maine, and a maximum depth of 1,000 m on the continental slope (NEFMC 2017). Diverse habitats, including hard sand, pebbles, gravel, broken shells, and soft mud, are critical for juvenile monkfish, as well as algae covered rocks that provide shelter (Steimle *et al*. 1999a). In the Mid-Atlantic, juvenile monkfish have been predominantly collected at the center of the continental shelf, but have also been collected in the shallow, nearshore waters east of Long Island, in the shelf valley of the Hudson Canyon, and the perimeter of Georges Bank (NEMFC 2017).

Adult: Adult monkfish can be found at depths of 1 to 800 m and are associated with varying bottom habitats (e.g., hard sand, sand and shell mix, pebbly gravel, and rocks covered in algae), in temperatures that range from 0°C to 24°C, with salinities between 29.9 and 36.7 ppt (Steimle *et al*. 1999a, Richards *et al*. 2008). Opportunistic ambush feeders, adult monkfish feed on a variety of benthic and pelagic fish, such as skates, eels, dogfish, sand lance, herring, mackerel, cod, flounders, and hake, as well as invertebrates, such as crabs and squid, and sometimes sea birds (Steimle *et al*. 1999a, Bigelow and Schroeder 1953, Johnson *et al*. 2008). In response to seasonal changes in water temperature, adult monkfish exhibit onshore-offshore migration habitats and are found seasonally distributed in the southern Middle Atlantic Bight (Steimle *et al*. 1999a, Richards *et al*. 2008). From 1968 to 1997, NMFS bottom trawl surveys collected adult (≥43 cm) monkfish off the coast of New Jersey; monkfish have also been observed in the waters offshore of Atlantic City (Steimle *et al*. 1999a, Fowler 1952).

3.4.1.4 Ocean Pout (Macrozoarces americanus)

General: The ocean pout is a bottom-dwelling, cool-temperate species of fish that utilizes both open and rough habitats, feeding on benthic organisms (Steimle *et al*. 1999d). The distribution of ocean pout is from the Atlantic continental shelf of North America between Labrador and the southern Grand Banks and Virginia. Ocean pout also occur south of Cape Hatteras in deeper, cooler waters. The Project Area is designated EFH for egg, juvenile, and adult life-stages (**Table 2**).

Egg: Ocean pout eggs are laid in gelatinous masses in sheltered nests, holes, or rocky crevices. Prior to spawning, ocean pout congregate in rocky areas and occupy nesting holds under rocks or in crevices in depths less than 100 m (NEFMC 2017). Ocean pout EFH for eggs includes hard bottom habitats on Georges Bank, in

[2]Total Length is defined as the measurement taken from the anterior-most part of the fish to the end of the caudal fin rays.

the Gulf of Maine, and in the Mid-Atlantic Bight, as well as high salinity zones of bays and estuaries. Eggs occur at depths less than 100 m on rocky bottom habitats (NEFMC 2017).

Juvenile: Ocean pout juvenile EFH includes intertidal and subtidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high salinity zones of a number of bays and estuaries north of Cape Cod. EFH extends to a depth of 120 m and occurs on a variety of substrates, including shells, rocks, algae, soft sediments, sand, and gravel (NEFMC 2017).

Adult: Ocean pout EFH includes subtidal benthic habitats between 20 and 140 m in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high salinity zones of bays and estuaries north of Cape Cod. EFH for adult ocean pout includes mud and sand, as well as structure forming habitat such as shells, gravel, or boulders (NEFMC 2017).

3.4.1.5 Pollock (Pollachius pollachius)

General: Pollock is a bony fish found in the northwest Atlantic, being most common on the Scotian Shelf, Georges Bank, in the Great South Channel, and in the Gulf of Maine (Cargnelli *et al*. 1999c). The Project Area is designated EFH for the larval life-stage (**Table 2**).

Larvae: The larval pollock stage lasts approximately 3 to 4 months and are commonly found at temperatures of 3 to 9ºC (Bigelow and Schroeder 1953). Pollock larvae normally occur from the shore out to the 200 m depth contour (Cargnelli *et al*. 1999c). Primary prey of small larvae (4 to 18 mm) are larval copepods (Cargnelli *et al*. 1999c). EFH for pollock larvae includes pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, including Great South Bay (NEFMC 2017).

3.4.1.6 Red hake (Urophycis chuss)

General: Red hake can be found from southern Nova Scotia to North Carolina, and historically, the heaviest concentrations of red hake were documented from the southwestern area of Georges Bank to the shelf valley of the Hudson Canyon (Bigelow and Schroeder 1953, Grosslein and Azarovitz 1982). In the inland waters of New Jersey, red hake are rare. However, red hake has been observed in the offshore waters near Atlantic City (Stone *et al*. 1994, Fowler 1952, Fowler 1920). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Red hake eggs (0.6-1.0 mm in diameter) can be found on the inner continental shelf near the surface due to buoyancy, in temperatures less than 10°C, with salinities less than 25 ppt (Steimle *et al*. 1999b). Although not documented in the inland waters of New Jersey, red hake eggs were collected from May to July and October to November off the coast of New Jersey in NEFSC MARMAP ichthyoplankton surveys from 1978-1987 (Steimle *et al*. 1999c).

Larvae: Larval stages of red hake can be found in surface waters at depths of 200 m or less, in temperatures less than 19°C, with salinities 0.5 ppt or greater (Steimle *et al*. 1999b). At approximately 2 mm in length, red hake larvae hatch and spend the next two months free floating at the surface, generally with debris, sargassum, and jellyfish (Steimle *et al*. 1999c). Red hake larvae distribution is not known to be associated with a substrate type and red hake larvae have not been observed in the inland waters of New Jersey (Stone *et al*. 1994).

Juvenile: Once red hake larvae reach 35 to 40 mm in length, they sink to the bottom on fine, silty sand at depths approximately 100 m or less, where they take shelter in depressions in the substrate (Bigelow and Schroeder 1953, Steimle *et al*. 1999b). In inshore areas, small red hake juveniles (5-15 cm) are highly correlated with eelgrass (*Zostera marina*) and in deep offshore areas, they can be found frequently hiding in sea scallops (*Pecten magellanicus*) (Steimle *et al*. 1999b). Structures, shell fragments, and sea scallops provide shelter for older juveniles (until red hake are approximately 14 cm in length) found in bottom habitats at less than 100 m depth, in water temperatures below 16°C, with salinities between 31-33 ppt (Steimle *et al*. 1999b). In the inland waters of New Jersey, red hake juveniles are rare in winter through mid-spring and in the fall (Stone *et al*. 1994). Juvenile red hake prey on euphausiids, amphipods, decapods, and mysids (Bowman *et al*. 2000).

Adult: Preferring bottom habitats of sand and mud with depressions, adult red hake can be found in depths that range from 30 to 130 m, in water temperatures 12°C or lower, with salinities between 33-34 ppt (Steimle *et al*. 1999b). Adult red hake have not been documented within the inland bays of New Jersey, but were observed offshore of Atlantic City (Stone *et al*. 1994, Fowler 1952, Fowler 1920). At two years of age, red hake reach sexual maturity and peak spawning occurs during June and July off Long Island, Georges Bank, and the New York Bight (Musick 1969, Perlmutter 1939, Grosslein and Azarovitz 1982). Red hake primarily feed on shrimp, small crustaceans, and small fish and red hake predators include striped bass, spiny dogfish, goosefish, white hake, silver hake, sea raven, and harbor porpoise (*Phocoena phocoena*) (Bowman *et al*. 2000, Steimle *et al*. 1999b, Bigelow and Schroeder 1953).

3.4.1.7 Silver Hake (Merluccius bilinearis)

General: Silver Hake (a.k.a. Whiting) are found from the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Lock and Packer 2004). The areas of highest abundance in the U.S. are the Gulf of Maine, Georges Bank, and the Middle Atlantic Bight off Long Island (Lock and Packer 2004). The Project Area contains designated EFH for whiting egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg and Larvae: Whiting eggs and larvae are found in surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). EFH for whiting eggs includes sea surface temperatures that are below 20°C within water depths between 50 and 150 m, and juveniles are found within water depths between 50 and 130 m (NEFMC 2017). Eggs can be observed all year, but have peak counts from June through October and larvae are observed year round with peaks from July through September (NEFMC 2017).

Juvenile: Juvenile whiting EFH includes bottom habitats of all substrate types in the Mid-Atlantic south to Cape Hatteras. Whiting juveniles are found at depths between 20 and 270 m; salinities greater than 20%; and sea surface temperatures below 20°C (NEFMC 2017).

Adult: Adult whiting EFH includes bottom habitats of all substrate types in the Gulf of Maine, on Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras (NEFMC 2017). Adult whiting are generally found at water temperatures below 22°C and at depths between 20 and 270 m (NEFMC 2017). Auster *et al.* (1997) found silver hake were more abundant on silt-sand bottoms containing amphipod tubes in the Middle Atlantic Bight. Silver hake were also found on flat sand, sand-wave crests, shell, and biogenic depressions within the Mid-Atlantic Bight (Auster *et al.* 1991).

3.4.1.8 White Hake (Urophycis enuis)

General: White hake is a species that is able to tolerate wide temperature ranges and inhabits the continental shelf and slope from the Gulf of St. Lawrence to the Middle Atlantic Bight (Chang *et al*. 1999a). They also inhabit estuaries across the continental shelf to the submarine canyons along the upper continental slope and the deep, muddy basins the Gulf of Maine (Bigelow and Schroeder 1953). The Project Area contains designated EFH for the white hake adult life-stage (**Table 2**).

Adult: Adult white hake are demersal and attain a maximum length of 1.4 m and weight up to 22 kg (Chang *et al*. 1999a). Adult white hake prefer fine grained, muddy substrates and are found at temperatures from 6 to 11ºC in the spring and autumn and most abundance at depths of 50 to 325 m (Chang *et al*. 1999a). Prey items include juveniles of their own species, shrimps, and other crustaceans (Chang *et al*. 1999a). EFH for white hake includes sub-tidal habitats in the Gulf of Maine, including depths greater than 25 m in certain mixed and high salinity zones within bays and estuaries (NEFMC 2017). EFH includes waters between 100 and 400 m in the outer gulf, and between 400 and 900 m on the outer continental shelf and slope. EFH occurs on fine-grained, muddy substrates and in mixed soft and rocky habitats.

3.4.1.9 Windowpane Flounder (Scophthalmus aquosus)

General: The range of windowpane flounder is from the Gulf of Saint Lawrence to Florida (Gutherz 1967). In New Jersey, windowplane flounder is abundant in the Inland Bays System and offshore near waters near Atlantic City (Stone *et al*., 1994, Chang *et al*. 1999b). The Project Area contains designated EFH for windowpane flounder egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Windowpane flounder produce buoyant, pelagic eggs that are 1-1.4 mm in diameter (Colton and Marak 1969). Eggs are found on the continental shelf from Georges Bank to Cape Hatteras and in mixed and high salinity zones of coastal bays and estuaries throughout the region.

Larvae: Larvae are found on the continental shelf from Georges Bank, southern New England, and the middle Atlantic down to Cape Hatteras. They are found at depths less than 70 m and are common in the New Jersey Inland Bays from May through October (Stone *et al*. 1994).

Juvenile: Juvenile windowpane flounder are found in intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida (NEFMC 2017). EFH for juvenile windowpane flounder is identified as extending from the intertidal zone to a maximum depth of 60 m on muds and sandy substrates (NEFMC 2017).

Adult: Adult windowpane flounder are found in the same marine and coastal habitats as juveniles. EFH for adult windowpane flounder extends from the intertidal zone to a maximum depth of 60 m on mud and sand substrates (NEFMC 2017).

3.4.1.10 Winter Flounder (Pseudopleuronectes americanus)

General: The range for winter flounder is from the coastal waters in the Strait of Belle Isle, Newfoundland, south to Georgia (Collette and Klein-MacPhee 2002). These economically important flatfish are also found in inshore areas from Massachusetts and occur regularly in New Jersey waters (Stone *et al*. 1994). In New Jersey, winter flounder are most abundant off Sandy Hook in the winter and spring and occur less frequently off the nearshore coast of southern New Jersey (Wuenschell *et al*. 2009). The Project Area contains designated EFH for winter flounder egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Winter flounder eggs are approximately 0.7 to 0.9 mm in diameter and deposited in adhesive clusters on sand, muddy sand, mud, macroalgae, and gravel bottom substrates (Pereira *et al*. 1999). Bottom habitats are unsuitable if exposed to excessive sedimentation which can reduce hatching success. In the New Jersey Inland Bays System, winter flounder eggs are common from January through March (Stone *et al*. 1994). The preferred designation for winter flounder eggs defines EFH as sub-tidal coastal waters from the shoreline to a maximum depth of 5 m from Cape Cod to Absecon Inlet, New Jersey.

Larvae: Winter flounder larvae are found within estuarine, coastal, and continental shelf benthic habitats from the Gulf of Maine to Absecon Inlet, as well as in the mixed and high salinity zones of bays and estuaries (NEFMC 2017). Larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites, where they later settle to the bottom as juveniles (NEFMC 2017). As larvae age, they become increasingly less buoyant and occupy the lower water column. In New Jersey, winter flounder larvae are common in the Inland Bays system from January through April (Stone *et al*. 1994).

Juvenile: Juvenile winter flounder are found within estuarine, coastal, and continental shelf water column habitats, as well as the mixed and high salinity zones in New Jersey bays and estuaries (NEFMC 2017). EFH for juvenile winter flounder extends from the intertidal zone to a maximum depth of 60 m, and includes a variety of bottom types, including mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass (NEFMC 2017). Young-of-the-year (YOY[3]) juveniles are found inshore on muddy and sandy sediments within eelgrass and macroalgae, in bottom debris, and march creek habitat (NEFMC 2017). Juvenile winter flounder generally settle to the bottom in soft-sediments and disperse to coarser-grained substrates as they age.

Adult: Adult winter flounder are found in estuarine, coastal, and continental shelf benthic habitats from the intertidal zone to a maximum depth of 70 m, as well as the mixed and high salinity zones in bays and estuaries (NEFMC 2017). EFH for adult winter flounder occurs on muddy and sandy substrates and hard bottom.

3.4.1.11 Witch Flounder (Glyptocephalus cynoglossus)

General: The witch flounder is a small-mouthed, right-eyed flounder occurring on both sides of the Atlantic Ocean. In U.S. waters, it is common throughout the Gulf of Maine and occurs in deeper areas around Georges Bank and along the continental shelf edge to Cape Hatteras, North Carolina. The Project Area contains designated EFH for the witch flounder egg, larval, and adult life-stages (**Table 2**).

Egg and Larvae: Witch flounder spawning occurs at or near the bottom, with the buoyant eggs rising into the water column where egg and larval development occurs (Cargnelli *et al*. 1999a). Eggs range in diameter from 0.7 to 1.45 mm and hatching occurs 7 to 8 days following spawning at 7.8 to 9.4ºC (Bigelow and Schroeder 1953). Resulting larvae measure 3.5 to 5.6 mm in length (Cargnelli *et al*. 1999a). EFH for both egg and larval life stages for witch flounder includes pelagic habitats on the continental shelf throughout the Northeast region (NEFMC 2017). Witch flounder eggs have the potential to occur in the Project Area in the water column in April, when temperatures are between 4°C to 17°C.

Adults: Once larvae transition to juveniles, juveniles settle to the ocean bottom. Juveniles are found at temperatures ranging from 4°C to 10°C and depths of 75-200 m during the NEFSC trawl survey. Most adults were taken at 4°C to 11°C and at depths of 50-200 m. For adults, EFH includes sub-tidal benthic habitats between 35 and 400 m in the Gulf of Maine and as deep as 1500 m on the outer continental shelf and slope, with mud and muddy sand substrates (NEFMC 2017).

3.4.1.12 Yellowtail Flounder (Limanda ferruginea)

General: Yellowtail flounder have a range along the Atlantic coast of North America from Newfoundland to the Chesapeake Bay, with the majority located on the western half of Georges Bank, the western Gulf of Maine, east of Cape Cod, and southern New England (Collette and Klein-MacPhee 2002). The Project Area contains designated EFH for yellowtail flounder egg, larvae, juvenile, and adult life-stages (**Table 2**).

[3]Young-of-the-year are fish produced in one reproductive year. Small fish, hatched from eggs spawning in the current year, are considered young-of-year or age 0.

Egg: In the northwest Atlantic, spawning occurs from March through August at temperatures of 5-12°C (Fahay 1983). Yellowtail spawn buoyant, round, pelagic eggs with an average diameter of 0.88 mm and ranging in size from 0.79 to 1.01 mm (Johnson *et al*. 1999). Eggs hatch approximately 5 days after fertilization at temperatures of 10-11°C (Bigelow and Schroeder 1953; Hildebrand and Schroeder 1928; Miller *et al*. 1991). The NEFSC MARMAP ichthyoplankton surveys occurred within the Project Area. The survey collected yellowtail flounder eggs from 1977-1987 and found that most eggs were collected in water from 10 to 170 m deep and most frequently caught between 30 and 90 m. Densities near the Project Area in March and April were 1 to < 10 eggs per 10 m^2. EFH for yellowtail flounder includes coastal and continental shelf habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region.

Larvae: Hatching times for yellowtail flounder larvae range from 14.5 days at 4°C to 4.5 days at 14°C (Yevseyenko and Nevinsky 1981; Walsh 1992). Larvae hatch at lengths of 2.0-3.5 TL and do not become benthic until reaching approximately 14 mm standard length (Johnson *et al*. 1999). NEFSC MARMAP ichthoplankton surveys from 1978-1987 collected in April to June near the Project Area identified densities from 1 to < 10 to 10 to < 100 larvae per 10 m^2. EFH for yellowtail flounder includes coastal marine and continental shelf habitats in the Gulf of Maine, and from Georges Bank to Cape Hatteras.

Juvenile: Juveniles are found in waters 5 to 75 m at temperatures ranging from 9°C to 13°C (Johnson *et al*. 1999). Yellowtail flounder larvae occur in the water column briefly before entering the juvenile stage at approximately 11.6-16 mm standard length (SL)[4] (Johnson *et al*. 1999). EFH for juveniles includes sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic. In the Mid-Atlantic, juveniles settle to the bottom of the continental shelf consisting of sandy substrates at depths of 40-70 m.

Adult: Yellowtail flounder adults reach a maximum size of 50 cm and are generally found at depths between 37 and 73 m (Johnson *et al*. 1999). The diet of yellowtail flounder consists of benthic macrofauna, including amphipods (*Unicola inermis, Ericthonius fasciatus, Ampelisca agassizi*), polychaetes (*Chone infondibuliformis, Nephtys incise*), and sand dollars (*Echinarachius parma*). Yellowtail flounder are preyed on by spiny dogfish, winter skate, Atlantic cod, Atlantic halibut (*Hippoglossus hippoglossus*), fourspot flounder (*Hippoglossina oblonga*), goosefish, little skate (*Leucoraja erinacea*), smooth skate (*Dipturus innominatus*), silver hake, bluefish, and sea raven. The EFH for adult yellowtail flounder has been identified as sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic, including high salinity zones of bays and estuaries. EFH consists of substrate made of sand and sand with mud, shell hash, gravel, and rocks at depths between 25 and 90 m.

3.4.2 Mid-Atlantic Finfish Species

3.4.2.1 Atlantic Butterfish (Peprilus triacanthus)

General: Atlantic butterfish is a demersal/pelagic species ranging from the Gulf of St. Lawrence south to Florida, but is most abundant from the Gulf of Maine to Cape Hatteras (Bigelow and Schroeder 1953, Overholtz 2006). Butterfish are found in the Mid-Atlantic shelf in the summer and autumn, but migrate to the edge of the continental shelf where they aggregate in response to seasonal cooling of water temperatures (Grosslein and Azarovitz 1982). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Eggs: Atlantic butterfish are broadcast spawners that spawn primarily in the evening or at night (Cross *et al*. 1999). Butterfish eggs are buoyant, transparent and have a diameter of 0.68-0.82 mm, with an incubation

[4] Standard length is defined as the measurement take from the tip of the lower jaw to the posterior end of the hypural bone

period of about 48 hours at 18ºC (Cross *et al*. 1999). Spawning may occur in the upper part of the water column and eggs were found between 0 to 4 m at night in the Middle Atlantic Bight than during the day (Kendall and Naplin (1981). EFH for butterfish eggs is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to the south shore of Long Island, New York, in Chesapeake Bay, and on the continental shelf and slope, primarily from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic butterfish eggs is generally over bottom depths of 1,500 m or less (Mid-Atlantic Fishery Management Council (MAFMC) 2011).

Larvae: Atlantic butterfish larvae are generally found over bottom depths between 41 and 350 meters (m) where average temperatures are 8.5°C to 21.5°C in the upper water column (<200 m) (Cross *et al*. 1999). The size of Atlantic butterfish larvae ranges from 2.6 to 16 mm SL with metamorphosis occurring gradually (Able and Fahay 1998). Butterfish larvae begin taking on the characteristics of adults (i.e., thin, deep body) at approximately 6 mm SL, and at 15-16 mm SL they have a forked tail (Martin and Drewry 1978, Horn 1970, Ditty and Truesdale 1983). Between 10-15 mm, Atlantic butterfish are free swimming and generally move independent of currents (Martin and Drewry 1978). Larval Atlantic butterfish are believed to participate in diurnal vertical migrations; however, more larvae have been collected in the water column between 0-4 m at night than during the day (Kendall and Naplin 1981).

Juvenile: Small juvenile butterfish (less than 30 mm) are surface-dwelling, forming loose schools in association with flotsam and large jellyfish to avoid predation from larger fish (Cross *et al*. 1999, Mansueti 1963, Bigelow and Schroeder 1953). Larger juvenile butterfish (>30 mm) are found over sand and muddy substrate at depths between 10-365 m in water temperatures that range between 3-28°C (Stone at el. 1994, Cross *et al*. 1999). Juvenile butterfish are common in the inland bays of New Jersey from June through October and have been documented in trawl surveys conducted along the New Jersey coast (Stone *et al*. 1994, Cross *et al*. 1999). Sexual maturity of butterfish begins at age 1 and all fish are mature by age 2 (DuPaul and McEachran 1973). Butterfish prey on predominantly pelagic species such as thaliaceans, ctenophores, mollusks, small fish, squid (Decappodiformes), crustaceans, and benthic polychaetes. Their predators include several species of fish such as silver hake (*Merluccius bilinearis*), bluefish (*Pomatomus saltatrix*), goosefish (*Lophiidae* spp.), weakfish (*Cynoscion regalis*), sharks (Selachimorpha), swordfish (*Xiphias gladius*) and long-finned squid (*Loligo forbesi*) (Cross *et al*. 1999, Bowman *et al*. 2000, Rountree 1999).

Adult: Adult Atlantic butterfish are primarily found at bottom depths between 10 m and 250 m where water temperatures are between 4.5°C and 27.5 °C and salinities are above 5 parts per thousand (ppt) (Cross *et al*. 1999). Spawning generally occurs at water temperatures over 15°C (Cross *et al*. 1999). Adult butterfish prey on predominantly planktonic species, including squids and fishes (Cross *et al*. 1999). From 1974 to 2008, the Atlantic butterfish stock, which is managed as a single stock by the Mid-Atlantic Fishery Management Council under the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan, declined (Overholtz 2006, NEFSC 2010). Butterfish spawning and recruit biomasses were highly variable during that time period and have continued to decline despite very low relative mortality to natural mortality for over 20 years (NEFSC 2010). Since the butterfish is a short-lived species that matures early, and has a high natural mortality rate, butterfish spawning biomass is highly dependent on recruitment; the cause of the poor recruitment rates is unknown currently (NEFSC 2010). Since 1985, Atlantic butterfish landings have declined and since 2002, butterfish have been primarily landed as bycatch in the small-mesh bottom trawl fishery for squid (NEFSC 2010). Over the last twenty years, fisheries targeting other species comprised more than half the total landings of butterfish (NEFSC 2010). Commercial landings in the U.S. peaked in 1984 and recreational landings are negligible (Overholtz 2006, NEFSC 2010). New Jersey commercial butterfish landings reached a 59-year (1950-2009) record low in 2009 (NMFS 2010).

3.4.2.2 Atlantic mackerel (Scomber scombrus)

General: Atlantic mackerel is a pelagic, schooling species that can be found from the Gulf of St. Lawrence to Cape Lookout, North Carolina (MAFMC 2011, Studholme *et al*. 1999). The Project Area is designated EFH for Atlantic mackerel egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Atlantic mackerel eggs are pelagic and spherical and can generally be found over bottom depths of less than 100 m when temperatures in the upper 15 m of the water column average 6.5 to 12.5°C (Berrien 1975, Studholme *et al*. 1999). Atlantic mackerel eggs have one oil globule and have an average diameter of 1.08 to 1.20 mm. However, sampling in the Gulf of St. Lawrence indicates that egg size has decreased in response to ambient temperatures over time (Berrien 1975, Ware 1977)

Larvae: Atlantic mackerel larvae can generally be found over bottom depths ranging between 10-130 m, in temperatures ranging from 6°C to 22°C, with the largest portion observed in temperatures between 8-13°C (Studholme *et al*. 1999). Mackerel larvae measure approximately 3.1-3.3 mm SL at hatching, which occurs between 90 and 120 hours post-fertilization in average water temperature of 13.8°C (Sette 1943, Bigelow and Schroeder 1953, Colton and Marak 1969, Berrien 1975, Ware and Lambert 1985, Scott and Scott 1988). Metamorphosis occurs rapidly for Atlantic mackerel larvae, likely increasing successful capture of prey and avoidance of predation (Sette 1943, Ware and Lambert 1985). Mackerel larvae (<13 mm) were collected in NEFSC MARMAP ichthyoplankton surveys from waters off Chesapeake Bay to the Gulf of Maine, with peak abundances offshore of Delaware Bay to Massachusetts Bay in inshore waters to the seaward limits (Studholme *et al*. 1999).

Juveniles and Adults: Atlantic mackerel juveniles can generally be found over bottom depths that range from the surface to 340 m, in temperatures between 4°C and 22°C (Studholme *et al*. 1999). Juveniles collected in Hudson-Raritan estuary of New York and New Jersey were found at depths between 4.9-9.8 m, in temperatures that ranged from 17.6 to 21.7, with salinities of 26.1-28.9 ppt (Studholme *et al*. 1999). At approximately 30-50 mm, post-larvae begin to exhibit swimming and schooling behavior, and within approximately two months juveniles reach a length of 50 mm at which time they resemble adults (Sette 1943, Bigelow and Schroeder 1953, Anderson and Paciorkowski 1980, Berrien 1982). Juvenile Atlantic mackerel tend to have similar distribution patterns as adult Atlantic mackerel. However, juveniles have been collected in near coastal waters in the Mid-Atlantic Bight and southern New England, particularly in the fall (Studholme *et al*. 1999). The diet of Atlantic mackerel juveniles consists primarily of small crustaceans, larval fish, and other pelagic organisms (Studholme *et al*. 1999). EFH for juveniles and adults is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay and Penobscot Bay, Maine to the Hudson River, in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina.

3.4.2.3 Black Sea Bass (Centropristis striata)

General: Black sea bass is a pelagic, warm temperate species that can be found in the western Atlantic, ranging from southern Nova Scotia and the Bay of Fundy to southern Florida (Drohan *et al*. 2007). Black sea bass are found in an array of complex, structured habitats, including reefs, shipwrecks, and lobster pots along the continental shelf (Steimle *et al*. 1999c). YOY are generally found in estuarine habitats with structural complexity (Drohan *et al*. 2007). The Project Area is designated EFH for the larval, juvenile, and adult life-stages (**Table 2**).

Larvae: Black sea bass larvae was collected at temperatures ranging between 11-26°C and depths ranging from 10 m to 2,000 m in NEFSC MARMAP ichthyoplankton surveys (Drohan *et al*. 2007). At approximately 1.5-2.1 mm TL, larval black sea bass hatch from eggs (Kendall 1972, Fahay 1983, Able *et al*. 1995). Black sea bass larval growth and development is directly correlated with temperature (Drohan *et al*. 2007). Based on NEFSC MARMAP surveys, the peak abundance for black sea bass larvae in the Mid-Atlantic were in the months of July through September, with the highest density collected in August (Drohan *et al*. 2007). Historically, larvae have been collected close to shore on the continental shelf, but rarely in estuaries (Drohan *et al*. 2007). Black sea bass larvae feed on microalgae and zooplankton (Tucker 1989).

Juvenile: Black sea bass juveniles can be found in demersal waters over the continental shelf and in estuaries, in temperatures greater than 6°C with salinities greater than 18 ppt (Steimle *et al*. 1999c). Juvenile black sea bass are associated with structured habitats. YOY juveniles are frequently collected within large amounts of shell hash (Able and Fahey 2010). In the summer, juvenile sea bass are found in estuarine nursery areas following settlement in coastal areas. However, due to declining water temperature, older juveniles will migrate seasonally to nearshore habitats in the spring through fall, and outer coastal areas at depths of 30 to 128 m in winter (Nichols and Breder 1927, Hales and Abe 2001). Black sea bass juveniles can be found in the inland bays of New Jersey from April through December, but are most abundant May through September. Benthic and epibenthic invertebrates (i.e., amphipods, isopods, and small crabs) and small fish dominate the diets for juvenile black sea bass (Drohan *et al*. 2007, Bowman *et al*. 2000).

Adult: Black sea bass adults can be found in demersal waters over the continental shelf and in estuaries, in temperatures greater than 6°C and salinities greater than 18 ppt (Steimle *et al*. 1999c). Adult black sea bass can be found in the inland bays of New Jersey May through December, with peak abundances occurring from June through September (Stone *et al*. 1994). Winter habitats tend to be up to 150 m deeper than shelf areas occupied in the summer, and black sea bass are known to migrate north and south along the shelf break relatively quickly (Moser and Shepherd 2009). Black sea bass become more piscivorous as they mature (between one and four years of age) and in the Mid-Atlantic, feed primarily on crustaceans (*Cancer irroratus* and *Meganyctiphanes norvegica*) and small fish, as well as polychaetes and mollusks (Grosslein and Azarovitch 1982, Steimle *et al*. 1999c, Bowman *et al*. 2000, Byron and Link 2010). Northern populations of adult sea bass located primarily between Chesapeake Bay and Montauk, New York, spawn during summer months in water 18 to 44 m (Musick and Mercer 1977).

3.4.2.4 Bluefish (Pomatomus saltatrix)

General: Bluefish are a coastal migratory pelagic species that can be found in inshore and offshore temperate and warm temperate waters of the continental shelf, ranging from Nova Scotia to Florida, as well as the Gulf of Mexico from Florida to Texas (Bigelow and Schroeder 1953, Briggs 1960). In mid-to-late May, bluefish, traveling in large schools of like-size fish, migrate into Mid-Atlantic waters, returning to deeper offshore waters of southeastern Florida in November (Grosslein and Azarovitz 1982, Stone *et al*. 1994). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Bluefish eggs (0.8-1.2 mm) are found in mid-shelf waters ranging from 30 to 70 m in southern New England to Cape Hatteras, in temperatures ranging from 18°C to 22°C, with salinities greater than 31 ppt (Hardy 1978, Fahay *et al*. 1999). The incubation times for bluefish eggs varies with temperature with egg hatching generally occurring within 46 to 48 hours at temperatures ranging between 18°C to 22.2°C (Deuel *et al*. 1966, Hardy 1978). Bluefish eggs are not found in estuarine waters and have not been observed in the inland bays of New Jersey. However, from 1978-1987, bluefish eggs were collected along the coast of New Jersey in the month of July in ichthyoplankton surveys conducted by the NEFSC for the MARMAP (Stone *et al*. 1994, Fahay *et al*. 1999).

Larvae: Bluefish larvae are found in oceanic waters in temperatures of 18°C, with salinities of greater than 30 ppt (Able and Fahay 1998, Shepherd and Packer 2006). Larval bluefish are 2-2.4 mm when they hatch (Shepherd and Packer 2006). Bluefish spend their larval stage at no deeper than 15 m in the water column, are most concentrated at 4 m during the day, and are equally distributed between 4 m and the surface at night (Kendall and Naplin 1981). Bluefish larvae are transported across the shelf to estuarine nurseries via active migration presumably facilitated by oceanographic features (i.e., warm-core ring streamers and Gulf Stream filaments) or Eckman transport (active or passive), which is critical for recruitment success (Hare *et al*. 2001, Munch and Conover 2000). Bluefish larvae consume primarily copepods (Shepherd and Packer 2006).

Juvenile: Juvenile bluefish are found in pelagic, nearshore areas and estuaries in temperatures between 19°C and 24°C, with salinities that range from 23 to 36 ppt (Shepherd and Packer 2006). In North Atlantic estuaries, bluefish juveniles are typically found March through December and associated with sand, mud, clay, submerged aquatic vegetation (*Ulva* and *Zostera*) beds and bottom habitats (*Fucus* spp*;* Nelson *et al*. 1991, Jury *et al*. 1994, Stone *et al*. 1994, Fahay *et al*. 1999). Bluefish juveniles are found in the inland waters of New Jersey from May through November, with peak abundances observed from June through October (Stone *et al*. 1994). Sexual maturity of bluefish juveniles occurs at two years of age (Stone *et al*. 1994). Locally abundant macroinvertebrates (including *Neomysis* spp., *Crangon* spp., *Nereis* spp., and squid) and fish (including bay anchovy [*Anchoa mitchilli*], round herring, Atlantic silverside, and butterfish) make up the diet of juvenile bluefish (Friedland *et al*. 1988, Buckel *et al*. 1999, Bowman *et al*. 2000, Shepherd and Packer 2006).

Adult: Bluefish adults can be found in oceanic, nearshore, and continental shelf waters and prefer temperatures above 14-16°C and salinities above 25 ppt (Fahay *et al*. 1999). Adult bluefish are observed in the inland bays of New Jersey from May through October and are not associated with a specific substrate (Stone *et al*. 1994). The species migrates extensively and is distributed based on season and size of the individuals within the schools (Shepherd and Packer 2006). There are two predominant spawning areas on the east coast for bluefish adults: one during the spring that is located offshore from southern Florida to North Carolina and the other during summer in the Middle Atlantic Bight (Wilk 1982). Adult bluefish prey on schooling species such as bay anchovy, butterfish, round herring, and squid and their primary predators include tuna, billfish, and sharks (specifically shortfin mako [*Isurus oxyrinchus*]) (Buckel *et al*. 1999 Bowman *et al*. 2000, Fahay *et al*. 1999, Chase 2002).

3.4.2.5 Scup (Stenotomus chrysops)

General: Scup is a demersal species that can be found from the Bay of Fundy and Sable Island, Nova Scotia to Florida, but are most common from Massachusetts to South Carolina, with a winter distribution that ranges from approximately New Jersey to Cape Hatteras in waters 36-146 m deep and a summer distribution that ranges from southern New England to Mid-Atlantic coasts (Bigelow and Schroeder 1953, Collette and Klein-MacPhee 2002, Grosslein and Azarovitz 1982, MAFMC 1998). The Project Area is designated EFH for juvenile and adult life-stages (**Table 2**).

Juvenile: Scup juveniles (18-19 mm TL or greater) school in demersal waters over the continental shelf and inshore estuaries with salinities of 15 ppt or greater and prefer diverse habitats, including mud, sand, mussel beds, and eelgrass (Steimle *et al*. 1999d). Juvenile scup have been reported in inland bays of New Jersey and are most abundant from June through October (Stone *et al*. 1994, Able and Fahey 2010). In the Great Bay-Little Egg Harbor estuary in New Jersey, juveniles have been found to occupy various substrates, but are most common on unstructured bottom habitat at 3 to 5 m depth (Able and Fahey 2010). Scup reach sexual maturity by two years of age and their diet shifts gradually, from small pelagic crustaceans (copepods) to a variety of benthic organisms, based on size (Steimle *et al*. 2000, Bigelow and Schroeder 1953).

Adult: Adult scup prefer nearshore habitats within close proximity to large bays during the summer that are deeper than 1.8 to 3.7 m, with salinities greater than 15 ppt (Bigelow and Schroeder 1953, Steimle *et al*. 1999d). In early May, scup adults can be found off the coast of New Jersey and have been reported offshore of Atlantic City from June through October, but are rarely observed in inland bays of New Jersey (Grosslein and Azarovitz 1982, Stone *et al*. 1994, Fowler 1952, Fowler 1920). Scup are bottom feeders, preying on crustaceans, polychaetes, hydroids, sand dollars, squid, and small fish, and can be found in a variety of habitats, including smooth to rocky bottoms and mixed sand and mud sediments that allow scup to forage on small benthic invertebrates (Bigelow and Schroeder 1953, Bowman *et al*. 2000). Spawning takes place for Mid-Bight scup from May to August along the inner continental shelf of southern New England and the Bays of New York, with peak spawning occurring from June through July. No spawning has been observed south of Barnegat Bay, New Jersey or within inland waters of New Jersey (Steimle *et al*. 1999d, Grosslein and Azarovitz 1982).

3.4.2.6 Summer Flounder (Paralichthys dentatus)

General: Summer flounder is a demersal, left-sided flatfish that is distributed from Georges Bank to South Carolina and Florida, and is concentrated in the Middle Atlantic Bight from Cape Cod to Cape Hatteras (Bigelow and Schroeder 1953, Collette and Klein-MacPhee 2002, Packer *et al*. 1999). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Summer flounder eggs, which are transparent and spherical, can be found in pelagic waters at depths between 10-110 m, in temperatures ranging from 9°C to 23°C (Packer *et al*. 1999). The Development of summer flounder eggs is directly related to temperature, with growth rates increasing as temperature increases (Packet *et al*. 1999). While summer flounder eggs have not been recorded within the inland bays of New Jersey, eggs were collected in NEFSC MARMAP 1978-1987 ichthyoplankton surveys in October along the coast of New Jersey (Packer *et al*. 1999).

Larvae: After hatching, at approximately 3 mm in length, summer flounder larvae remain in the water column at depths of 10-70 m, in temperatures ranging between 0°C and 23°C, with salinities 35 ppt or less before settling to the bottom (Marin and Drewry 1978, Colton and Marak 1969, Packer *et al*. 1999). Larval and post-larval summer flounder migrate to shallower areas in inshore coastal and estuarine habitats where they metamorphose (at approximately 8-18 mm SL) into juveniles that will bury into sandy bottom substrate (Pack*et al*. 1999, Keefe and Albe 1994). The primary prey for summer flounder larvae includes zooplankton and small crustaceans (Packer *et al*. 1999). Summer flounder larvae are observed within inland New Jersey waters, albeit rarely, from January to May, and October to December; in the New York Bight, summer flounder larvae have peak abundances from October through December (Stone *et al*. 1994, Packer *et al*. 1999).

Juvenile: Summer flounder juveniles can be found in a variety of estuarine, soft-bottom habitats (i.e., mud flats, seagrass beds, marsh creeks, and open bays) with water temperatures 11°C or greater and salinities ranging from 10 to 30 ppt (Packer *et al*. 1999, Deubler and White 1962). Present year round in the inland waters of New Jersey, summer flounder juveniles are most abundant from May through September (Stone *et al*. 1994). Juvenile summer flounder are generalists when it comes to diet, feeding primarily on benthic invertebrates and then, fish, as individuals grow in size (Bowman *et al*. 2000, Packer *et al*. 1999).

Adult: In the summer, adult summer flounder can be found in demersal waters over the continental shelf and on sandy or muddy bottoms of inshore estuaries at depths of 0 to 25 m in an extensive range of salinities, whereas, in winter, adult summer flounder are found offshore at depths between 75-150 m (Packer *et al*. 1999, Grosslein and Azarovitz 1982). NMFS has designated habitat area of particular concern (HAPC) for juvenile and adult summer flounder, which includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed within EFH. Adult summer flounder are most common in the inland waters of New Jersey from May to September (Stone *et al*. 1994). The diet of adult summer flounder includes a variety of smaller fish (i.e., windowpane [*Scophthalmus aquosus*], winter flounder [*Pseudopleuronectes americanus*], northern pipefish [*Syngnathus fuscus*], Atlantic menhaden [*Brevoortia tyrannus*], bay anchovy, red hake, silver hake, scup, Atlantic silverside, American sand lance [*Ammodytes americanus*], bluefish, weakfish, and mummichog [*Fundulus heteroclitus*]), squids, crabs, shrimp, small mollusks, worms, and sand dollars (Bowman *et al*. 2000, Packer *et al*. 1999). Adult summer flounder predators include large sharks, rays, and goosefish (Bigelow and Schroeder 1953).

HAPC: HAPC for summer flounder includes 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 (MAFMC 2016).

3.4.3 Invertebrate Species

3.4.3.1 Atlantic Sea Scallop (Placopecten magellanicus)

General: The Atlantic sea scallop is a commercially important marine bivalve that is present from the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Hart and Chute 2004). Atlantic sea scallops generally inhabit waters less than 20°C and depths of 20 to 80 m in the Mid-Atlantic. In federal waters, the Atlantic sea scallop is managed by the New England Fishery Management Council. The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Atlantic sea scallop eggs are found in benthic habitats as they are denser than seawater and remain on the seafloor until the larval stage (Hart and Chute 2004). Eggs do not travel far from the adults and are found in the general vicinity of adult scallops. Spawning occurs from summer to fall, with spawning occurring earlier in the southern portion of their range. EFH for Atlantic sea scallop eggs occurs in benthic habitats in inshore areas and on the continental shelf.

Larvae: Larvae of Atlantic sea scallops develop in stages. Scallop larvae are pelagic for one to two months, until they settle on the seafloor once they grow a shell height of approximately 0.25 mm (Posgay 1953, Hart and Chute 2004). Larvae typically become benthic in the late fall or early winter and are known as “spat” once settled. They also have the ability to attach to substrates such as shell fragments, plants, and animals. Attachment to a hard surface is thought to enhance survival rates of larval scallops. EFH for larvae is benthic and water column habitat inshore and offshore.

Juvenile: Juvenile Atlantic sea scallops have a shell height between 5 and 12 mm and inhabit depths of 18 to 110 meters (Hart and Chute 2004). Maximum survival of juveniles occurs in waters 1.2 to 15°C and above a salinity of 25 ppt. Juveniles detach from the substrate they attached to as larvae and prefer gravel, but typically occur in sand, gravel, or mixed substrate habitats. Juvenile Atlantic sea scallops are free swimming and more mobile than adults but can only swim for short distances when disturbed or threatened. However, when swimming they may be transported by currents. EFH for juveniles includes benthic habitat in the Gulf of Maine, on Georges Bank, and the Mid-Atlantic between 18 and 110 m depth.

Adult: Adult Atlantic sea scallops typically have the same benthic habitat and are found at the same water depth as juveniles (Hart and Chute 2004). Adults are most common on firm sandy bottom habitats, gravel, shell, or rock substrates. In the Mid-Atlantic, adults primarily inhabit depths between 45 and 75 m. Adults aggregate in groups called beds and are essentially immobile at this life stage. Adults prefer water temperatures between 10 and 15°C with full strength seawater with bottom currents less than half a knot, which would otherwise inhibit suspension feeding. Adults become sexually mature around two years old, but significant egg production does not occur until scallops reach approximately four years old. While spawning generally occurs from late summer to fall, biannual spawning in spring and fall south of Hudson Canyon has been documented (DuPaul *et al*. 1989, Schmitzer *et al*. 1991, Davidson *et al*. 1993). EFH for adult Atlantic sea scallops includes sand and gravel substrates between 18 and 110 m depth.

3.4.3.2 Longfin Inshore Squid (Loligo pealeii)

General: The longfin inshore squid is a pelagic, schooling species that can be found from Newfoundland to the Gulf of Venezuela and is considered a commercially important species from Georges Bank to Cape Hatteras (Cargnelli *et al*. 1999b). Longfin inshore squid are known to migrate seasonally, moving south and offshore in the late fall and wintering on the continental shelf edge; as temperatures increase seasonally, this species moves inshore and north (Cargnelli *et al*. 1999b). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Like most squids, longfin inshore squid produce egg masses that are demersal and anchored to the substrates they are laid on. Females deposit the gelatinous capsules of eggs typically in depths less than 50 m to different substrate types, including shells, fish traps, boulders, submerged aquatic vegetation (e.g., *Fucus* sp.), sand, and mud (MAFMC 2011). EFH for longfin inshore eggs occurs in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, where bottom temperatures are between 10ºC to 23ºC, salinities between 30 and 30 ppt, and depth is less than 50 m (MAFMC 2011).

Larvae: Larvae of longfin inshore squid are planktonic and referred to as pre-recruits, found in the water column near the surface following hatching (Cargnelli *et al*. 1999). Larvae migrate offshore in the fall where they overwinter in deeper waters along the edge of the continental shelf. Very little is known about longfin inshore squid larvae because they are planktonic and require special sampling techniques. Larvae between 2 to 4 mm have been caught in the Gulf of Maine (Bigelow 1924). Longfin inshore squid larvae make daily vertical migrations and feed on planktonic organisms. EFH for longfin inshore squid larvae is pelagic in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments, including Narragansett Bay, Long Island Sound, and Raritan Bay (MAFMC 2011). EFH is generally found over bottom depths between 6 and 160 m where bottom water temperatures are 8.5 to 24.5ºC and salinities are 28.5 to 36.5 ppt (MAFMC 2011).

Juvenile: Juvenile long finned squid are found at bottom depths that range between 6 and 160 m, in temperatures of 8.5°C to 24.5°C, with salinities of 28.5 to 36.5 ppt (Cargnelli *et al*. 1999, MAFMC 2011). In the fall, juveniles in the pre-recruitment stage migrate offshore to winter in deeper waters along the continental shelf edge (Cargnelli *et al*. 1999). Long finned squid juveniles participate in diurnal vertical migration. The diet of immature long finned squid juveniles consists primarily of planktonic organisms, while larger, mature long finned squid juveniles prey primarily on crustaceans and small fish (Cargnelli *et al*. 1999). EFH is considered pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, and Raritan Bay (MAFMC 2011).

Adult: In open waters, long finned squid utilize varying depths of the water column. However, in inshore habitats, long finned squid adults are typically found at bottom depths ranging from 6 to 200 m, in bottom water temperatures of 8.5°C to 14°C, with salinities of 24 to 36.5 ppt (Cargnelli *et al*. 1999). Individuals that are larger than 16 cm feed on fish and squid (MAFMC 2011). Longfin inshore squid are key prey species for marine mammals, diving birds, and finfish species, such as silver hake, mackerel, herring, menhaden (*Clupeidae* sp.), sand lace (Ammodytidae), bay anchovy, weakfish, and silversides (Jacobson 2005). EFH is pelagic habitats in inshore and offshore continental shelf waters and within the same embayments as juvenile long finned squid.

3.4.3.3 Northern Shortfin Squid (Illex illecebrosus)

General: The northern shortfin squid is a highly migratory species distributed in the northwest Atlantic Ocean between the Sea of Labrador and the Florida Straits. Its range is from Newfoundland to Cape Hatteras, North Carolina (Hendrickson and Holmes 2004). The Project Area contains designated EFH for the juvenile (pre-recruit) life-stage (**Table 2**).

Juvenile: Juvenile shortfin squid are referred to as pre-recruits. EFH for pre-recruits is pelagic habitats along the outer continental shelf and slope to South Carolina, on Georges Bank, and on the inner continental shelf off New Jersey and southern Maine and New Hampshire (MAFMC 2011). Pre-recruit EFH is found over bottom depths between 41 and 400 m, with bottom temperatures between 9.5 to 16.5ºC and salinities between 34.5 to 36.5 ppt (MAFMC 2011). Pre-recruits also inhabit pelagic habitats in the Gulf Stream and migrate onto the shelf as they grow. Pre-recruits make daily vertical migrations though the water column, moving up at night to feed on euphausiids near the surface and down during the day (MAFMC 2011).

3.4.3.4 Ocean Quahog (Arctica islandica)

General: The ocean quahog is a commercially important bivalve mollusk distributed along the continental shelf that can be found from Newfoundland to Cape Hatteras, with peak offshore densities occurring south of Nantucket to the Delmarva Peninsula (Cargnelli *et al*. 1999e). The ocean quahog is managed by the Mid-Atlantic Fishery Management Council under the Atlantic surfclam and ocean quahog fishery management plan. The Project Area is designated EFH for juvenile and adult life-stages (**Table 2**).

Juvenile: Ocean quahog juveniles are typically found offshore in sandy substrates, although they are known to survive in muddy intertidal habitats when protected from predators, and in the Middle Atlantic Bight exist at depths of 45-75 m with salinities ranging between 32-34 ppt (Kraus *et al*. 1991). Juvenile ocean quahog grow relatively quickly, with lengths ranging from 1 to 3.9 mm after 7.5 months of metamorphosis (Lutz *et al*. 1982).

Adult: Adult ocean quahogs generally exist in dense beds on level bottoms, just below the surface of medium to fine grain sediments, at depths of 14-82 m, with most being found at 25 to 61 m and some individuals as deep as 256 m (Medcof and Caddy 1971, Beal and Kraus 1989, Brey *et al*. 1990, Fogarty 1981, MAFMC 1997, Merrill and Ropes 1969, Serchuk *et al*. 1982, Ropes 1978). The optimal temperature for adult ocean quahogs ranges from approximately 6°C to 16°C, with lethal temperatures reportedly being 20°C or greater (Golikov and Scarlato 1973, Merill *et al*. 1969). Dissimilar to juveniles, adult ocean quahogs are slow-growing, with those living off New Jersey recorded at growing an average of 1 mm in 1.6 years (Ropes and Murawski 1983; MAFMC 1997). Ocean quahog are long-lived, with the possibility of reaching a maximum age of 225 years (Ropes and Murawski 1983, MAFMC 1997). Additionally, ocean quahogs mature slowly, reaching sexual maturity at approximately 13.1 years for males and 12.5 years for females (Rowell *et al*. 1990).

3.4.3.5 Surf Clam (Spisula solidissima)

General: The surf clam is a commercially important bivalve that can be found in sandy habitats along the continental shelf and ranges from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina, with concentrations located on Georges Bank, south of Cape Cod, off Long Island, southern New Jersey, and the Delmarva Peninsula (Merrill and Ropes 1969, Ropes 1980). The surf clam is managed by the Mid-Atlantic

Fishery Management Council under the Atlantic surf clam and ocean quahog fishery management plan. The Project Area is designated EFH for juvenile and adult life-stages (**Table 2**).

Juvenile: High concentrations of surf clams are found at depths ranging from 8 to 66 m (18 m in New Jersey) in areas of turbidity deeper than the break zone, with salinities ranging from 14-52 ppt (Fay *et al*. 1983, Ropes 1980). Surf clam juveniles are distributed in well-sorted, medium sand and may also be found in fine and silty-fine sand (Cargnelli *et al*. 1999b). As siphon feeders, juvenile surf clam diet consists primarily of diatoms and ciliates, and they are preyed on by the sevenspine bay shrimp (*Crangon septemspinosa*) (Cargnelli *et al*. 1999b). Predators of older juvenile surf clams include moon snails, crabs, and sea stars, and occasionally, Atlantic cod and haddock (Fay *et al*. 1983, Ropes 1980).

Adult: Adult surf clams are distributed similar to juveniles, with high concentrations found in well-sorted, medium sand or fine and silty-fine sand (Cargnelli *et al*. 1999b). Surf clams reach sexual maturity at varying sizes and ages, including as early as 3 months and 5 mm length after settlement off the coast of New Jersey to as long as 4 years and 80-95 mm length off Prince Edward Island, Canada (Chintala and Grassle 1995, Sephton and Bryan 1990). Surf clam development and behavior is highly dependent on temperatures and adult surf clams may grow as big as 226 mm and live more than 30 years (Ambrose *et al*. 1980, Davis *et al*. 1997, Jones *et al*. 1978, Jacobson *et al*. 2006). Spawning occurs in the summer and fall, with two annual spawnings occurring along the New Jersey coast; one as early as late May to early June when water temperature is 15°C or greater to approximately 30°C and the other more, minor spawning event in October (Tarnowski 1982, Ropes 1980, Sephton 1987).

3.4.4 Highly Migratory Species

3.4.4.1 Bluefin Tuna (Thunnus thynnus)

General: Bluefin tuna is a large, epipelagic, coastal migratory species that inhabit the warmer waters of the Atlantic, north to Hamilton Inlet, Labrador and off the west, south, and southeast coasts of Newfoundland (Collette and Klein-MacPhee 2002). From approximately mid-June through July, bluefin tuna appear in coastal New Jersey (Collette and Klein-MacPhee 2002). The Project Area is designated EFH for juvenile and adult life-stages (**Table 2**).

Juvenile: Juveniles and subadults (<145 cm TL) can be found in all inshore and pelagic surface waters at depths ranging from 25 to 200 m and in temperatures less than 12°C from the Gulf of Maine continuing south to Cape Hatteras, NC (Collette and Klein-MacPhee 2002). Bluefin tuna feed on primarily fishes, squids, crustaceans, salps, and other invertebrates, with size cohorts ranging from 52 to 102 cm feeding primarily on fishes (Scombridae, Bramidae, and Myctophidae) and squids (Dragovich 1970, Eggleston and Bochenek 1989, Chase 2002).

Adult: Adult bluefin tuna inhabit offshore and coastal pelagic habitats from the Gulf of Maine to the outer extent of the U.S. (NMFS 2009). The Bluefin tuna leaves spawning ground in the Gulf of Mexico in the spring, passing off the coast of New Jersey, Long Island, and southern New England in June, and moving north into New England and Canada through the summer and into the beginning of fall (Collette and Klein-MacPhee 2002). When swimming near the surface, Bluefin tuna jump out of water alone or in schools and given their wide geographic range covered via migration, they inhabit open ocean environments with varying temperature and salinity level (NMFS 2009).

3.4.4.2 Yellowfin Tuna (Thunnus albacares)

General: Yellowfin tuna is an epipelagic, circumglobal species found in water temperatures between 18 and 31ºC (NMFS 2017). This tuna species is characteristically large in size, fast growing, short-lived and generally confined to the upper 100 m of the water column (NMFS 2017). The Project Area is designated EFH for the juvenile life-stage (**Table 2**).

Juvenile: Yellowfin tuna is a schooling species, and juveniles are found at surface waters mixed with schools of skipjack and bigeye tuna (NMFS 2017). Juveniles are often found nearer to shore than adults and have a size less than 108 cm fork length (FL[5]). EFH for Yellowfin tuna includes offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the Exclusive Economic Zone (EEZ) boundary on Georges Bank and Cape Cod, Massachusetts. EFH also includes offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau (NMFS 2017). Prey items for juvenile Yellowfin tuna include cephalopods, fish, and crustaceans.

3.4.4.3 Skipjack Tuna (Katsuwonus pelamis)

General: The skipjack tuna is a pelagic species that can be found in tropical, subtropical, and warm temperate waters from Newfoundland to Brazil (NOAA 2009, NOAA n.d.a). The Project Area is designated EFH for the juvenile and adult life-stage (**Table 2**).

Juvenile: Juvenile skipjack tuna are normally found in waters greater than 20 m and are less than 45 cm FL (NMFS 2017). EFH for juveniles includes offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and includes coastal and offshore habitats between Massachusetts and South Carolina, localized areas off Georgia and South Carolina, as well as the Blake Plateau through the Florida Straits (NMFS 2017).

Adult: Skipjack tuna grow quickly, reaching lengths of approximately 0.9 m, weights of approximately 18 kilometers (km), and live approximately 7 years (NOAA n.d.a). Skipjack tuna spawn throughout the year, sometimes more than once a season, with peak spawning occurring during summer near the equator (NMFS 2017). This species is often associated with birds, drifting objects, whales, and sharks because it prefers areas of convergence (Collette and Nauen 1983). Adult skipjack tuna are opportunistic predators, preying on a variety of fish (e.g., herrings), crustaceans, cephalopods, mollusks, and occasionally, other skipjack tunas (NOAA n.d.a). Predators of the skipjack tuna include billfish, sharks, and other large tunas (NOAA n.d.a.)

3.4.4.4 Swordfish (Xiphias gladius)

General: The swordfish is a pelagic, highly migratory species that can be found in tropical, temperate, and occasionally cold waters and is distributed in the Western North Atlantic from the Grand Banks of Newfoundland south to the Gulf Stream (NOAA n.d.b). The Project Area is designated EFH for the juvenile stage (**Table 1**).

Juveniles: Swordfish juveniles can generally be found in the middle of the oceanic water column at depths ranging from 200 to 600 m, in temperatures between 18°C and 22°C. However, they can be found in waters ranging from 5°C to 27°C (Florida Museum of Natural History 2017). Swordfish are frequently observed close to the surface, but are believed to swim to depths greater than 650 m (Florida Museum of Natural History 2017). Juveniles grow rapidly and feed on a variety of pelagic fish and invertebrates, including squid and other cephalopods (NOAA n.d.b, Florida Museum of Natural History 2017). Predators of juvenile swordfish include a

[5] Fork length is defined as the measurement taken from the anterior-most part of the fish to the end of the median caudal fin rays (Anderson and Gutreuter 1983).

variety of sharks and large predatory fish such as blue marlin (*Makaira nigricans*), black marlin (*Makaira indica*), sailfish (*Istiophorus platypterus*), yellowfin tuna (*Thunnus albacares*), and the dolphinfish (*Coryphaena hippurus*) (Florida Museum of Natural History 2017).

3.4.5 Coastal Migratory Pelagic Species

3.4.5.1 Cobia (Rachycentron canadum)

General: Cobia are relatively uncommon coastal, pelagic species that migrate extensively and are found in tropical, subtropical, and warm temperate waters around the world; in the western Atlantic, Cobia range from Massachusetts to Argentina (Hardy 1978, Shaffer and Nakamura 1989). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Largely found in offshore waters near the surface (<1 m) in temperatures that range from 26°C to 30°C with salinities of 23-35 ppt. Cobia eggs measure 1.1-1.4 mm in diameter and are transparent with one large oil globule (Hardy 1978, Shaffer and Nakamura 1989, GMFMC 2016). At approximately 3 mm in length, Cobia larvae hatch (Shaffer and Nakamura 1989).

Larvae: Cobia larvae are found in offshore waters, at less than 300 m in the water column, and sometimes in estuarine waters, in temperatures that range from 24°C to 32°C, with salinities between 19 and 37 ppt (Shaffer and Nakamura 1989, GMFMC 2016).

Juvenile: Cobia juveniles are found in coastal and offshore waters at less than 300 m, in temperatures ranging from 17°C to 25°C and salinities between 22 to 26 ppt (GMFMC 2016). As juvenile Cobia mature, growing from 13-15 mm to 45-140 mm, they occupy inshore coastal habitats (i.e., beaches, bays, high salinity [< 25 ppt] regions of estuaries) (Shaffer and Nakamura 1989). Fish, crustaceans, and squid primarily make up the diet of juvenile Cobia (Shaffer and Nakamura 1989).

Adult: Adult Cobia prefer coastal and offshore waters ranging from 1 to 70 m, in temperatures between 19-28°C, with salinities that range from 22 to 36 ppt (GMFMC 2016, Shaffer and Nakamura 1989). Cobia can be found in the Middle Atlantic from late May to October and the species habitat varies, including rock, gravel, sand, and mud substrates, and coral reefs, and pilings (Joseph *et al*. 1964, Richards 1967). The Cobia migrate north from the Florida Keys where they winter, arriving in late spring and early summer in the estuarine and coastal areas of Virginia and the Carolinas (Williams 2001). Rarely observed in groups, Cobia adults travel singly or in small schools and prefer to exist in the shadow of near-surface objects (i.e., buoys, boats, platforms, etc.) (Shaffer and Nakamura 1989, Williams 2001). Though uncommon to New Jersey, Cobia adults seasonally migrate to the waters of New Jersey, including Absecon Inlet and offshore of Atlantic City (Milstein and Thomas 1976, Fowler 1952). Voracious predators, Cobia consume their prey whole, including primarily crustaceans, other benthic invertebrates, and fish (Shaffer and Nakamura 1989, Bowman *et al*. 2000).

3.4.5.2 King Mackerel (Scomberomorus cavalla)

General: The king mackerel is a pelagic, schooling species that migrates extensively with a range from North Carolina to Brazil, including occasional occurrences in the waters of New Jersey (Collette and Klein-MacPhee 2002). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: King mackerel have a long spawning season that peaks May through September in the coastal waters off the Carolinas (Godcharles and Murphy 1986). The fecundity of king mackerel is 69,000 to 12.2 million eggs and is associated with an individual's morphology (i.e., length, total weight) and age (Finucane *et al*. 1986). Ranging from 0.9 to 0.98 mm in diameter and found in pelagic waters at depths of 35 to 118 m, king mackerel eggs are spherical, containing a single oil globule, and hatching at approximately 2.98 mm in length (Fritzsche 1978).

Larvae: Larval king mackerel are found in pelagic waters at depths between 35 m and 180 m, in temperatures ranging from 22°C to 31°C with salinities of 27 to 37 ppt (Godscharles and Murphy 1986, GMFMC 2016). The king mackerel larval diet consists predominantly of larval fishes such as carangids (Carangidae), clupeids (Clupeidae), and engraulids (Engraulidae) (GMFMC 2016).

Juvenile: Juvenile king mackerel can be found in inshore waters at temperatures above 20°C, in salinities ranging from 32 to 36 ppt. Fish and some squid make up the diet of king mackerel juveniles. (GMFMC 2016)

Adult: Located in pelagic waters at the shore to the edge of the continental shelf, king mackerel adults are found in depths no greater than 80 m, in temperatures 20°C or greater with salinities that range from 32 to 36 ppt (GMFMC 2016). King mackerel adults migrate in response to seasonal changes, moving north in the spring and south in the fall (GMFMC 2016). Fish, penaeid shrimps, and squid make up the primary diet of adult king mackerel (Collette and Klein-MacPhee 2002, Bowman *et al*. 2000, GMFMC 2016).

3.4.5.3 Spanish Mackerel (Scomberomorus maculatus)

General: Spanish mackerel is a pelagic, schooling species that migrates extensively and can be found in shallow coastal waters overlying the continental shelf from the Gulf of Maine to the Yucatan Peninsula and most commonly south of the Chesapeake Bay (Collette and Klein-MacPhee 2002, Godcharles and Murphy 1986). The Project Area is designated EFH for egg, larval, juvenile, and adult life-stages (**Table 2**).

Egg: Spanish mackerel eggs, measuring approximately 1 mm in diameter, are spherical and transparent, with a single oil globule, and can be found in pelagic waters shallower than 50 m (Godcharles and Murphy 1986). Incubation time is inversely correlated with temperature, with eggs hatching at approximately 25 hours or 15.5 hours at 26°C or 29°C, respectively (Godcharles and Murphy 1986, Fritzsche 1978, GMFMC 2016).

Larvae: At approximately 2.6 mm TL, Spanish mackerel larvae hatch and can be found in pelagic waters at depths shallower than 50 m, in temperatures that range from 20°C to 32°C, with salinities between 28 and 37 ppt (Godcharles and Murphy 1986). Spanish mackerel larvae feed primarily on crustaceans and other larval fish, including carangids, clupeids, and engraulids (GMFMC 2016).

Juvenile: Spanish mackerel juveniles prefer coastal and estuarine waters with temperatures warmer than 25°C and salinities between 11-34 ppt (GMFMC 2016). Larval fish, including clupeids, and engraulids, as well as crustaceans and squid are the primary food items for juvenile Spanish mackerel (Saloman and Naughton 1983).

Adult: Adult Spanish mackerel can be found at depths of up to 75 m in estuarine and coastal habitats, in temperatures warmer than 20°C, with salinities of approximately 35 ppt (GMFMC 2016). Spanish mackerel adults spawn in groups over the continental shelf, progressing northward as water temperatures increase in the spring (Godcharles and Murphy 1986). Occasionally, during summer migrations (late August to September), adult Spanish mackerel can be found in waters of New Jersey (Fowler 1952, Briggs and Waldman 2002, Godcharles and Murphy 1986). Fish, including predominantly Clupeoids, pandalid and penaeid shrimps, and squid make up the primary diet of adult Spanish mackerel (Bowman *et al*. 2000, Collette and Klein-MacPhee 2002, Saloman and Naughton 1983).

3.4.6 Skate Species

3.4.6.1 Clearnose Skate (Raja eglanteria)

General: Clearnose skate occurs from Nova Scotia to northeastern Florida, and includes the northern Gulf of Mexico from northwestern Florida to Texas (Packer *et al*. 2003a). This is considered a southern species and is considered rare in the northern portion of its range (Packer *et al*. 2003a). The Project Area contains EFH for clearnose skate for juvenile and adult life-stages (**Table 2**).

Juvenile: Juvenile clearnose skate are fully developed at hatching. However, maximum size and size at maturity varies with latitude, and age designations are difficult to interpret (Packer *et al*. 2003a). EFH for juvenile clearnose skate includes subtidal benthic habitats in coastal and inner continental shelf waters from New Jersey to the St. John's River in Florida. EFH also includes the high salinity zones of bays and estuaries, including the Chesapeake and Delaware Bays. EFH consists primarily of mud and sand, but also on gravelly and rocky bottom from the shoreline to 30 m (NEFMC 2017).

Adult: Bigelow and Schroeder (1952) reported clearnose skate inshore between April and November off the shore of New Jersey. Clearnose skate were most abundant between 1-30 m during NEFCS spring trawl surveys, and water temperatures ranged from 4 to 21ºC (Packer *et al*. 2003a). Adult clearnose skate feed on polychaetes, amphipods, and mysid shrimps (e.g., *Neomysis americana*), shrimp *Crangon septemspinosa*, mantis shrimp, crabs including mud, hermit, and spider crabs, bivalves, squids, and small fishes, such as soles, weakfish, butterfish, and scup (Packer *et al*. 2003a). This skate species is regularly preyed upon by sand tiger shark. EFH for adult clearnose skate includes subtidal benthic habitats in coastal and inner continental shelf waters from New Jersey to Cape Hatteras. EFH also includes the high salinity zones of bays and estuaries, including the Chesapeake and Delaware Bays. EFH consists primarily of mud and sand, but also on gravelly and rocky bottom from the shoreline to 40 m (NEFMC 2017).

3.4.6.2 Little Skate (Leucoraja erinacea)

General: The little skate is a demersal fish species that occurs from Nova Scotia to Cape Hatteras (Packer *et al*. 2003). Little skate are most abundant and found year-round in the northern section of the Mid-Atlantic Bight and Georges Bank (Packer *et al*. 2003b). The little skate prefers sandy or pebbly bottom, but can also be found on mud and ledges (Collette and Klein-MacPhee 2002) where temperature ranges from 1 to 21ºC. The Project Area contains EFH for little skate juvenile and adult life-stages (**Table 2**).

Juvenile: Little skate are able to mate any time throughout the year, and mating occurs frequently (Packer *et al*. 2003b). A single fertilized egg is encapsulated and deposited on the seafloor bottom until hatching. Juvenile little skate are fully developed at hatching, with an approximate size of 93-102 mm TL (Packer *et al*. 2003b). EFH for juvenile little skate includes intertidal and subtidal benthic habitats in coastal waters extending from the Gulf of Maine to Delaware Bay, and on Georges Bank. EFH consist of sand and gravel substrates, but juvenile little skate are also found on mud to a maximum depth of 80 m (NOAA 2016).

Adult: Adult little skate have an average size of 41-51 cm TL and a maximum of 53 cm TL (Bigelow and Schroeder 1953). Prey items for little skate include invertebrates such as decapod crustaceans, amphipods, and polychaetes (Packer *et al*. 2003b). Eggs of little skate are preyed up by sea urchins (*Strongylocentrotus droebachiensis*) and whelks (*Buccinum undatum*), and juvenile and adult little skate are preyed upon by sharks, other skates, teleost fishes, gray seals, and rock crabs (Packer *et al*. 2003b). EFH for adult little skate includes intertidal and subtidal benthic habitats in coastal waters extending from the Gulf of Main to Delaware Bay, and on Georges Bank. EFH consist of sand and gravel substrates, but juvenile little skate are also found on mud to a maximum depth of 100 m (NEFMC 2017).

3.4.6.3 Winter Skate (Leucoraja ocellata)

General: Winter skate occurs from the south coast of Newfoundland and the southern Gulf of St. Lawrence to Cape Hatteras (Packer *et al*. 2003c). Like the little skate, winter skate are highly abundant on Georges Bank and in the northern section of the Mid-Atlantic Bight. The Project Area contains EFH for the winter skate juvenile and adult life-stages (**Table 2**).

Juvenile: Like the little skate, winter skate is fully developed at hatching, with a TL between 11.2 cm to 12.7 cm. Winter skate predominately feeds on infaunal organisms, such as burrowing polychaetes, amphipods, and bivalves (Packer *et al*. 2003c). Winter skate is preyed upon by sharks, other skates, gray seals, and gulls (Packer *et al*. 2003c). EFH for juvenile winter skate includes subtidal benthic habitats in coastal waters extending from eastern Maine to Delaware Bay, as well as on the continental shelf in southern New England and the Mid-Atlantic region. EFH for juvenile winter skate occurs on sand and gravel substrates, but is also found on mud from the shoreline to a maximum depth of 90 m (NEFMC 2017).

Adult: The average size of adult winter skate is 76.2 to 86.4 cm. TL (Bigelow and Schroeder 1953).EFH for adult winter skate includes subtidal habitats in coastal waters in the southwestern Gulf of Main, in coastal and continental shelf waters in southern New England and the Mid-Atlantic region, and on Georges Banks. EFH includes depths of 80 m, including the high salinity zones of bays and estuaries, which includes Great South Bay and Barnegat Bay, and occurs on sand and gravel substrates, as well as mud substrates (NEFMC 2017). Prey items for adult winter skate include polychaetes, amphipods, decapods, isopods, bivalves, and fishes (Packer *et al*. 2003c).

3.4.7 Shark Species

3.4.7.1 Atlantic Angel Shark (Squatina dumeril)

General: The Atlantic angel shark is a benthic, flattened shark inhabiting coastal waters from Massachusetts to the Florida Keys, the Gulf of Mexico, and the Caribbean (NMFS 2017). This shark species is commonly found from southern New England to the Maryland coast and migrates seasonally from shallow to deep water (Castro 2011). The Project Area contains designated EFH for Atlantic angel shark larvae, juvenile, and adult life-stages (**Table 3**). As of the NMFS 2017 assessment, the description for all life stages is the same as described below.

Neonate/Juvenile/Adult: Accurate age and growth models have not been developed and maturity is probably reached at a length of 90 to 105 cm TL (Baremore 2010, NFMS 2017). Birth of Atlantic angel shark occurs at depths of 18-27 m during the spring or early summer months, with pups measuring 28 to 30 cm TL (Castro 2011). EFH in the Atlantic Ocean includes continental shelf habitats from Cape May, New Jersey, to Cape Lookout, North Carolina (NMFS 2017). The diet of the Atlantic angel shark is dominated by teleost fishes as well as squid, crustaceans, and portunid crabs (Baremore *et al*. 2008, 2009).

3.4.7.2 Atlantic sharpnose shark (Rhizopriondon terraenovae)

General: The Atlantic sharpnose shark occurs in warm temperate and tropical waters, ranging primarily from New Brunswick, Canada to Florida, including the Gulf of Mexico and the coast of Brazil (RI Sea Grant/NMFS 2003, Florida Museum of Natural History 2018). The Project Area is designated EFH for the adult life-stage (**Table 3**).

Adult: Adult Atlantic sharpnose sharks grow to approximately 1.2 m in length and are found in coastal, shallow habitats at depths ranging from the surface to 280 m, although they remain primarily in waters less than 10 m deep (RI Sea Grant/NMFS 2003, Florida Museum of Natural History 2018). This species forages close to the surf zone and in enclosed bays, sounds, harbors, and marine to brackish estuaries (RI Sea Grant/NMFS 2003). Male Atlantic sharpnose sharks reach maturity at approximately 2 to 2.4 years and are generally 80-85 cm in length, and females reach maturity at 2.4-2.8 years and measure 85-90 cm in length (Florida Museum of Natural History 2018). The adult Atlantic sharpnose shark migrates inshore to offshore seasonally, forming large sexually segregated schools during migration (Florida Museum of Natural History 2018). Mating occurs during late spring and early summer, followed by a 10-11 month gestation period, after which females return inshore from their offshore overwintering habitat to give birth (Florida Museum of Natural History 2018). Adult Atlantic sharpnose shark prey on small bony fish (i.e., eels [Anguilliformes], silversides [Atherinidae], wrasses [Labridae], jacks [Carangidae], toadfish [Batrachoididae], and filefish [Monacanthidae]), worms, shrimp, crabs, and mollusks and their predators are large carnivorous fish, including larger sharks (Florida Museum of Natural History 2018).

3.4.7.3 Basking Shark (Cetorhinus maximus)

General: Basking shark is a pelagic species with an extensive temporal and spatial range in the northwestern and eastern Atlantic that is believed to be associated with seasonal changes in water stratifications, temperature, and prey abundance (NOAA 2009). Basking sharks are found off the Atlantic coast most frequently in the winter. However, they are observed in surface waters from spring to fall. EFH designations for all life stages have been combined and are considered the same. Therefore, the Project Area is designated EFH for the neonate, juvenile and adult life-stages (**Table 3**).

Neonate, Juvenile and Adult: Basking sharks give birth to live young, with juvenile sizes ranging from 2.1 to 8.9 m FL. The reproductive process for basking sharks in not well known. However, they are believed to be ovoviviparous, giving birth after a 2-3 year gestation period to live young (NOAA 2009, DFO 2018a). The location of pupping and nursery grounds is unknown. Reaching lengths upwards of 10 m, adult basking sharks can be found in coastal and oceanic waters at depths ranging from 200 to 2,000 m, but they often reside within inshore habitats, such as headlands, islands, and bays (DFO 2018a). In offshore habitats, basking sharks appear to be driven by oceanic fronts at temperatures between 7°C and 16°C (DFO 2018a). Concentrations of basking sharks were observed south and southeast of Long Island (NMFS 2009). This species may migrate south during the winter and populations are often segregated by sex and size (DFO 2018a). Adult basking sharks are planktonic feeders and their diet consists primarily of copepods, crustaceans, and fish eggs and larvae (DFO 2018a).

EFH designations for all life stages have been combined and are considered the same. EFH for basking shark includes the Atlantic east coast from the Gulf of Maine to the northern Outer Banks of North Carolina, following the mid-South Carolina to coastal areas of northeast Florida (NMFS 2017). Aggregations of basking sharks have been observed south and southeast of Long Island, east of Cape Cod, and along the coast of Maine. Aggregations have been associated with persistent thermal fronts within areas of high prey density (NMFS 2017).

3.4.7.4 Blue Shark (Prionace glauca)

General: The blue shark is a pelagic, highly migratory species, occurring in temperate and tropical inshore and offshore waters, and ranging from Newfoundland and the Gulf of St. Lawrence south to Argentina (DPO

2018b). The blue shark prefers deep, clear waters with temperatures ranging from 10 to 20°C (Castro 1983). The Project Area is designated EFH for neonate/YOY, juvenile, and adult life-stages (**Table 3**).

Neonate: Blue sharks become reproductively mature at 6 or 7 years of age and females are placental viviparous (Cailliet *et al*. 1983). Blue shark gestation for females in the Atlantic usually lasts about 12 months and typically produces litters of 28 to 54 pups, but up to 135 pups have been reported (Pratt 1979; Bigelow and Schroeder 1948; Gubanov and Grigoryev 1975). Neonate/YOY sizes for blue shark are less than or equal to 76 cm FL (NMFS 2017). EFH designated habitat in the Atlantic occurs offshore of Cape Cod through New Jersey, seaward of the 30 m bathymetric line, with the exclusion of inshore waters (i.e., Long Island Sound, NMFS 2017). EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine.

Juvenile and Adult: Blue shark males and females in differing life-stages are known to segregate and make use of ecologically important areas (Vandeperre *et al*. 2014). Nursery areas are typically closed bays or sheltered coastal areas that provide protection from predators. The EFH designations are the same for juvenile and adult blue shark life-stages. EFH includes localized areas in the Atlantic Ocean in the Gulf of Maine, from Georges Bank to North Carolina, South Carolina, Georgia, and off the coast of Florida. Blue sharks are opportunistic predators that feed on squids, octopi, lobsters, crabs, small sharks, and various fishes such as haddock (*Melanogrammus aeglefinus*), pollock (*Pollachius* sp.), flounder (*Pleuronectoidei* sp.), mackerel, herring, sea raven (*Hemitripteridae* sp.), silver hake, white hake (*Urophycis tenuis*), red hake (*Urophycis chuss*), butterfish (*Stromateidae* sp.), and cod. The younger sharks are frequently eaten by larger shark species, such as great white (*Carcharodon carcharias*) and tiger sharks (*Galeocerdo cuvier*) (Vandeperre *et al*. 2014).

3.4.7.5 Common Thresher Shark (Alopias vulpinus)

General: The common thresher shark is found in warm and temperate waters in both coastal and oceanic waters, but is more abundant near land (NMFS 2017). McCandless *et al*. (2002) showed nursery area characteristics in nearshore waters of North Carolina consisted of temperatures from 18.2 to 20.9ºC and at depths from 4.6 to 13.7 m. The common thresher shark completes north to south migrations along the U.S. East Coast in the offshore and cold inshore waters during the summer months. Prey items include invertebrates such as squid and small fishes such as anchovy, sardines, hakes, and small mackerels (Preti *et al*. 2004). Mating is suspected to occur in the late fall, after females reach maturation between three to seven years (NMFS 2017). Gervelis and Natanson (2013) found males reach maturity at 314 to 420 cm TL and 315 to 400 cm TL for females. Gestation lasts approximately nine months and female thresher sharks give birth annually every spring (Bedford 1985). Litters consists of four to six pups, which measure 137 to 155 cm TL at birth (Castro 1983). The Project Area is designated EFH for neonate/YOY, juvenile, and adult life-stages (**Table 3**).

Neonate/Juvenile/Adults: Designated EFH for all common thresher shark life-stages is located in the Atlantic Ocean from Georges Bank to Cape Lookout, North Carolina. EFH also includes from Maine to locations offshore of Cape Ann, Massachusetts. EFH has been determined for the nearshore waters of North Carolina, in areas with temperatures from 18.2 to 20.9ºC and at depths from 4.6 to 13.7 m (McCandless *et al*. 2002).

3.4.7.6 Dusky shark (Carcharhinus obscurus)

General: The dusky shark can be found in warm and temperate coastal waters in the Atlantic, Pacific, and Indian Oceans, preferring inshore and deeper waters along the edge of the continental shelf, and using coastal waters as nurseries (NMFS 2017). In June and July, the dusky shark gives birth in the Chesapeake Bay in

Maryland and another birthing site was identified in Bulls Bay, South Carolina (NMFS 2017). The Project Area is designated EFH for neonate/YOY, juvenile and adult life-stages (**Table 3**).

Neonate: Neonate/YOY sizes for dusky shark are less than or equal to 98 cm FL (NMFS 2017). Dusky shark larvae can be found in water depths of 4.3 to 15.5 m, in temperatures ranging from 18.1°C to 22.2°C, with salinities of 25 to 35 ppt (NMFS 2017). EFH for neonate/YOY in the Atlantic Ocean includes offshore areas of southern New England to Cape Lookout, North Carolina, with a seaward extent of 60 m in depth (NMFS 2017).

Juvenile and Adult: Juvenile dusky shark are generally found at shallower depths than adults. However, there is some overlap in the habitats that both life-stages use (NMFS 2017). The designated EFH for juvenile dusky shark along the Atlantic east coast includes coastal and pelagic waters inshore of the continent shelf break (<200 m in depth). Inshore extent for these life-stages is the 20 m bathymetric line, except in habitats of southern New England, where EFH is extended seaward of Martha's Vineyard, Block Island, and Long Island (NMFS 2017).

3.4.7.7 Sand Tiger Shark (Carcharias taurus)

General: The sand tiger shark is a large coastal species found in shallow tropical and temperate waters throughout its range (NMFS 2009). Male adult and juvenile sand tiger sharks occur between Cape Cod and Cape Hatteras in the northwestern Atlantic, while mature females inhabit the southern waters between Cape Hatteras and Florida (Gilmore 1993). The Project Area contains designated EFH for sand tiger shark neonate/YOY, juvenile, and adult life-stages (**Table 3**).

Neonate/Juvenile: Embryonic development is ovoviviparous, and one pup usually survives due to consuming all of its smaller siblings during gestation (UF 2018). Gestation periods may be around 9 to 12 months and pups usually measure 99 cm at birth (UF 2018). Neonate/YOY sand tiger shark sizes are less than or equal to 109 cm FL and juvenile sand tiger sharks range in size from 109 to 193 cm FL (NMFS 2017). Designated EFH for both neonate and juvenile life stages occurs along the Atlantic east coast from northern Florida to Cape Cod and includes the Plymouth, Kingston, Duxbury (PKD) bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay, and Raleigh Bay (NMFS 2009). Nursery habitat for sand tiger shark was characterized for the Delaware Bay, which consisted of temperatures from 19 to 25°C, salinities from 23 to 30 ppt at depths of 2.8-7 m in sand and mud areas (McCandless *et al*. 2002). Nursery characteristics of nearshore waters of North Carolina consists of temperatures from 19 to 27°C, salinities of 30 to 31 ppt at depths of 8 to 13 m in rocky and mud areas and in areas containing artificial reefs or wrecks (McCandless *et al*. 2002).

3.4.7.8 Sandbar Shark (Carcharhinus plumbeus)

General: The sandbar shark is a common species found in coastal habitats and subtropical and warm temperature waters (NMFS 2009). The North Atlantic population ranges from Cape Cod to the western Gulf of Mexico (NMFS 2009). This bottom-dwelling species is common in 20 to 55 m of water and only found occasionally at depths of approximately 200 m (NMFS 2009). The Project Area contains designated EFH for neonate/YOY, juvenile, and adult life-stages (**Table 3**).

Neonate: The neonate and YOY for sandbar shark are less than 78 cm in TL (NMFS 2009). Sandbar sharks are viviparous and produce litters of 1 to 14 pups after an 8 to 12 month gestation period (Collette and Klein-MacPhee 2002, Spring 1960). Designated EFH is identified in localized coastal areas on the Florida panhandle, as well as localized areas along the Georgia and South Carolina coastlines and from Cape Lookout to Long Island, New York (NMFS 2009). Sandbar shark nursery areas are typically in shallow coastal waters for neonates and young-of-the-year life-stages and have been identified in Great Bay, New Jersey (Merson and Pratt, 2001, 2007). The juvenile diet consists of blue crabs, mantis shrimp and other crustaceans, and a variety of fish, such as menhaden, black sea bass, and flatfish (Medved and Marshal 1981).

Juvenile: Juvenile sandbar shark sizes are 79 to 190 cm TL and have designated EFH along localized areas of the Atlantic coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New England (NFMS 2009). Juveniles will remain in or near the nursery grounds until late fall, later forming schools and migrating to deeper waters (NFMS 2009). Juvenile sandbar sharks return to nursery grounds during warmer months and repeat this migratory pattern until they are approximately 7 to 10 years of age and begin a wider migration into the adult life-stage (HMSMD 2006). The diet of juvenile sandbar sharks consists of hakes, mackerels, monkfish, flatfish, squids, and crabs (Stillwell and Kohler 1993).

Adult: Adult sandbar shark sizes are greater than or equal to 191 cm TL (NFMS 2009). EFH designations for sandbar shark occur within localized areas off Alabama and coastal areas from the Florida panhandle to the Florida Keys in the Gulf of Mexico. Adult sandbar sharks are found along the Atlantic coast from the shore to a depth of 280 m in southern Nantucket, Massachusetts, to the Florida Keys (NMFS 2009). Sandbar sharks migrate seasonally along the western Atlantic coast, moving north with warming water temperatures during the summer and south as temperatures begin to decrease during the fall (Collette and Klein-MacPhee 2002). Sandbar sharks are opportunistic bottom feeders that prey on bony fishes, smaller sharks, rays, cephalopods, gastropods, crabs, and shrimps (Collette and Klein-MacPhee 2002, Bowman *et al*. 2000, Stillwell and Kohler 1993).

HAPC: The sandbar shark has mapped HAPC located within the backbays and nearshore estuarine waters just north of Great Egg Harbor, outside of the Project area. The HAPC extends north into Great Bay, the inland bays to the southwest surrounding Atlantic City, and the offshore coastal waters extending to approximately the state-seaward boundary. Sandbar shark HAPC is also mapped within Delaware Bay. HAPC for sandbar shark constitutes important nursery and pupping grounds which have been identified in shallow areas at the mouth of Great Bay, New Jersey; in lower and Middle Delaware Bay, Delaware; in lower Chesapeake Bay, Maryland; and offshore of the Out Banks of North Carolina (NMFS 2017). HAPC includes water temperatures ranging from 15 to 30ºC; salinities at least from 15 to 35 ppt; water depths ranging from 0.8 to 23 m; and in sand and mud habitats (NMFS 2017).

3.4.7.9 Shortfin Mako Shark (Isurus oxyrinchus)

General: The shortfin mako shark is a coastal and oceanic species found in warm-temperate and tropical waters that are predominately greater than 16°C throughout the world (NMFS 2009). In the Western Atlantic, they are found from the Gulf of Maine to southern Brazil and southern Argentina (Collette and Klein-Macphee 2002, Compagno 2001). Shortfin mako sharks are found in New Jersey southern waters in early June to October (Casey and Kohler 1992) and have been identified off the New Jersey coast near Atlantic City (Fowler 1952, Kohler *et al*. 1998). The Project Area contains designated EFH for shortfin mako shark neonate, juvenile, and adult life-stages (**Table 3**). EFH by life stage is not differentiated (NMFS 2017).

Neonate/Juvenile/Adults: Designated EFH for all shortfin mako shark life-stages is found in the Atlantic from southern New England through Cape Lookout, and specific areas off Maine, South Carolina, and Florida (NMFS 2009). Neonate/YOY are less than 128 cm FL, juveniles are 129 to 274 cm FL, and adults are greater than 275 cm FL (NMFS 2017). The diets of juvenile and adult shortfin mako sharks include bluefish, mackerels, tuna, herrings, menhaden, cod, squid, and crustaceans (Bowman *et al*. 2000, Maia *et al*. 2007, Wood *et al*. 2009).

3.4.7.10 Smoothhound Shark Complex (Atlantic stock; Smooth Dogfish (Mustelus canis))

General: The smoothhound shark complex consists of three species that are difficult to differentiate, making EFH designations difficult to determine. Smooth dogfish is the only smoothhound shark complex species found in the Atlantic Ocean. Smooth dogfish is a common coastal shark species found from Massachusetts to northern Argentina. They are primarily demersal sharks that inhabit coastal shelves and inshore waters to a maximum depth of 200 m (NMFS 2017). Smooth dogfish is a migratory species that responds to water temperature and congregates between southern North Carolina and the Chesapeake Bay in the winter. Smooth dogfish have diets that are predominately invertebrates, such as large crustaceans consisting mostly of crabs, but also American lobsters (Scharf *et al*. 2000). The maximum size limit for smooth dogfish is 150 cm TL and males mature at 2-3 years old, while females mature between 4-7 years old (NMFS 2017). Female smooth dogfish have an 11-12 month gestation period and produce 3 to 18 pups per litter (Conrath and Musick 2002). YOY pups grow rapidly and are abundant in Mid-Atlantic Bight estuaries (Rountree and Able 1996). The Project Area contains designated EFH for smooth dogfish neonate, juvenile, and adult life-stages (**Table 3**).

Neonate/Juveniles/Adults: EFH for smoothhound shark complex identified in the Atlantic is exclusively for smooth dogfish. EFH for smooth dogfish includes coastal areas from Cape Cod Bay, Massachusetts, to South Carolina, inclusive of inshore bays and estuaries (e.g., Delaware Bay, Long Island Sound). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina (NMFS 2017).

3.4.7.11 Spiny Dogfish (Squalus acanthias)

General: The spiny dogfish is widely distributed throughout the world, with populations existing on the continental shelf of the northern and southern temperate zones, which includes the North Atlantic from Greenland to northeastern Florida, with concentrations from Nova Scotia to Cape Hatteras (Compagno 1984a, Cohen 1982). The Project Area is designated EFH for juvenile and adult life-stages (**Table 3**).

Juvenile: Spiny dogfish are born offshore in fall or winter, ranging from approximately 20-33 cm TL (Soldat 1979, Nammack *et al*. 1985, Burgess 2002). Sexual maturity is reached at approximately 6 years of age for males and 12 years of age for females (Collette and Klein-MacPhee 2002, Nammack *et al*. 1985, Bigelow and Schroeder 1953). From 1963-2003, NEFSC bottom trawl surveys collected spiny dogfish juveniles at depths ranging from 11 to 500 m, in water approximately 3-17°C, with salinities ranging from 24 to 36 ppt (Stehlik 2007).

Adult: Adult spiny dogfish are found in deeper waters inshore (more commonly males and mature females) and offshore from the shallows to approximately 900 m deep, in water temperatures that range from 6-8°C, and seldom over 15°C (Collette and Klein-MacPhee 2002, Jensen 1965). Individuals travel in schools by size until maturity, at which point they form schools segregated by size and sex (Collette and Klein-MacPhee 2002, Nammack *et al*. 1985, Bigelow and Schroeder 1953). Spawning occurs offshore during the winter and pups are born via live birth after approximately 18-22 months of gestation (Bigelow and Schroeder 1953, Jensen 1965). Based on seasonal temperatures, spiny dogfish migrate up to 1,600 km along the east coast (Compagno 1984a, Jensen 1965). Spiny dogfish have been observed along the New Jersey coast in March (Bigelow and Schroeder 1953). Opportunistic feeders, adult spiny dogfish will feed on a variety of fish including mackerel, herring, scup, flatfish, and cod, shrimp, crabs, squid, siphonophores, and sipunculid worms (Bigelow and Schroeder 1953, Jensen 1965, Bowman *et al*. 2000). Sharks and whale are the few predators that exist for spiny dogfish (Bowman *et al*. 2000, Stehlik 2007).

3.4.7.12 Tiger Shark (Galeocerdo cuvieri)

General: The tiger shark is found from Cape Cod, Massachusetts, to Uruguay, including the Gulf of Mexico and the Caribbean Sea (NEFSC 2018b). They are found near inshore coastal waters to the outer continental shelf, as well as offshore including oceanic island groups (NEFSC 2018b). The tiger shark inhabits warm waters in both deep oceanic and shallow coastal regions (Castro 1983). They occur in the western North Atlantic, but rarely occur north of the Mid-Atlantic Bight (Skomal 2007). The Project Area contains EFH for juvenile and adult tiger shark life-stages (**Table 3**).

Juvenile and Adults: Designated EFH for juvenile and adult tiger sharks extends from offshore pelagic habitats associated with the continental shelf break at the seaward extent of the U.S. EEZ boundary to the Florida Keys and is found in the central Gulf of Mexico and off Texas and Louisiana, and from Mississippi through the Florida Keys. EFH in the Atlantic Ocean extends from offshore pelagic habitats associated with the continental shelf break (NMFS 2017).

3.4.7.13 White Shark (Carcharodon carcharias)

General: The distribution of white shark is from Newfoundland, Canada, and the Gulf of St. Lawrence to Florida, Cuba, Bahamas, and the Gulf of Mexico. Throughout its range, it is found in coastal and offshore habitats along continental shelves and islands; however, it is highly uncommon throughout its range (NEFSC 2018a). EFH for the neonate life-stage has not been identified (NMFS 2006). The Project Area contains designated EFH for the neonate, juvenile, and adult white shark life-stages (**Table 3**).

Neonate: Little is known about the reproductive processes of white shark because few studies have been conducted on gravid females (MAFMC 2011). Neonate/YOY are less than 159 cm FL and EFH for white shark neonates includes inshore waters out to 105 km from Cape Cod, Massachusetts to an area offshore of Ocean City, New Jersey (NMFS 2017).

Juvenile and Adult: Juvenile white shark EFH includes pelagic northern New Jersey and Long Island waters of depths between 25 and 100 m (NMFS 2006). Small and intermediate size white sharks are common in continental shelf waters of the Mid-Atlantic Bight up through coastal waters of Massachusetts, suggesting this area serves as a nursery for juvenile white shark (Casey and Pratt 1985, Skomal 2007). Reproductive processes are not well known because few gravid females have been examined by researchers (NMFS 2017). Further, the types of habitats and locations of nursery areas are unknown. The Massachusetts Division of Marine Fisheries suggests that tagged white sharks exhibit seasonal site-fidelity over multiple years (Skomal and Chisholm 2014). Juvenile white sharks use the entire water column when present over the continental shelf and foraging occurs in the mixed layer and near the surface at night (Dewar *et al*. 2004). Daytime dive patterns suggest that diurnal feeding occurs at or near the bottom (Dewar *et al*. 2004). Juveniles may be able to tolerate colder waters than previously thought, but vertical movement patterns suggest thermal constraints on juvenile white shark behavior (Dewar *et al*. 2004).

Diet switches occur with increasing size over time, with a shift from fish to marine mammals (Estrada *et al*. 2006). After birth, juvenile white sharks are known to be piscivorous and white sharks longer than 300 cm shift from a diet of fish to marine mammals. Juvenile and adult EFH includes inshore waters to habitats 105 km from shore, in water temperatures ranging from 9 to 28°C, with 14 to 23°C from Cape Ann, Massachusetts to Long Island, New York (NMFS 2017).

3.4.8 Habitat Areas of Particular Concern

One species, summer flounder, has HAPC within the Project area. HAPC for summer flounder includes 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 (MAFMC 2016). SAV is mapped extensively in the Project area based on the Ocean Wind 2019 aerial survey and 2020 in-water survey of Great Egg Harbor and Barnegat Bay. Impacts to SAV will be minimized by the use of trenchless technologies such as horizontal directional drilling (HDD) or direct pipe, as practicable, which can be used to install the cable beneath overlying sediments and SAV without direct physical disturbance. One potential effect of trenchless methods can be the inadvertent return of drilling fluids. This fluid has the potential to increase turbidity, as well as impact plants, fish, and their eggs (TetraTech 2016b). BMPs, such as monitoring of the drilling mud volumes, pressures, and pump rates and returns, would be followed to determine if drill mud loss occurs in amounts that signal a possible inadvertent return. An Inadvertent Return Plan would be developed and implemented as described in Attachment 3. Any fluids used during the onshore HDD work will be minimized by containment and reused as necessary. Following BMPs, the direct impacts from cable landfall are anticipated to be minimal and not cause any long-term adverse impacts to surface and ground water quality.

3.5 Assessment of Impacts

Construction, operations and maintenance, and decommissioning activities associated with the Project have the potential to cause direct and indirect impacts on EFH. Impact producing factors (IPFs) will have various levels of impact on EFH and associated species' life-stages. **Table 4** presents the IPFs for Project construction and operations effects on EFH and associated EFH species' life-stages. **Table 5** presents the IPFs for Project decommissioning and its effects on EFH and associated EFH species' life-stages.

Table 4 - Impact producing factors and potential impact on EFH for the Ocean Wind Project during construction and decommissioning.

Project Area	Impact Producing Factor	Project Activity	Benthic EFH Species Impacts				Pelagic EFH Species Impacts				Impact Analysis
			Eggs	Larvae	Juveniles	Adults	Eggs	Larvae	Juveniles	Adults	
Lease Area*	Seafloor Disturbance	Seafloor Preparation	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	**Direct Impacts:** Potential adverse impacts to EFH associated with Project seafloor preparation activities would affect all life stages of benthic species. Sandy, smooth bottom habitat will be lost and removal or clearing of patchy cobbles and boulders during seafloor preparation could negatively impact EFH for these species. Further, removal or clearing of cobbles and boulders could cause injury or mortality to these species. Benthic species could further lose shelter and foraging habitat during preparation. These impacts to EFH are anticipated to be short-term, and localized due to the disturbance of a relatively small area (within the Lease Area) of EFH and not cause adverse impacts long-term once seafloor preparation activities are completed. Pelagic species that have designated EFH within the Lease Area are not anticipated to have direct short- or long-term adverse impacts because they will not be directly affected by seafloor preparation and will likely avoid the area during Project activities. **Indirect Impacts:** Following seafloor preparation activities, benthic and pelagic finfish species are anticipated to move back into the EFH area. However, benthic habitat that serves as forage area for bottom-dwelling species may take longer to recover to pre-impact conditions. Successional epifaunal and infaunal species are anticipated to recolonize the sediments, gradually providing the continuation of foraging habitat for EFH species. EFH for pelagic species and associated life stages are expected to have short-term indirect impacts, as they will likely actively avoid areas of seafloor preparation and utilize similar habitat outside of the Project area, returning to the area following completion of these activities.
		Pile Driving/Foundation Installation	Short-term direct	Short-term direct	Short-term direct	Short-term direct	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	**Direct Impacts:** Direct impacts from pile driving or foundation installation activities are anticipated to be similar to those direct impacts discussed in the seafloor preparation impact analysis above. Direct adverse impacts, such as mortality to immobile species and life stages from being crushed in the footprint of the piles and foundation installation during construction, are anticipated for those EFH species with benthic/demersal life stages. No short-term direct impacts to EFH are anticipated for pelagic species as they will likely vacate the area during Project activities and return following completion. **Indirect Impacts:** Indirect impacts to EFH for pelagic species and associated life stages from pile driving and foundation installation are anticipated to be similar to those indirect impacts discussed in the seafloor preparation impact analysis above.
		Scour Protection	Short-term direct	Short-term direct	Short-term direct	Short-term direct	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	**Direct Impacts:** Direct impacts from scour protection installation activities are anticipated to be similar to those direct impacts discussed in the seafloor preparation impact analysis above. Direct adverse impacts, such as mortality to immobile species and life stages from being crushed in the footprint of scour protection installation during construction, are anticipated for those EFH species with benthic/demersal life stages. No short-term direct impacts to EFH are anticipated for pelagic species as they will likely vacate the area during Project activities and return following completion. **Indirect Impacts:** Indirect impacts to EFH for pelagic species and associated life stages from scour protection installation are anticipated to be similar to those indirect impacts discussed in the seafloor preparation impact analysis above.
		Offshore Substation Installation	Short-term direct	Short-term direct	Short-term direct	Short-term direct	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	No short-term direct Short-term indirect	**Direct Impacts:** Direct impacts from offshore substation installation activities are anticipated to be similar to those direct impacts discussed in the seafloor preparation impact analysis above. Direct adverse impacts, such as mortality to immobile species and life stages from being crushed in the footprint of offshore substation pile driving and foundation installation during construction, are anticipated for those EFH species with benthic/demersal life stages. No short-term direct impacts to EFH are anticipated for pelagic species as they will likely vacate the area during Project activities and return following completion. **Indirect Impacts:** Indirect impacts to EFH for pelagic species and associated life stages from offshore substation installation are anticipated to be similar to those indirect impacts discussed in the seafloor preparation impact analysis above.
		Vessel anchoring	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	**Direct Impacts:** Direct impacts to EFH from vessel anchoring are anticipated to be similar to those direct impacts discussed in the seafloor preparation impact analysis above, such as mortality to immobile species and life stages from being crushed by vessel anchoring. **Indirect Impacts:** Indirect impacts to EFH from vessel anchoring are anticipated to be similar to those indirect impacts discussed in the seafloor preparation impact analysis above, such as benthic habitat recovery following vessel anchoring removal and pelagic species avoiding and returning to the area once the activities have ceased.

Project Area	Impact Producing Factor	Project Activity	Benthic EFH Species Impacts				Pelagic EFH Species Impacts				Impact Analysis
			Eggs	Larvae	Juveniles	Adults	Eggs	Larvae	Juveniles	Adults	
	Sediment Suspension	Same activities as bottom disturbance	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** There will be temporary increases in sediment suspension and deposition during bottom disturbance activities, such as jet plowing or water jetting. Modeling simulations of sediment suspension and deposition were conducted for similar wind projects in Massachusetts, Rhode Island, and Virginia and concluded that sediment resuspension would not be great in terms of both duration and spatial extent. In Rhode Island (TetraTech 2012), modeling indicated that in areas characterized by mostly coarse sand (particle diameter > 130 µm), sediment suspended during jet plow operations settled quickly to the seafloor, and major plumes would not form in the water column. While suspended sediment concentrations would be elevated within a few meters of the jet plow, beyond this nearfield zone, concentrations would not exceed 100 mg/L. Concentrations greater than 10 mg/L would occur in an area within 50 m (160 ft) of the jet plow trenching for a duration of approximately 10 minutes. Sediment deposition was estimated to exceed 10 mm (0.4 in) only immediately adjacent to the trench. Sediment re-deposition would not be greater than 1 mm at distances greater than 40 m (130 ft) from the trench (TetraTech 2012). Sediment within the Wind Farm Area is generally fine and medium grained sand with areas of gravelly sand and gravel deposits near the Wind Farm Area. Based on the grain sizes evaluated by the studies in Massachusetts, Rhode Island, and Virginia, the gravelly sand and gravel deposits near the Wind Farm Area are likely to settle to the bottom of the water column quickly and sand re-deposition would be minimal and close in vicinity to the trench centerline. For grain sizes that are fine and medium-grained sand within the Ocean Wind Project, such as those modelled in the Virginia Offshore Wind Technology Advancement Project, sediments would settle on the seafloor within minutes and potentially extend laterally up to 160 m. These increases in sediment suspension and deposition may cause temporary adverse impacts to EFH because of decrease in habitat quality for benthic species, with more impacts occurring to the egg and larval life stages. Juveniles and adults are anticipated to vacate the habitat because of the suspended sediment levels in the water column and would likely experience no impacts. No impacts are anticipated for the pelagic life stages as pelagic habitat quality and EFH is expected to quickly return to pre-disturbance levels. **Indirect Impacts:** Increased sediment resuspension and deposition may cover areas adjacent to Project activities and smother benthic habitat. The infaunal and epifaunal species may take longer to recover to pre-impact numbers, resulting in long-term indirect adverse impacts to EFH for benthic species' egg and juvenile life stages. Increased suspended sediment is not expected to result in indirect long-term adverse impacts for EFH of later life stages of benthic and pelagic species.
	Noise	Pile Driving	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	**Direct Impacts:** Increased underwater noise during construction would mostly be associated with pile-driving activities in the construction area. Effects of sound on fish vary with acoustic intensity but can include behavioral alterations and physiological damage such as minor ruptured capillaries in fins or severe hemorrhaging of major organs or burst swim bladders (Stephenson *et al*. 2010, Halvorson *et al*. 2011). However, there are limited studies that examine the circumstances under which immediate finfish mortality occurs when exposed to pile-driving activities. Mortality appears to occur when fish are within 30 feet of driving of relatively large diameter piles. Studies conducted by California Department of Transportation (2001) showed in some mortality for several different species of wild fish exposed to driving of steel piles 2.4 m in diameter, whereas Ruggerone *et al.* (2008) found no mortality to caged yearling coho salmon (*Oncorhynchus kisutch*) placed as close as 2.0 ft (0.6 m) from a 1.5 ft (0.45 m) diameter pile and exposed to over 1,600 strikes. Therefore, direct impacts from pile driving are anticipated to have an adverse impact to EFH for pelagic species or those that are mobile and can detect sound. The noise levels will temporarily make the habitat less suitable and cause individuals to vacate the area of Project activities. Pile driving is anticipated to cause adverse impacts to EFH for both pelagic and demersal life stages; however, this impact will be short-term and EFH is expected to return to pre-pile driving conditions. Measures to mitigate underwater noise impacts will be determined in consultation with NMFS and included in Attachment 3 of this EFH Assessment.
		Vessel Traffic, Aircraft	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	**Direct Impacts:** Short-term adverse impacts to EFH are expected for mobile species that can detect sound associated with vessel, aircraft, or other transit noises. These adverse impacts are anticipated to be temporary and similar in nature to the current noise levels of vessels and aircraft that transit the area. Direct adverse impacts to EFH may result from a degradation of habitat for species that vacate the area during increased noise levels during Project activities. Both pelagic and demersal life stages would have a temporary impact from vessel and aircraft traffic noise.
	Discharge/Releases and Withdrawals	Vessels transiting Project Area	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** During construction of the Project, multiple vessels will be used to transit materials to and from the Project Area. Potential contamination may be introduced by liquid wastes that are discharged to coastal and marine waters from vessels or facilities, such as sewage, solid waste or chemicals, solvents, oils, and greases from equipment. These potential impacts to EFH and EFH-associated species will be minimized by implementing an approved oil spill response plan, by following proper storage and disposal protocols on land, and by requiring operators of vessels used for construction to have a vessel-specific spill response plan in the event of an accidental release, per the APMs. With

Project Area	Impact Producing Factor	Project Activity	Benthic EFH Species Impacts				Pelagic EFH Species Impacts				Impact Analysis
			Eggs	Larvae	Juveniles	Adults	Eggs	Larvae	Juveniles	Adults	
											application of the APMs, discharges/releases and withdrawals into the marine environment are unlikely. Pelagic and demersal life stages would not experience any adverse impacts.
	Vessel Traffic	Same activities as bottom disturbance, sediment resuspension and deposition, and noise	See bottom disturbance, sediment resuspension and deposition, and noise impact-producing factors.								
Inshore and Offshore Export Cable Corridor	Seafloor Disturbance	Jet plow, mechanical plow, and/or mechanical trenching	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	**Direct Impacts:** Short-term direct impacts to EFH from bottom disturbance are anticipated during jet plow, mechanical plow, and/or mechanical trenching during inshore and offshore export cable burial. Direct impacts to EFH are expected to result in similar adverse impacts to those anticipated during seafloor preparation because the cable will be installed in the same area that will be disturbed during seafloor preparation. Within inshore areas, approximately 19.5 acres of SAV and 66 acres of shellfish habitat would be disturbed during seafloor preparation activities (from indicative cable installation). Additionally, fish eggs and larval life stages (ichthyoplankton) are expected to be entrained during jet plow operations. Jet plowing involves the use of seawater to circulate through hydraulic motors and jets during installation. This process causes entrainment of eggs, larvae, phytoplankton, and zooplankton to likely experience mortality when seawater is withdrawn and released back into the ocean. Entrainment of organisms typically results in high mortality due to temperature changes and mechanical and hydraulic injury from pump impellors and passage through the plow's piping. The South Fork Wind Farm conducted an ichthyoplankton and zooplankton loss assessment from jet plowing operations that indicated the total estimated losses related to entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the study region. Similar results of minimal mortality were identified during the Fishermen's Energy Offshore Wind Project (2015). Ichthyoplankton losses are anticipated to be minimal compared to the overall number of ichthyoplankton larvae within the Project Area. For example, a female Black sea bass 2-5 years of age in the Mid-Atlantic Bight releases between 191,000 and 369,500 eggs annually. Therefore, impacts to early life stages of EFH species from entrainment caused by jet plowing activities during cable placement are anticipated to be short-term. **Indirect Impacts:** Indirect impacts from cable installation are anticipated to result in similar adverse impacts as described in Seafloor Preparation. For example, benthic fish species may potentially return to the area shortly after the completion of the activity. However, the benthic habitat and species may take longer to recover to pre-existing conditions following cable installation. Recovery of benthic habitats following sediment disturbance varies from 6 months to a year (Wilber and Clark 2007). Indirect impacts associated with installation of armoring for the cable are discussed in the Operation and Maintenance phase in **Table 4**.
	Sediment Suspension	Jet plow, mechanical plow, and/or mechanical trenching	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** Direct impacts to EFH associated with sediment resuspension and deposition are anticipated to be similar to the impact analysis for bottom disturbances described above. **Indirect Impacts:** Indirect impacts to EFH associated with sediment resuspension and deposition are anticipated to be similar to the impact analysis for bottom disturbances described above.
	Noise	Jet plow, mechanical plow, and/or mechanical trenching	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	**Direct Impacts:** Direct impacts to EFH associated with noise are anticipated to be similar to the impact analysis for vessel noise disturbances described above. **Indirect Impacts:** Indirect impacts to EFH associated with noise are anticipated to be similar to the impact analysis for vessel noise disturbances described above.
	Vessel Traffic	Same activities as bottom disturbance, sediment resuspension and deposition, and noise	See bottom disturbance, sediment resuspension and deposition, and noise impact-producing factors.								

* Lease Area also contains array cables and substation interconnector cables. Those impacts would be similar to those described for the inshore and offshore export cable corridor.

Table 5 - Impact producing factors and potential impact on EFH for the Ocean Wind Project during operations and maintenance.

Project Area	Impact Producing Factor	Project Activity	Benthic EFH Species Impacts				Pelagic EFH Species Impacts				Impact Analysis
			Eggs	Larvae	Juveniles	Adults	Eggs	Larvae	Juveniles	Adults	
Lease Area*	Seafloor Disturbance	Foundations, Scour Protection, and Cable Maintenance	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	**Direct and Indirect Impacts:** Direct and indirect impacts from bottom disturbance for maintenance of foundation, scour protection and cables within the Lease Area would be similar to those described for construction, but would affect small areas, and would be of shorter duration than those for construction in **Table 4**.
		Vessel anchoring	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	No short- or long-term direct Short-term indirect	**Direct Impacts:** Direct impacts from vessel anchoring are anticipated to be short-term during maintenance activities within the Lease Area. Adverse impacts to EFH resulting from vessel anchoring are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities (**Table 4**). **Indirect Impacts:** Indirect impacts to EFH associated with vessel anchoring during operations and maintenance activities are anticipated to be similar to those experienced during the construction phase of Project activities, but shorter in duration (**Table 4**).
	Sediment Suspension	Same activities as bottom disturbance	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** Direct impacts from sediment resuspension and deposition during operations and maintenance would result from vessel anchoring. Vessel anchoring is not anticipated to occur frequently, and no impacts of sediment resuspension and deposition are anticipated to EFH and EFH species. Adverse impacts to EFH are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities, but shorter in duration (**Table 4**). **Indirect Impacts:** Adverse indirect impacts to EFH from sediment resuspension and deposition during operations and maintenance activities are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities, but shorter in duration (**Table 4**).
	Habitat Conversion	Foundations and Scour Protection	Long-term indirect	Long-term indirect	Long-term indirect	Long-term indirect	Long-term indirect	Long-term indirect	Long-term indirect	Long-term indirect	**Indirect Impacts:** Maintenance and operation of monopile, piled jacket, and gravity base foundations along with scour protection will permanently shift a portion of the sandy, smooth-bottom habitat to a structure-based habitat, and these structures will act as artificial reefs for the duration of the Project. The foundations and associated scour protection may result in adverse and beneficial indirect impacts to EFH through habitat conversion. The conversion from soft-bottom habitat within the Project Area to hard-bottom habitat may have long-term adverse impacts to those species whose life stages require soft-bottom habitat, but EFH species that utilize hard-bottom habitat would have a long-term beneficial impact with an increase in available vertical structured, hard-bottom habitat. Therefore, a small area of habitat conversion will not result in adverse impacts long-term to the benthic community outside of the immediate impact area. The presence of WTG and offshore substation structures has the potential to result in localized changes to hydrodynamics and sediment transport, which could cause scour; these structures could also result in seasonal localized changes in stratification.
	Noise	Vessel, Aircraft Noise	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	Short-term direct	**Direct Impacts:** Adverse direct impacts to EFH from ship and aircraft noise during operation and maintenance activities are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities (**Table 4**).
		WTG Operational Noise	Long-term direct	Long-term direct	Long-term direct	Long-term direct	Long-term direct	Long-term direct	Long-term direct	Long-term direct	**Direct Impacts:** Long-term direct impacts are anticipated during operation and maintenance activities as a result of WTG operational noise. Increased underwater ambient noise during the operation of the turbines for the life of the Project could cause impacts to benthic and pelagic finfish communities. Ambient noise will increase as a result of the Project in general. However, when the Project is in operation and during periods of high wind, ambient noise will further increase. Some research has been done to suggest that impacts of increased ambient noise levels related to wind turbines drives fish away from the turbines during high wind events. Wahlberg and Westerberg (2005) found that at high wind speeds, fish avoid the area within 13 feet of the foundation. Atlantic Cod catch rates were found to be significantly higher in areas around turbines when turbines were stopped than catch rates when turbines were in operation (Thomsen *et al*. 2006). Other studies suggest that during the operational phase, disturbances caused by noise are considered to be of minor importance to the marine environment (Raoux *et al*. 2017). Because there are no previous studies that identify adverse impacts on individual species, WTG operational noise is not anticipated to cause adverse long-term impact to EFH for species.

Project Area	Impact Producing Factor	Project Activity	Benthic EFH Species Impacts				Pelagic EFH Species Impacts				Impact Analysis
			Eggs	Larvae	Juveniles	Adults	Eggs	Larvae	Juveniles	Adults	
	Discharge/Releases and Withdrawals	Vessels transiting the Project Area for maintenance activities	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** Multiple vessels will be transiting the Project Area during operations and maintenance. Potential contamination may be introduced by liquid wastes that are discharged to coastal and marine waters from vessels or facilities, such as sewage, solid waste or chemicals, solvents, oils, and greases from equipment. These potential impacts to EFH and EFH-associated species will be minimized by implementing an approved oil spill response plan, by following proper storage and disposal protocols on land, and by requiring operators of vessels used for construction to have a vessel-specific spill response plan in the event of an accidental release, per the APMs in Attachment 3. With application of the APMs, discharges/releases into the marine environment are unlikely. Pelagic and demersal life stages would not experience any adverse impacts.
Inshore and Offshore Export Cable Corridor	Electromagnetic Field (EMF)	EMF emitted by the cable.	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	No short- or long-term direct	**Direct Impacts:** Cable operation during the life of the Project could result in impacts related to the EMF emitted by the cable. Species most likely to experience impacts from the cable EMF would be benthic and demersal fish and invertebrates. Sharks, rays, and skate species have been well documented to detect electric fields with anatomical structures known as ampullae of Lorenzini, a feature absent in most bony fish. These species utilize this feature to locate and capture prey (Normandeau *et al.* 2011). While these species can detect EMF, little research has been done to conclusively determine the extent to which these impacts are manifested (Acres 2006). Recent evidence indicated that the Atlantic halibut (*Hippoglossus hippoglossus*), Dungeness crab (*Metacarcinus magister*), and American lobster (*Homarus americanus*) showed few behavioral responses that would indicate explicit avoidance or attraction to EMF in a laboratory setting (Pacific Northwest National Laboratory 2013). In a BOEM-funded study, researchers from the University of Rhode Island evaluated the behavioral response of American lobsters and little skate (*Leucoraja erinacea*), contained in netted enclosures, to EMF from the Cross Sound Cable, a 330 MW capacity high-voltage direct current (HVDC) subsea cable, south of New Haven, CT (Hutchison *et al.* 2018). The study found that while behavioral responses did occur in both lobsters and skate when exposed to EMF, “neither of the species showed spatial restriction in their movements and at the power levels transmitted, the cable did not act as a barrier to movement.” Skates appeared to demonstrate an attraction response to the EMF, which could be linked with benthic elasmobranch foraging behavior, and researchers stated that “…there is a low likelihood of significant biological impact associated with a single cable with a constant EMF”. Researchers concluded that there appeared to be no “…significant effect that would be deemed an impact for lobsters”. The researchers concluded “While the behavioral studies conducted in this project provided clear evidence of a behavioral response when receptive animals encountered the EMF, the evidence for a biological impact of a single HVDC cable under the conditions observed in this study would most likely be assessed as minor” (Hutchison *et al.* 2018). BOEM has evaluated EMF from power cables by conducting in-situ studies of both powered and unpowered cables (Love *et al.* 2015, 2016). Results from three years of surveys included: • “Researchers did not observe any significant differences in the fish communities living around energized and unenergized cables and natural habitats; • They found no compelling evidence that the EMF produced by the energized power cables in this study were either attracting or repelling fish or macroinvertebrates; • EMF strength dissipated relatively quickly with distance from the cable and approached background levels at about one meter from the cable; and • Cable burial would not appear necessary strictly for biological reasons” (BOEM 2016). Based on BOEM's and other's findings, it is not anticipated that EMF will have any short- or long-term adverse impacts on benthic of pelagic species with designated EFH within the Offshore Export Cable Corridor. EMF produced by cables decreases rapidly with distance from the cable, as shown in Figures 2.2.5-6 and 2.2.5-7 of Volume II of the COP. Shielding and burial of the cables will further minimize potential EMF impacts.
	Sediment Suspension	Same activities as bottom disturbance	Short-term direct Long-term indirect	Short-term direct Long-term indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	No short- or long-term direct or indirect	**Direct Impacts:** Direct impacts from sediment resuspension and deposition during operations and maintenance would result from the same activities causing bottom disturbances within the Lease Area, such as vessel anchoring and maintenance of monopiles, scour protection, and cables. Bottom disturbances are not anticipated to occur frequently, and no impacts of sediment resuspension and deposition are anticipated to EFH and EFH species. Adverse impacts to EFH are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities, but shorter in duration and less frequent (**Table 4**). **Indirect Impacts:** Adverse indirect impacts to EFH from sediment resuspension and deposition during operation and maintenance activities are anticipated to be similar to those experienced during the construction and decommissioning phases of Project activities, but shorter in duration (**Table 4**).

* Lease Area also contains array cables and substation interconnector cables. Those impacts would be similar to those described for the inshore and offshore export cable corridor.

Based on the impacts summarized in **Tables 4** and **5**, benthic species that have EFH for all life stages generally will experience impacts from bottom disturbing activities and underwater noise, while pelagic species with designated EFH will likely experience no impacts other than underwater noise as a result of Project construction, operations and maintenance, and decommissioning activities. Both pelagic and benthic species are anticipated to experience short-term direct impacts from noise during Project activities. While sandbar shark does have designated HAPC near shore of Atlantic City north of the Project Area, there will be no impacts to the HAPC from the Project. No changes to water temperature, salinity, or water depths would occur.

Benthic species are anticipated to experience short-term direct impacts to EFH because benthic habitat will primarily be affected during Project installation activities. The maximum wind farm area benthic impacts are identified in **Table 6** and the maximum offshore export cable route benthic impacts by landfall are identified in **Table 7** below. Potential impacts to wetland communities are identified in **Table 8** below. The level of impact to the various benthic species is identified in **Table 9** below. The early life stages of pelagic species that are found near the bottom of the water column are anticipated to have short-term direct impacts due to Project activities. The level of impact to the various pelagic species is identified in **Table 10** below.

3.5.1 Species Anticipated to Experience Short-Term Direct Impacts

Potential impacts to red hake juveniles are possible because juveniles utilize sea scallops as EFH in offshore areas. Sea scallops could be displaced, removed, or buried along the cable route during installation and remove habitat for this species' life stage. Surf clam beds may also experience direct impacts due to direct mortalities within the footprint of the foundations for piles and offshore substations (**Table 7**). Species that utilize sandy substrates, such as the flounder species, butterfish, monkfish, scallop, clam, quahogs, and skate species, will likely experience direct impacts as result of habitat conversion in the area of foundation installation (**Table 6**). Summer flounder has designated HAPC habitat that includes SAV habitats. A maximum of 19.3 acres of summer flounder HAPC within SAV could be disturbed as a result of the installation of the cable along the indicative Oyster Creek offshore export cable route. All impacts to HAPC would be temporary and limited to the duration of construction. Based on SAV mapping, a maximum of 20 acres of SAV could be temporarily impacted in Barnegat Bay from indicative cable installation (**Table 7**). Following construction, the areas of cable burial would be restored to previous elevations and natural succession would proceed, reestablishing the HAPC areas. If necessary, mitigation will be performed in accordance with N.J.A.C. 7:7-17 mitigation requirements for SAV.

Table 6 - Indicative benthic impacts for the Project.

Component	Temporary Benthic Disturbance (acres)	Permanent Benthic Disturbance (acres)	Total Benthic Disturbance within Carl N. Shuster Horseshoe Crab Reserve (acres)
WTG Foundations	-	3	0.1
WTG Scour Protection	-	81	3.2
Offshore Substation Foundations	-	0.1	-
Offshore Substation Scour Protection	-	3	-
Array Cables	2,220	77 (cable protection)	29

Component	Temporary Benthic Disturbance (acres)	Permanent Benthic Disturbance (acres)	Total Benthic Disturbance within Carl N. Shuster Horseshoe Crab Reserve (acres)
Substation Interconnector Cables	222	8 (cable protection)	-
Offshore Export Cables within Wind Farm Area	120	4(cable protection)	-
TOTAL within Wind Farm Area	***2,562***	***176***	***32***
Offshore Export Cables outside Wind Farm Area	1,980	82(cable protection)	113
TOTAL for Project	**4,542**	**258**	**145**

Note: These are indicative estimates based on the project design envelope. Potential temporary and permanent impacts will be updated based on final design and will be included in permit applications.

Table 7 - Maximum offshore indicative export cable route benthic impacts to shellfish habitat and SAV by landfall.

Export Cable Route	Total Benthic Disturbance within Shellfish Habitat (acres)	Total Benthic Disturbance within SAV (acres)
Oyster Creek	38	20
BL England	28	-
TOTAL	66	20

Note: These are indicative estimates based on the project design envelope. Potential temporary and permanent impacts will be updated based on final design and will be included in permit applications.

Temporary and permanent upland and wetland habitat alteration is anticipated. Based on NJDEP's wetland mapping and indicative cable route options as described in Volume I of this COP, approximately 0.54 and 2.52 acres of temporary wetland impacts could potentially occur as a result of cable burial at BL England and Oyster Creek, respectively. Of these totals, 0.13 acres of *Phragmites* dominated coastal wetlands and 0.06 acres of saline low marsh may be temporarily impacted at BL England. At Oyster Creek, less than 0.01 acres of indicative impacts may occur to saline high marsh (**Table 8**). These wetland communities are assumed to be areas that lie below mean high water. These impacts to EFH and EFH-designated species are anticipated to be short-term and temporary. Following construction, these areas would be restored to pre-existing conditions, and herbaceous vegetation would become reestablished.

Table 8 - Summary of wetland impacts along indicative onshore export cable routes by NJDEP wetland community type within the study areas.

Export Cable Route	Wetland Community Type	Acres of Temporary Impact
BL England	Managed (freshwater) wetland in built-up maintained rec area	0.34
	Phragmites dominate coastal wetlands	0.13
	Saline marsh (low marsh)	0.06

Export Cable Route	Wetland Community Type	Acres of Temporary Impact
Oyster Creek	Deciduous scrub/shrub wetlands	0.22
	Deciduous wooded wetlands	0.78
	Herbaceous wetlands	0.06
	Mixed scrub/shrub wetlands (coniferous dom.)	0.64
	Mixed scrub/shrub wetlands (deciduous dom.)	0.81
	Mixed wooded wetlands (coniferous dom.)	0.01
	Saline marsh (high marsh)	<0.01

Note: These are indicative estimates based on the project design envelope. Potential temporary and permanent impacts will be updated based on final design and will be included in permit applications.

3.5.2 Species Anticipated to Experience Long-Term Beneficial Impacts

Some species may benefit from the conversion of soft-bottom habitat to hard-bottom. Juvenile and adult black sea bass and scup are structure-oriented and would experience direct beneficial impacts because of the suitable habitat now available from foundation installation.

3.5.3 Species Anticipated to Experience Long-Term Indirect Adverse Impacts

Species and their associated life stages that are anticipated to experience long-term indirect adverse impacts to their EFH are associated with permanent habitat conversion following foundation, scour protection, and any protective armoring of the cable. Monkfish, flounder species, scup, bivalve species, and skate species are anticipated to experience long-term indirect adverse impacts from this habitat conversion. With the exception of the sandy substrate habitats being converted to hard-bottom habitat, the remaining substrates within the Project component areas are anticipated to function the same as pre-existing conditions and allow the continued use by designated EFH species.

Table 9 - Summary of EFH-designated species with benthic life stages and preferred habitats and level of impacts.

Species	Life Stage	Preferred Habitat Description	Preferred Habitat Presence in Project Area	Level of Impact
Atlantic cod	Egg	Pelagic habitats and high salinity zones of bays and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Larvae	Pelagic habitats and high salinity zones of bays and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Adult	Structurally complex hard bottom composed of gravel, cobble, and boulder substrates with and without epifauna and macroalgae	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none Direct beneficial impact
Atlantic sea scallop	Egg	Sand and gravel substrate in inshore areas and on the continental shelf	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect
	Larvae	Benthic and water column in inshore and offshore areas	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect
	Juvenile	Benthic habitat with shells, gravel, and small rocks to attach to	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect
	Adult	Benthic habitat with firm sand, gravel, shell, or rock	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect
Monkfish	Egg	Surface waters	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Larvae	Initially pelagic and become bottom dwellers (habitats unknown)	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Juvenile	Sub-tidal benthic habitat of hard sand, pebbles, gravel, broken shells, soft mud, and algae covered rocks	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Benthic habitat of hard sand, pebbles, gravel, broken shells, soft mud, and algae covered rocks	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Ocean Pout	Egg	Hard bottom habitat	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Juvenile	Intertidal and subtidal benthic habitat on shells, rocks, algae, soft sediments, sand, and gravel	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Direct beneficial impact
	Adult	Subtidal and benthic habitats on mud and sand substrates, as well as shells, gravel, or boulders	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Direct beneficial impact
Ocean Quahog	Juvenile	Offshore sandy substrates	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Adult	Medium to fine grained sediments	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Red Hake	Egg	Pelagic habitats on the continental shelf	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none

Species	Life Stage	Preferred Habitat Description	Preferred Habitat Presence in Project Area	Level of Impact
	Larvae	Free floating at surface with debris, sargassum, and jellyfish	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Juvenile	Depressions in substrates of fine, silty sand; eelgrass; deep areas offshore in sea scallops	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct impacts
	Adult	Bottom habitats of sand and mud with depressions	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
Scup	Juvenile	Demersal waters over the continental shelf and inshore estuaries; found in mud, sand, mussel beds, and eelgrass habitat	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Adult	Soft, sandy bottoms on or near structures such as rocky ledges, wrecks, artificial reefs, and mussel beds	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Spiny Dogfish	Juvenile	Pelagic habitats on the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Adult	Pelagic habitats on the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
Summer Flounder	Egg	Pelagic habitats on the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Larvae	Buried in inshore coastal and marine sandy bottom substrate	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Juvenile	Estuarine, soft-bottomed habitats such as mudflats, seagrass beds, marsh creeks, open bays	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Adult	Demersal waters over the continental shelf and sandy or muddy bottoms of inshore estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	HAPC	SAV habitats, including 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	Inshore Cable Corridor	Short-term direct
Surf Clam	Juvenile	Medium sands, fine and silty-fine sands	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Adult	Medium sands, fine and silty-fine sands	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
Silver Hake	Egg	Pelagic habitats on the continental shelf	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none

Species	Life Stage	Preferred Habitat Description	Preferred Habitat Presence in Project Area	Level of Impact
	Larvae	Pelagic habitats on the continental shelf	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Juvenile	Bottom habitats of all substrate types	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Adult	Silt-sand bottoms, sand-wave crests, shell, and biogenic depressions	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
White Hake	Adult	Fine-grained, muddy substrates and mixed soft and rocky habitats	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
Windowpane Flounder	Egg	Pelagic habitats on the continental shelf, coastal bays, and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Larvae	Pelagic habitats on the continental shelf, coastal bays, and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Juvenile	Muds and sandy substrates in intertidal and sub-tidal habitats	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Adult	Muds and sandy substrates in intertidal and sub-tidal habitats	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
Winter Flounder	Egg	Sand, muddy sand, mud, macroalgae, gravel bottom substrates	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Larvae	Pelagic habitats on the continental shelf, estuarine, and coastal areas	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Juvenile	Mud, sand, rocky substrates, tidal wetlands, eelgrass habitat	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
	Adult	Muddy and sandy substrates; hard bottom	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct Long-term indirect adverse
Witch Flounder	Egg	Pelagic habitats on the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Larvae	Pelagic habitats on the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Sub-tidal benthic habitats on the outer continental shelf and slope, with mud and muddy sand substrates	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Yellowtail Flounder	Egg	Coastal and continental shelf in water column	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none
	Larvae	Coastal and continental shelf in water column	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct to none

Species	Life Stage	Preferred Habitat Description	Preferred Habitat Presence in Project Area	Level of Impact
	Juvenile	Sandy substrates	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Sand, sand with mud, shell hash, gravel and rocks	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Clearnose skate	Juvenile	Primarily mud and sand, but also on gravelly and rocky bottom	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Primarily mud and sand, but also on gravelly and rocky bottom	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Little Skate	Juvenile	Sand and gravel substrates, but also on mud	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Winter Skate	Juvenile	Sand and gravel substrates, but also on mud	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Adult	Sand and gravel substrates, but also on mud	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Short-term direct

Table 10 - Summary of EFH-designated species with pelagic life stages and preferred habitats and level of impacts.

Species	Life Stage	EFH Habitat Description	EFH Habitat Presence in Project Area	Level of Impact
Atlantic angel shark	Neonate	Continental shelf habitats from Cape May, New Jersey, to Cape Lookout, North Carolina	Potentially Present	No short or long-term direct or indirect
	Juvenile			No short or long-term direct or indirect
	Adult			No short or long-term direct or indirect
Atlantic butterfish	Egg	Pelagic habitats in inshore estuaries and embayments and over bottom depths of 1,500 or less	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Pelagic habitats in depths between 31 and 350 m	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
	Juvenile	Surface waters associated with flotsam and large jellyfish	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Bottom depths between 10 and 250 m	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct
Atlantic herring	Larvae	Water column within inshore and estuarine waters	Offshore Export Cable Corridor	No short or long-term direct or indirect
	Juvenile	Pelagic and bottom waters of inland bays	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Pelagic and bottom waters of inland bays	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect

Species	Life Stage	EFH Habitat Description	EFH Habitat Presence in Project Area	Level of Impact
Atlantic mackerel	Egg	Pelagic in upper water column	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Bottom waters ranging between 10 to 130 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Bottom depths ranging from surface to 340 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Bottom depths ranging from surface to 340 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Atlantic Sharpnose Shark	Adult	Coastal, shallow habitats including enclosed bays, sounds, harbors, and marine to brackish estuaries	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Basking Shark	Neonate/ Juvenile/ Adult	Coastal and oceanic waters ranging from 200 to 2,000 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Black Sea Bass	Larvae	Close to shore on continental shelf	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Demersal waters over the continental shelf, inland bays, and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Direct beneficial impact
	Adult	Demersal waters over the continental shelf, inland bays, and estuaries	Inshore and Offshore Export Cable Corridor and Wind Farm Area	Direct beneficial impact
Blue Shark	Neonate	Offshore pelagic habitat	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Offshore pelagic habitat	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Offshore pelagic habitat	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Bluefin Tuna	Juvenile	Inshore and pelagic surface waters	Offshore Export Cable Corridor	No short or long-term direct or indirect
	Adult	Offshore and coastal pelagic habitats	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Common Thresher Shark	Neonate/ Juvenile/ Adult	Inshore, coastal, and oceanic waters	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Yellowfin Tuna	Juvenile	Offshore and coastal pelagic habitats	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Bluefish	Egg	Mid-shelf waters ranging from 30 to 70 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Oceanic waters no deeper than 15 m in water column; transported to estuarine nurseries	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect

Species	Life Stage	EFH Habitat Description	EFH Habitat Presence in Project Area	Level of Impact
	Juvenile	Pelagic nearshore areas and estuaries with sand, mud, clay, *Ulva*, *Zostera* beds, and *Fucus* bottom habitats	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Oceanic, nearshore, and continental shelf waters; inland bays; not associated with specific substrate	Inshore and Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Cobia	Egg	Offshore waters near the surface	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Water column of coastal and offshore waters	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Coastal and offshore waters; inshore coastal beaches, bays, and high salinity regions of estuaries	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Rock, gravel, sand, and muddy substrates; coral reefs and pilings	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Dusky Shark	Neonate	Water column at depths of 4.3 to 15.5 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Coastal and pelagic waters inshore of the continental shelf break	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Coastal and pelagic waters inshore of the continental shelf break	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
King Mackerel	Egg	Pelagic waters at depths between 35 to 118 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Pelagic waters at depths between 35 to 180 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Inshore waters	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Pelagic waters from the shore to the edge of the continental shelf	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Long Finned Squid	Egg	Inshore and offshore bottom habitats at depth is less than 50 m	Offshore Export Cable Corridor and Wind Farm Area	Short-term direct impacts
	Larvae	Pelagic inshore and offshore continental shelf waters and generally over bottom depths between 6 and 160 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Bottom depths between 6 to 160 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Varying depths of the water column; when inshore, found at bottom depths from 6 to 200 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect

Species	Life Stage	EFH Habitat Description	EFH Habitat Presence in Project Area	Level of Impact
Pollock	Larvae	Pelagic inshore and offshore habitats	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Sand Tiger Shark	Neonate	Pelagic and coastal habitats	Potentially present	No short or long-term direct or indirect
	Juvenile			No short or long-term direct or indirect
Sandbar Shark	Neonate	Pelagic and coastal habitats	Potentially present	No short or long-term direct or indirect
	Juvenile			No short or long-term direct or indirect
	Adult			No short or long-term direct or indirect
Shortfin Mako Shark	Neonate	Pelagic waters from southern New England through Cape Lookout	Potentially present	No short or long-term direct or indirect
	Juvenile			No short or long-term direct or indirect
	Adult			No short or long-term direct or indirect
Skipjack Tuna	Juvenile	Offshore and coastal pelagic habitats	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Pelagic habitats associated with birds, drifting objects, whales, and sharks	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Smoothhound Shark Complex	Neonate	Coastal shelves and inshore waters	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile/ Adult			
Spanish Mackerel	Egg	Pelagic waters shallower than 50 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Larvae	Pelagic waters shallower than 50 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Pelagic waters of coastal and estuarine waters	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Depths up to 75 m in estuarine and coastal habitats	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
Swordfish	Juvenile	Middle of oceanic water column at depths from 200 to 600 m	Potentially present	No short or long-term direct or indirect
Tiger Shark	Juvenile/ Adult	Offshore pelagic habitat	Potentially present	No short or long-term direct or indirect
White Shark	Neonate	Inshore waters out to 105 km	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Juvenile	Pelagic habitats between depths of 25 and 100 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect
	Adult	Pelagic habitats between depths of 25 and 100 m	Offshore Export Cable Corridor and Wind Farm Area	No short or long-term direct or indirect

4.0 Minimization/Mitigation of Potential Impacts

The proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project are presented in Volume II of the COP, Table 1.1-2, which is provided in Attachment 3 of this EFH Assessment. A monitoring plan will be developed in consultation with resource agencies, during the permitting process, prior to construction, to monitor environmental impacts.

5.0 Conclusion

The majority of the impacts anticipated to EFH will be short-term and temporary, such as pile driving noise during construction activities. In addition, potentially beneficial long-term impacts are anticipated with the conversion of soft-bottom, sandy habitats to hard-structure habitat. Impacts from the man-made structures on the seafloor and water column are minimal compared to the vast available habitat throughout the Wind Farm Area and offshore export cable corridors. Existing hard-bottom habitat composed of patchy cobbles and boulders will be avoided, to the extent practicable, during Project construction, minimizing the impacts on EFH-designated species and their life stages. The overall impacts of the Project on EFH and EFH-designated species will be short-term and temporary.

Long-term habitat disturbances from construction are associated with the conversion of sandy, smooth-bottom habitat to hard-bottom habitat. However, the new areas of hard-bottom habitat will be colonized by sessile benthic species and potentially provide additional habitat for structure-oriented species, such as Atlantic cod and black sea bass. Hard-bottom habitat and surfaces would continue to serve as foraging habitat for EFH-designated species.

Decommissioning activities would be similar in impacts and would result in temporary disturbances and would not cause any long-term adverse effects to EFH and EFH-designated species. Overall, the impacts associated with the construction, operation and maintenance, and decommissioning of the Ocean Wind Project are short-term and temporary.

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Attachment 1

Ocean Wind COP Volume I:

Section 4: Project Description

4. Project Description

The Lease Area will be developed for the Project, as further described in Sections 4.1 and 4.6. Pursuant to 30 CFR 585.626, this Project description details all planned facilities, including offshore, onshore and support facilities.

This Project description provides a reasonable range of Project designs to accommodate refinements following BOEM review and during detailed design. The design parameters assessed throughout the COP represent the maximum anticipated impact design for each resource. The PDE for each component is described in the relevant section of Section 6.

The physical dimensions of potential wind turbines are provided rather than turbine rated capacity. With advancements in wind turbine design, turbine capacity is less indicative of overall design parameters and may vary depending on site conditions. In addition, environmental impacts are generally related to physical dimensions, such as turbine height and rotor diameter, rather than capacity. Therefore, it is more appropriate to constrain the design envelope based on physical dimensions rather than turbine capacity.

4.1 Ocean Wind Project Location

4.1.1 Boundary

The boundaries of the Project Area are depicted on **Figure 1.1-1** and specifically consist of:

- Wind Farm Area: This is the area where the turbines, array cables, offshore substation(s), substation interconnector cables, and portions of the offshore export cables are located;
- Offshore export cable route corridor: Area in which the offshore export cable systems will be installed;
- Onshore export cable route corridor: Area in which onshore export cable systems will be installed, including onshore export cables) and grid connections; and
- Onshore substations.

The Wind Farm Area is located within Federal waters. The offshore export cable route corridor(s) will be partially located in Federal waters and partially in New Jersey waters. The onshore export cable route corridor(s) will be located within New Jersey. The Project boundary does not include interconnection upgrades or non-Project specific O&M and port facilities.

During construction, the Project will involve temporary construction laydown areas and construction ports. The primary ports that are expected to be used during construction, but which have independent utility and are not dedicated to the Project, are as follows:

- Atlantic City, NJ - construction management base. The site area is intended to offer an opportunity for a combined base for crew transfer vessel (CTV) operations for the construction phase.
- Paulsboro, NJ or Europe (directly) - for foundation scope. The port area is intended to offer an opportunity for both foundation fabrication facilities as well as staging and load-out operations in collaboration with a key subcontractor.
- Norfolk, VA or Hope Creek, NJ - for WTG scope. The port area is intended to offer an opportunity for WTG pre-assembly and load-out facility without any air draft clearance restrictions covering jack-up installation vessel assets.
- Port Elizabeth, NJ, Charleston, SC, or Europe (directly) - cable staging (unless transported directly from the cable supplier). The intended terminal area and quay infrastructure will be used for various cable staging and operation activities, if required.

During operations, Ocean Wind intends to utilize an O&M Facility in Atlantic City that will serve as a regional operations and maintenance center for multiple Orsted projects in the mid-Atlantic, including the Project. This facility is discussed in Section 6.2.3.1.

4.1.2 The Lease Area and Location Plat

The Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (Lease Area OCS-A 0498) from BOEM allows Ocean Wind the exclusive right to seek BOEM approval for the development of a leasehold. The lease allows Ocean Wind the exclusive right to submit a SAP and a COP, and to conduct activities in the leased area that are described in the SAP or COP as approved by BOEM.

Ocean Wind has requested that BOEM segregate portions of 160,480-acre original Lease Area OCS-A 0498 into a new lease area of approximately 84,955 acres (**Figure 1.1-1**). BOEM is currently processing this application and has indicated that this area will be designated a new lease number (OCS-A 0532) and assigned to a separate affiliate of Orsted. Ocean Wind is continuing to develop the Project on the remaining portions of Lease Area OCS-A 0498, which would total approximately 75,525 acres (**Figure 4.1-1**).

The portion of the Lease Area that the offshore infrastructure, including turbines, offshore substations, and array and substation interconnector cables would be located is referred to as the Wind Farm Area. (**Figures 4.1-1** and **4.1-2**). Water depths in the Wind Farm range from 49-118 ft below mean lower low water (MLLW) with the seabed sloping generally offshore toward the southeast at less than 1°. The Wind Farm Area is approximately 68,450 acres.

Approximate locations for the offshore turbines and offshore substations are provided in Appendix G. The results of HRG surveys will be used to inform decisions regarding micro-siting to avoid boulders or other features. To allow for micro-siting of Project offshore infrastructure, the HRG survey area has been designed to be larger than the actual area of impact for the WTGs, offshore substations, and cable routes.

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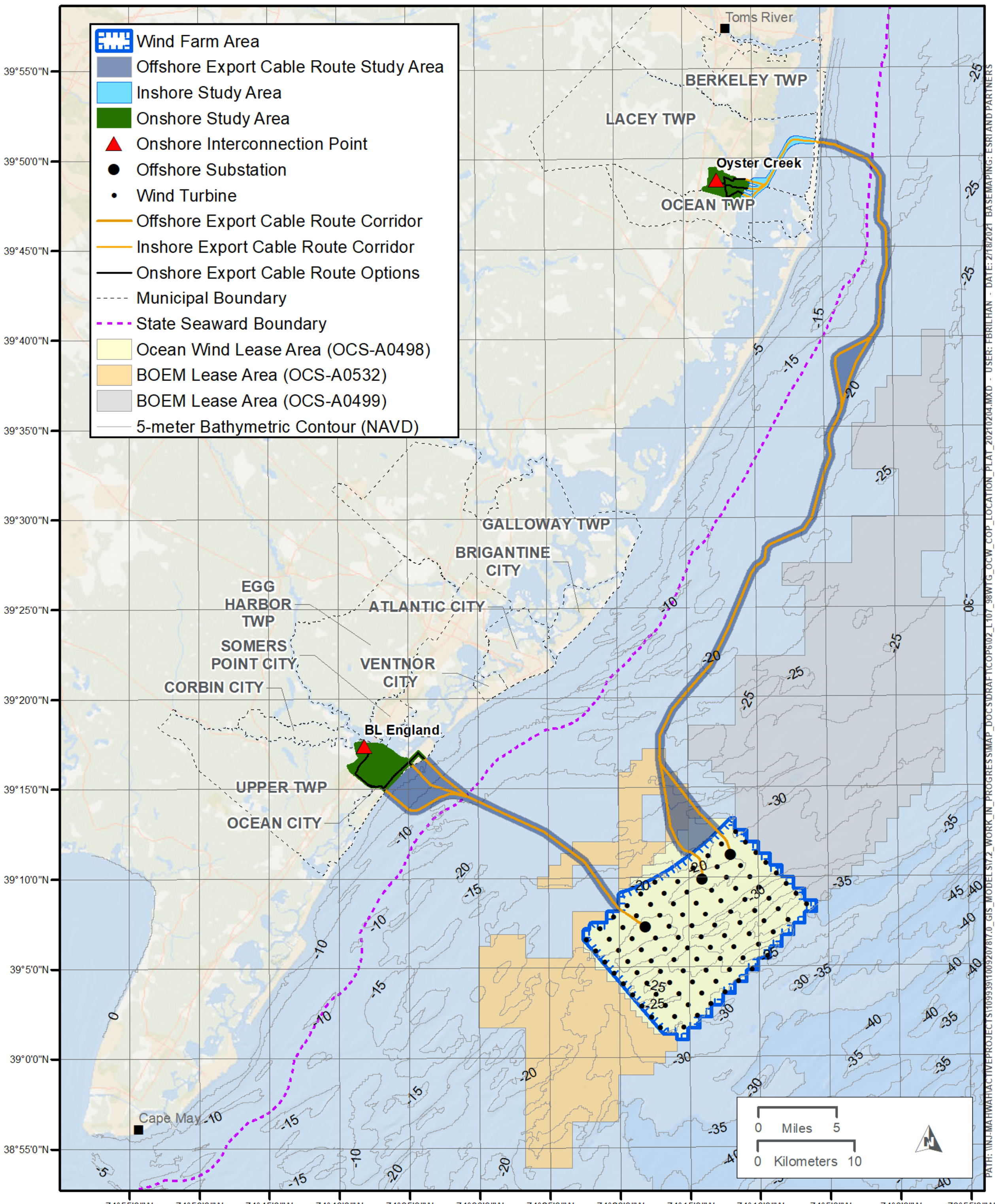

Figure 4.1-1 - Location plat and key Project components.

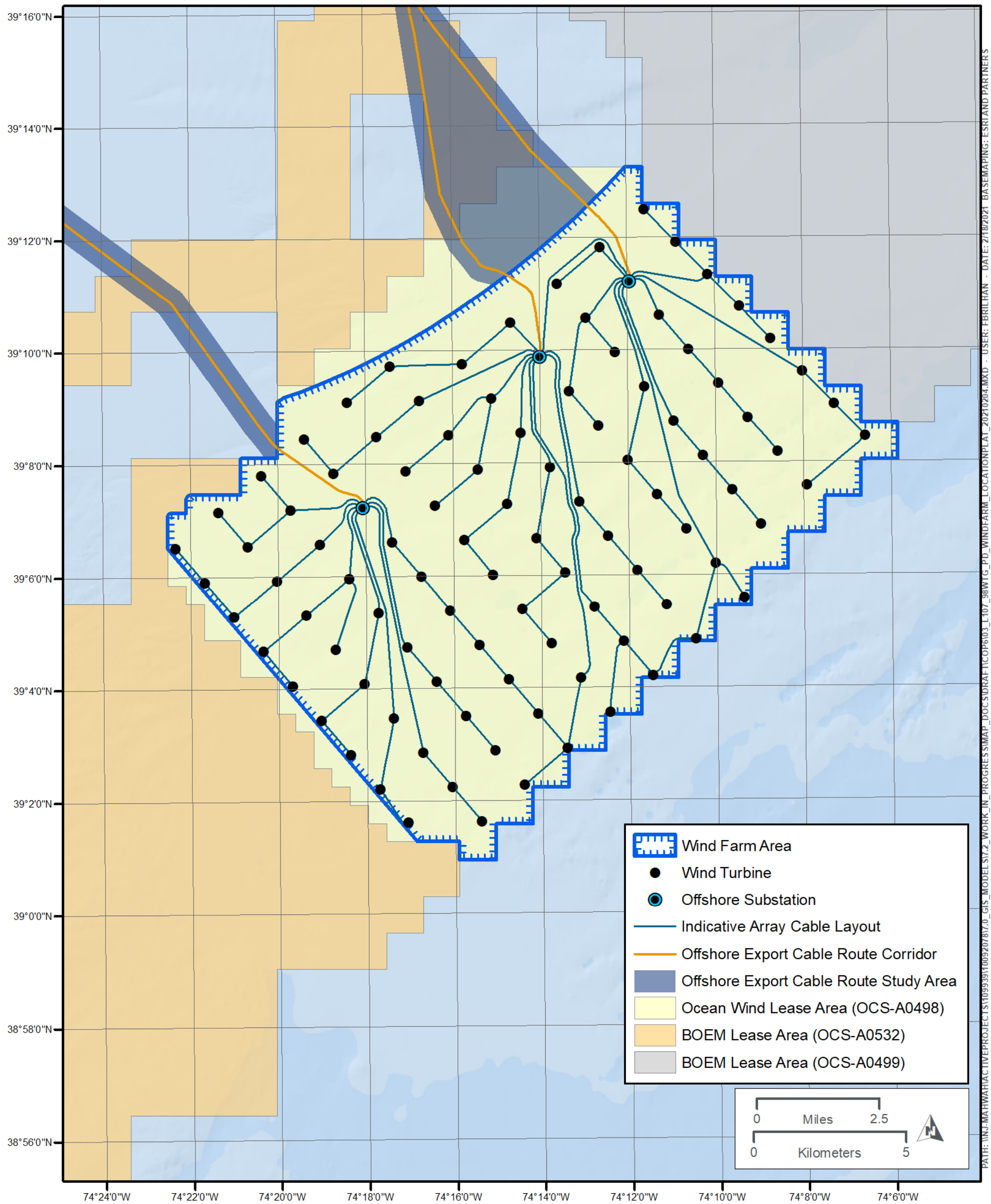

Figure 4.1-2 – Indicative Location Plan.

4.2 Design Envelope Approach

BOEM has communicated its support of and preliminary recommendation that applicants voluntarily use the PDE (or design envelope) Approach in submission of COPs for offshore wind energy facilities in its *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan*, dated January 12, 2018 (BOEM 2018). "BOEM has concluded that the Project-specific information in a COP may be submitted in the form of a PDE, and that BOEM may approve a COP using a PDE approach, so long as the PDE description provides sufficient detail to allow BOEM to analyze its environmental impacts and conduct required consultations consistent with the requirements of NEPA and other relevant environmental statutes" (BOEM 2018).

BOEM indicated that use of a design envelope approach allows a permitting agency to review and analyze the maximum impacts that could occur from a range of designs and facilitates review of projects with phased development and assessment of cumulative impacts. The permitting agency can then assess potential impacts, focusing on design parameters that result in the greatest potential impact to a given resource (e.g., fish, benthic habitat, marine mammals) referred to in the BOEM guidance as "maximum design scenario".

The design envelope approach has been taken throughout the COP to allow meaningful assessment of the Project to proceed, while still allowing reasonable flexibility for future Project design decisions.

4.3 Project Infrastructure Overview

The Project will include turbines and all infrastructure required to transmit power generated by the WTGs to two interconnection points with the PJM electric transmission system or power pool. Grid connections will be made at Oyster Creek and BL England.

The Project will have a maximum of 98 turbines.

The electrical system is comprised of the cables and components required to step up/down the voltages at the WTGs and to transport the electricity generated from the Offshore Wind Farm to the interconnection points. The system consists of a low voltage side from the WTGs to the offshore substation and a high voltage side from the offshore substations to the interconnection points. Each offshore substation will collect the power transmitted from the WTGs and transform the voltage for transmission through the export cable to the onshore substations. Where environmentally and economically feasible, Ocean Wind is also considering an alternative design to transport the electricity generated from the Project to the interconnection point directly. The alternative system consists of only low voltage electrical components from WTG to interconnection point without the need for an offshore substation.

The onshore infrastructure will consist of a buried onshore AC export cable system, AC substations, and a buried connection to the existing electrical grid at each interconnection point. As noted, two interconnection points will be required, one at BL England and one at Oyster Creek. As the Project design progresses, Ocean Wind is considering overhead grid connection options from the proposed onshore substations to the existing interconnection points at Oyster Creek and BL England as described in Section 6.2.1.3.

The Project will include the following components (**Figure 4.2-1**):

Offshore Components

- Offshore wind turbines, foundations, and scour protection;
- Offshore substations with supporting substructure foundation, including scour protection where required;
- Array cable systems - linking the individual turbines together to offshore substations and including cable protection;
- Substation interconnector cables - linking the substations to each other; and
- Offshore export cable systems (includes offshore export cables and cable protection).

Onshore Components

- Onshore export cable system - including TJBs, splice vaults/grounding link boxes, and fiber optic system, including manholes;
- Onshore substation(s); and
- Connection to the existing grid.

Other Supporting Components

- Supervisory Control and Data Acquisition (SCADA) system;
- Temporary construction staging areas, including storage areas; and
- Permanent and temporary access roads.

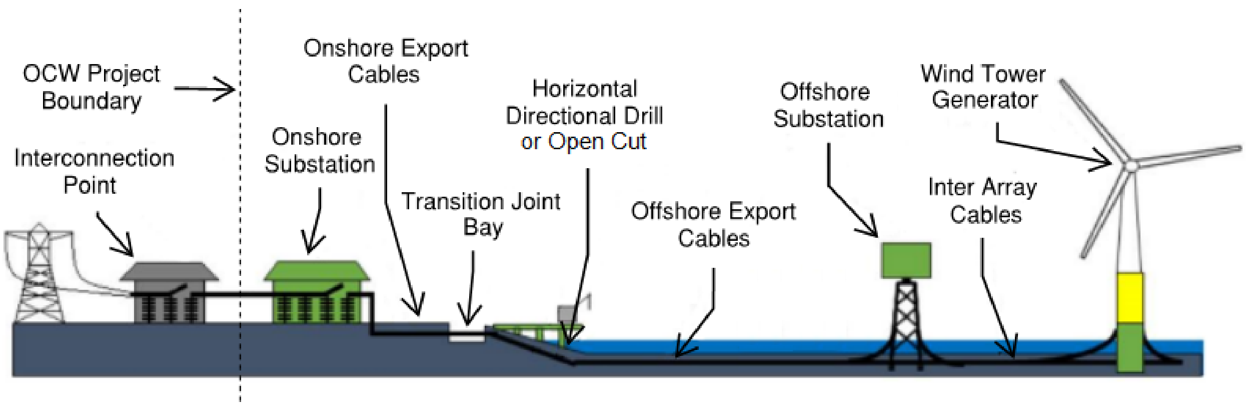

Figure 4.2-1 - Indicative key Project components.

Power will be generated at the offshore wind turbines. Array cables will carry that power to offshore substations where the power will be collected and 'stepped up' to a higher voltage by transformers within the substation. The offshore substations will be connected to each other by substation interconnector cables to provide redundancy, providing the voltage is the same across the wind farm. If the voltage is not the same, then back links may be utilized to keep the turbines energized. Power will be transmitted to shore via offshore export cables.

The offshore substations will be connected to the onshore substations via offshore and onshore export cable systems. The offshore export cable will connect with the onshore export cable at the TJBs at the landfall location(s). The onshore export cables then transmit the power to the onshore substation where the voltage will be stepped up or down to match the grid voltage. The onshore substation constructed at Oyster Creek will receive power from offshore power at 275 kV or 220 kV that will be transformed to 230 kV, whereas the onshore substation constructed at BL England will receive power at 275 kV or 220 kV from offshore that will be interconnected to the grid at 138 kV. The power generated by the Project would be provided to the grid via a connection with the onshore substation(s). Appendix U includes conceptual plans and drawings for the Project.

It is likely that the Project components will be fabricated at a number of manufacturing sites across the U.S., Europe, or elsewhere. This will be determined based on the development of the supply chain in the U.S., as part of a competitive bidding process, and the completion by Ocean Wind of a Final Investment Decision. Some components, including foundations and turbines, may be stockpiled at a port facility that serves as a construction base prior to delivery to the Wind Farm Area for installation. Other components may be delivered directly to the Wind Farm Area when required.

4.4 Project Key Parameters

The key components of the Project are listed in **Table 4.4-1** along with the function of the component. The proposed activities include construction, operation and maintenance, and decommissioning of the proposed facilities.

Table 4.4-1 - Summary of PDE Parameters.

Project Parameter Details
General (Layout and Project Size)
• Up to 98 WTGs • Project anticipated to be in service in 2024
Foundations
• Monopile foundations with transition piece; or one-piece monopile/transition piece, where the transition piece is incorporated into the monopile • Foundation piles to be installed using a pile driving hammer and/or drilling techniques • Scour protection around all foundations
Wind Turbine Generators (WTGs)
• Rotor diameter up to 788 ft (240 meters [m]) • Hub height up to 512 ft (156 m) above MLLW • Upper blade tip height up to 906 ft (276 m) above MLLW • Lowest blade tip height 70.8 ft (22 m) above MLLW
Inter-Array Cables
• Target burial depth of 4 to 6 ft (1.2 to 1.8 m) depending on site conditions, navigation risk and third-party requirement (final burial depth dependent on cable burial risk assessment and coordination with agencies). Cables could be up to 170 kV • Preliminary layout available however final layout pending • Maximum total cable length is 190 mi (approximately 300 kilometers [km]) • Cable lay, installation and burial: Activities may involve use of a jetting tool (both jet remotely operated vehicle (ROV) and/or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, controlled flow excavation (CFE)

Project Parameter Details
Offshore Export Cables
• Up to three max. 275 kV export cables. Target burial depth of 4 to 6 ft (1.2 to 1.8 m) depending on site conditions, navigation risk and third-party requirements (final burial depth dependent on burial risk assessment and coordination with agencies) • Two export cable route corridors, Oyster Creek and BL England. • Maximum total cable length is 143 miles (230 km) for Oyster Creek and 32 miles (51 km) for BL England • Cable lay, installation and burial: Activities may involve use of a jetting tool (both jet ROV and/or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, back hoe dredger, CFE
Offshore Substations
• Up to three offshore substations • Total structure height up to 296 ft (90 m) above MLLW • Maximum length and width of topside structure 295 ft (90 m; with ancillary facilities) • Offshore substations installed atop a modular support frame and monopile substructure or atop a piled jacket foundation substructure • Foundation piles to be installed using a pile driving hammer and/or drilling techniques • Scour protection installed at foundation locations where required
Landfall for the Offshore Export Cable
• Open cut or trenchless (e.g., HDD, direct pipe, or auger bore) installation at landfall • Up to six cable ducts for landfall, if installed by trenchless technology • A reception pit (may be subsea pit, not yet finalized) would be required to be constructed at the exit end of the bore • Construction reception pit: excavator barge, land excavator mounted to a barge, sheet piling from barge used for intertidal cofferdams, swamp excavators
Offshore Substations Interconnector Cable
• Max. 275 kV cables. Target burial depth 4 to 6 ft (1.2 to 1.8 m) depending on conditions (final burial depth dependent on burial risk assessment and coordination with agencies) • Potential layout available, however, not yet finalized • Maximum total cable length is 19 mi (approximately 30 km) • Cable lay, installation and burial: Activities may involve use of a jetting tool, vertical injection, pre-trenching, scar plow, trenching (including leveling, mechanical cutting), plowing, CFE
Onshore Export Cable
• Will connect with offshore cables at TJB and carry electricity to the onshore substation • Will be buried at a target burial depth of 4 ft (1.2 m) (this represents a target burial depth rather than a minimum or maximum) • Could require up to a 40 ft (12 m) wide construction corridor and up to a 7 ft (2 m) wide permanent easement for Oyster Creek cable corridor excluding landfall locations and cable splice locations; and up to a 20 ft (6 m) wide construction corridor and up to a 3.3 ft (1 m) wide permanent easement for BL England cable corridor • Up to eight export cables circuits will be required, with each cable circuit comprising up to three single cables. The cables will consist of copper or aluminum conductors wrapped with materials for insulation protection and sealing • TJBs, splice vaults/grounding link boxes, and fiber optic system, including manholes

Project Parameter Details
Onshore Substations and Interconnector Cable
• Two onshore substations located in proximity to existing substations with associated infrastructure • Each onshore substation would require a permanent site (for Oyster Creek interconnection point up to 31.5 acres and for BL England up to 11.3 acres), including area for the substation equipment and buildings, energy storage and stormwater management and landscaping • During construction, up to an additional 3 acres would be required for temporary workspace • The main buildings within the substations would be up to 1,017 ft long, 492 ft wide and 82 ft tall (310 m long, 150 m wide and 25 m tall)   • Secondary buildings may be used to house reactive compensation, transformers, filters, a control room and a site office. The external electrical equipment may include switchgear, busbars, transformers, high voltage (HV) reactors, static VAR compensator (SVC)/ static synchronous compensator (SVC/statcom), synchronous condensers, harmonic filters, and other auxiliary equipment. Lightning protection would include up to 24 lightning masts for a total height up to 98 ft (30 m). • Maximum height of overhead lines would be 115 ft (35 m) • Interconnector cable to existing sub-station

Other supporting infrastructure includes metbuoys[6], communication systems, temporary construction staging areas at each substation landfall, and on or near the onshore cable routes; permanent and temporary access roads; and a vessel support area.

[6] Ocean Wind will collect and analyze meteorological data, inclusive of wind speed and direction, waves and currents and information on other meteorological and metocean conditions within the Lease OCS-A 0498.

Attachment 2

Ocean Wind COP Volume II:

Section 2.2.5: Benthic Resources, Figure 2.2.5-1 - NJ Ocean Trawl Survey Areas and Carl N. Shuster Horseshoe Crab Reserve.

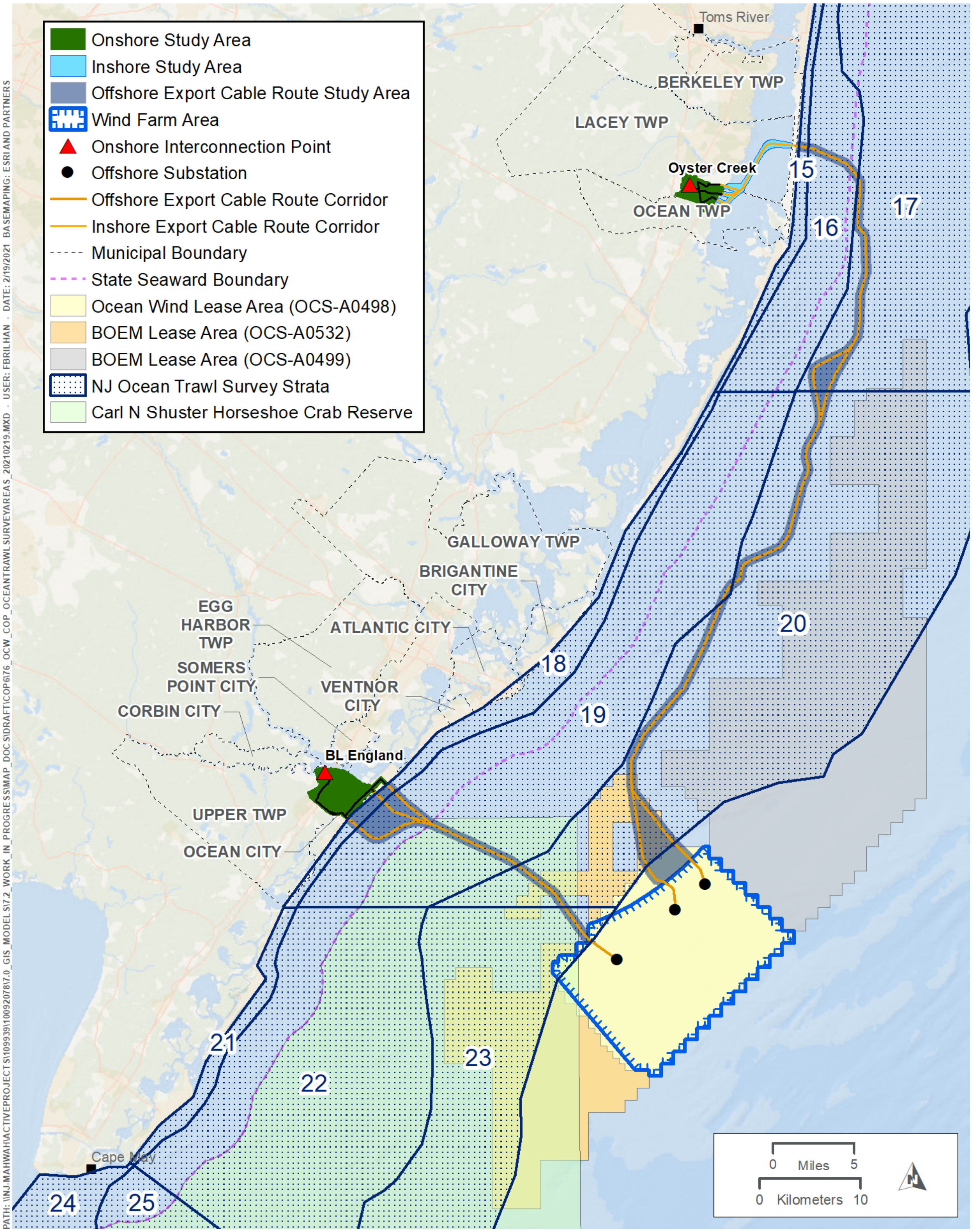

Figure 2.2.5-1 - NJ Ocean Trawl Survey Areas and Carl N. Shuster, Jr. Horseshoe Crab Reserve.

Attachment 3

Ocean Wind COP Volume II:

Table 1.1-2 Applicant Proposed Measures to Avoid, Minimize, or Mitigate Impacts

Table 1.1-2 - Applicant proposed measures (APMs) to avoid, minimize, or mitigate impacts, and monitoring (Bold items are beyond the requirements of or more specific than BOEM BMPs).

APM Number *	Applicant Proposed Measure**	Geological Resources	Water Quality	Air Quality	Terrestrial & Coastal Habitats	Terrest. & Coastal Fauna	Birds	Bats	Benthic Resources	Fish & EFH	Marine Mammals	Sea Turtles	Demog. Employ. & Econ.	Environmental Justice	Rec. & Tourism	Comm. & For-Hire Rec. Fishing	Land Use & Coastal Infrastructure	Nav. & Vessel Traffic	Other Marine Uses	Cultural Resources
General																				
Project Siting																				
GEN-01	**Site onshore export cable corridors and landfall within existing rights-of-way or previously disturbed/developed lands to the extent practicable.**	●	●	●	●	●	●	●					●	●	●		●			●
GEN-02	Site onshore, cable landfall and offshore facilities to avoid known locations of sensitive habitat (such as known nesting beaches) or species during sensitive periods (such as nesting season); important marine habitat (such as **high density, high value fishing grounds as determined by fishing revenues estimate [BOEM Geographical Information System (GIS) Data** - see Section 2.3.4]**)**; and sensitive benthic habitat; to the extent practicable. Avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities.	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GEN-03	Avoid areas that would require extensive seabed or onshore alterations to the extent practicable.	●	●	●	●	●	●	●	●	●	●	●				●	●			●
GEN-04	Bury **onshore** and offshore cables below the surface or seabed to the extent practicable and inspect offshore cable burial depth periodically during project operation, as described in the Project Description, to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GEN-05	**Use existing port and onshore operations and maintenance (office, warehouse, and workshop) facilities to the extent practicable** and minimize impacts to seagrass by restricting vessel traffic to established traffic routes where these resources are present.		●	●	●	●	●	●	●	●		●	●	●	●	●	●	●		●

APM Number *	Applicant Proposed Measure**	Geological Resources	Water Quality	Air Quality	Terrestrial & Coastal Habitats	Terrest. & Coastal Fauna	Birds	Bats	Benthic Resources	Fish & EFH	Marine Mammals	Sea Turtles	Demog. Employ. & Econ.	Environmental Justice	Rec. & Tourism	Comm. & For-Hire Rec. Fishing	Land Use & Coastal Infrastructure	Nav. & Vessel Traffic	Other Marine Uses	Cultural Resources
GEN-06	Develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases, designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. The monitoring plan will be developed during the permitting process, in consultation with resource agencies.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Design																			
GEN-07	**Implement aircraft detection lighting system (ADLS)[7] on wind turbine generators (WTGs).** Comply with Federal Aviation Administration (FAA), BOEM, and U.S. Coast Guard (USCG) lighting, marking and signage requirements to aid navigation per USCG navigation and inspection circular (NVIC) 02-07 (USCG 2007) and comply with any other applicable USCG requirements while minimizing the impacts through appropriate application including directional aviation lights that minimize visibility from shore**. Information will be provided to allow above water obstructions and underwater cables to be marked in sea charts, aeronautical charts and nautical handbooks.**		●				●	●			●	●	●	●	●	●	●	●	●	●
	Construction																			
GEN-08	To the extent practicable, use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
GEN-9	During pile-driving activities, **use ramp up procedures as agreed with National Marine Fisheries Service (NMFS) for activities covered by Incidental Take Authorizations,** allowing mobile resources to leave the area before full-intensity pile-driving begins.						●			●	●	●				●				

[7] ADLS would be used to provide continuous 360-degree radar surveillance of the airspace around the Project from the sea level to above aircraft flight altitudes, automatically issuing signals to activate obstruction lighting when aircraft are detected at a defined outer perimeter.

APM Number *	Applicant Proposed Measure**	Geological Resources	Water Quality	Air Quality	Terrestrial & Coastal Habitats	Terrest. & Coastal Fauna	Birds	Bats	Benthic Resources	Fish & EFH	Marine Mammals	Sea Turtles	Demog. Employ. & Econ.	Environmental Justice	Rec. & Tourism	Comm. & For-Hire Rec. Fishing	Land Use & Coastal Infrastructure	Nav. & Vessel Traffic	Other Marine Uses	Cultural Resources
GEN-10	Prepare waste management plans and hazardous materials plans as appropriate for the Project.		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GEN-11	Establish and implement erosion and sedimentation control measures in a **Stormwater Pollution Prevention Plan (SWPPP**, authorized by the State), and Spill Prevention, Control, and Countermeasures (SPCC) Plan to minimize impacts to water quality (signed/sealed by a New Jersey Professional Engineer and prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). Development and implementation of an Oil Spill Response Plan (OSRP, part of the SPCC plan) and SPCC plans for vessels.	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
GEN-12	**Where HDD trenchless technology methods are used, develop and implement an Inadvertent Return Plan that includes measures to prevent inadvertent returns of drilling fluid to the extent practicable and measures to be taken in the event of an inadvertent return.**	●	●		●	●	●		●	●	●	●		●		●	●		●	
Restoration																				
GEN-13	**Restore disturbance areas in the Onshore Project Area to pre-existing contours** (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable.	●	●	●	●	●	●	●		●				●			●			
Communication																				
GEN-14	Develop and implement a communication plan to inform the **USCG, Department of Defense (DOD) headquarters,** harbor masters, **public, local businesses**, commercial and recreational fishers, **among others** of construction and maintenance activities and vessel movements**, as coordinated by the Marine Coordination Center and Marine Affairs**.		●				●		●				●	●	●	●	●	●	●	
GEN-15	**Develop and implement an Onshore Maintenance of Traffic Plan to minimize vehicular traffic impacts during construction. Ocean Wind would designate and utilize onshore construction vehicle traffic routes, construction parking areas, and carpool/bus plans to minimize potential impacts.**			●		●	●						●	●	●		●			

APM Number *	Applicant Proposed Measure**	Geological Resources	Water Quality	Air Quality	Terrestrial & Coastal Habitats	Terrest. & Coastal Fauna	Birds	Bats	Benthic Resources	Fish & EFH	Marine Mammals	Sea Turtles	Demog. Employ. & Econ.	Environmental Justice	Rec. & Tourism	Comm. & For-Hire Rec. Fishing	Land Use & Coastal Infrastructure	Nav. & Vessel Traffic	Other Marine Uses	Cultural Resources
GEN-16	Prior to the start of operations, Ocean Wind will hold training to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operational procedures. This training will include all relevant personnel, crew members and protected species observers (PSO). New personnel must be trained as they join the work in progress. Vessel operators, crew members and protected species observers shall be required to undergo training on applicable vessel guidelines and the standard operating conditions. Ocean Wind will make a copy of the standard operating conditions available to each project-related vessel operator.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
GEN-17	**Implement Project and site-specific safety plans (Safety Management System, Appendix B).**		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
GEN-18	**No permanent exclusion zones during operation**												●		●	●	●	●	●	
	Geological Resources																			
GEO-01	Reduce scouring action by ocean currents around foundations and to seabed topography by taking reasonable measures and employing periodic routine inspections to ensure structural integrity.	●	●						●	●	●	●	●	●		●	●		●	●
GEO-02	Take reasonable actions (use BMPs) to minimize seabed disturbance and sediment dispersion during cable installation and construction of project facilities.	●	●			●			●	●	●	●				●			●	●
GEO-03	Conduct periodic and routine inspections to determine if non-routine maintenance is required.	●	●				●	●	●	●	●	●	●	●		●	●	●	●	●
GEO-04	**In contaminated onshore areas, comply with State regulations requiring the hiring of a Licensed Site Remediation Professional (LSRP) to oversee the linear construction project and adherence to a Materials Management Plan (MMP). The MMP prepared for construction can also be followed as a best management practice when maintenance requires intrusive activities.**	●	●		●	●	●		●	●	●	●	●	●	●	●	●			

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Water Quality																				
WQ-01	Implement turbidity reduction measures to minimize impacts to hard-bottom habitats, including seagrass communities, from construction activities, to the extent practicable.		●						●	●	●	●				●				
WQ-02	**Construction support vessels will not refuel at sea. All vessels will be certified by the Project to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks.**		●				●		●	●	●	●				●		●	●	
Air Quality																				
AQ-01	**Use low sulfur fuels to the extent practicable** (15 parts per million [ppm] per 40 Code of Federal Regulations [CFR] §80.510(c) as applicable)**.**			●										●						
AQ-02	**Select engines designed to reduce air pollution to the extent practicable (such as U.S. Environmental Protection Agency [USEPA] Tier 3 or 4 certified).**			●										●						
AQ-03	**Limit engine idling time.**			●										●						
AQ-04	**Comply with international standards regarding air emissions from marine vessels.**			●										●						
AQ-05	**Implement dust control plan.**	●	●	●																
Terrestrial and Coastal Habitats and Fauna																				
TCHF-01	Coordinate with the New Jersey Department of Environmental Protection (NJDEP) and United States Fish and Wildlife Service (USFWS) to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable.				●	●	●	●	●	●	●	●								
TCHF-02	**Conduct maintenance and repair activities in a manner to avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the near-shore zone.**		●		●	●	●	●	●	●	●	●	●		●					

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	Birds																			
BIRD-01	Evaluate avian use **by conducting pre-construction surveys for raptor nests, wading bird colonies, seabird nests, and shorebird nests during nesting periods.** (Focus being listed species or species identified of special concern by the Federal or State government.)						●													
BIRD-02	**An avian species monitoring plan for ESA-listed species and/or other priority species or groups will be developed and coordinated with NJDEP and USFWS and implemented as required.**						●													
BIRD-03	**Cut trees and vegetation, when possible, during the winter months when most migratory birds are not present at the site.**				●	●	●	●												
BIRD-04	Use lighting technology that minimizes impacts on avian and bat species to the extent practicable.						●	●												
BIRD-06	**WTG air gaps (minimum blade tip elevation to the sea surface) to minimize collision risk to marine birds which fly close to ocean surface.**						●													
BIRD-07	**Ocean Wind has sited Wind Farm Area facilities in the eastern portion of the original Lease Area, outside the migratory pathway, to reduce exposure to birds.**						●	●												
	Bats																			
BAT-01	**Onshore, the Project will avoid potential impacts by conducting tree clearing during the winter months, to the extent practicable.**					●	●	●												
BAT-02	**If tree clearing is required in areas with trees suitable for bat roosting during the period when northern long-eared bats may be present, develop avoidance and minimization measures in coordination with USFWS and NJDEP and conduct pre-construction habitat surveys.**							●												
	Benthic Resources																			
BENTH-01	Ocean Wind is conducting appropriate pre-siting surveys to identify and characterize potentially sensitive seabed habitats and topographic features.	●	●		●	●			●	●		●				●			●	●

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BENTH-02	Use standard underwater cables which have electrical shielding to control the intensity of electromagnetic fields (EMF). EMF will be further refined as part of the design or cable burial risk assessment.								●	●	●	●				●			●	
BENTH-03	**Conduct a submerged aquatic vegetation (SAV) survey of the proposed inshore export cable route.**				●	●			●	●		●								
	Fish and EFH																			
FISH-01	Evaluate geotechnical and geophysical survey results to identify sensitive habitats (e.g., shellfish and SAV beds) and avoid these areas during construction, to the extent practicable.				●				●	●		●	●		●	●	●		●	
FISH-02	Ocean Wind will coordinate with NJDEP, NMFS and USACE regarding time of year restrictions for winter flounder and river herring, as well as summer flounder habitat areas of particular concern (HAPC).				●				●	●					●	●				
	Marine Mammals and Sea Turtles																			
MMST-01	Vessels related to project planning, construction, and operation shall travel at speeds in accordance with National Oceanic and Atmospheric Administration (NOAA) requirements when assemblages of cetaceans are observed. Vessels will also maintain a reasonable distance from whales, small cetaceans, and sea turtles, as determined through site-specific consultations (**specifics to be added based on consultation**).										●	●								
MMST-02	Project-related vessels will be required to adhere to NMFS Regional Viewing Guidelines for vessel strike avoidance measures during construction and operation to minimize the risk of vessel collision with marine mammals and sea turtles. Operators shall be required to undergo training on applicable vessel guidelines.										●	●								
MMST-03	Vessel operators will monitor NMFS North Atlantic right whale (NARW) reporting systems (e.g., the Early Warning System, Sighting Advisory System) for the presence of NARW during planning, construction, and operations within or adjacent to Seasonal Management Areas and/or Dynamic Management Areas.										●									

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MMST-04	Ocean Wind will post a qualified observer as agreed to during the NMFS incidental take authorization process, on site during construction activities to avoid and minimize impacts to marine species and habitats in the Project Area.										●	●				●				
MMST-05	Obtain necessary permits to address potential impacts on marine mammals from underwater noise, and establish appropriate and practicable mitigation and monitoring measures in coordination with regulatory agencies.										●	●								
MMST-06	**Piling with a hammer will not start during nighttime hours, but if it started during daylight, it could continue until complete. Develop and implement a Protected Species Monitoring and Mitigation Plan.**[8] The Protected Species Monitoring and Mitigation Plan will describe these measures and will be provided to BOEM and NOAA Fisheries for review.										●	●								
	Socioeconomics and Environmental Justice																			
SOC-01	**Comply with NJDEP noise regulations (New Jersey Administrative Code [N.J.A.C.] 7:29), which limit noise from industrial facilities received at residential property lines to 50 decibels during nighttime (10:00 p.m. to 7:00 a.m.) and 65 decibels during daytime as well as specific octave band noise limits, and comply with any local noise regulations, to the extent practicable, to minimize impacts on nearby communities.**												●	●	●		●			
	Cultural, Historical, and Archaeological Resources																			
CUL-01	**Develop and implement an Unanticipated Discovery Plan.**																			●
CUL-02	**Use the results of geotechnical and geophysical surveys to identify potential cultural resources. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with relevant agencies and affected tribes to determine minimization and mitigation as necessary.**																			●

[8] The following proven mitigation measures and tools are currently under consideration: exclusion and monitoring zones; ramp-up/soft-start procedures; shut-down procedures; qualified and NOAA Fisheries-approved PSOs; noise attenuation technologies; Passive Acoustic Monitoring (PAM) systems (fixed and mobile); reduced visibility monitoring tools/technologies (e.g., night vision, infrared and/or thermal cameras); and utilization of software to share visual and acoustic detection data between platforms in real time.

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CUL-03	**Conduct background research and consult with the State Historic Preservation Office (SHPO) to determine the need for cultural resource surveys onshore. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with SHPO and affected tribes to determine minimization and mitigation as necessary.**																			●
CUL-04	**The Project has been designed to minimize visual impacts to historic and cultural properties to the extent feasible. The Project's layout was adjusted to align turbines at the eastern portion of the lease area, so that closest turbines are at least 15 miles from shore. Visibility of the turbine array from all identified properties within the Preliminary Area of Potential Effect would be minimized and mitigated further by measures adopted in this table including ADLS and markings (GEN-07), and as in Appendix F-4.**																			●
CUL-05	**Mitigation in the form of documentation, planning, or educational materials will be coordinated with stakeholders, as in Appendix F-4.**																			●
	Recreation and Tourism																			
REC-01	**Develop a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season, where practicable.**												●		●	●		●	●	
REC-02	**Coordinate with local municipalities to minimize impacts to popular events in the area during construction, to the extent practicable.**												●		●	●		●	●	
	Commercial and For-Hire Recreational Fishing																			
CFHFISH -01	Work cooperatively with commercial/recreational fishing entities and interests to ensure that the construction and operation of the Project will minimize potential conflicts with commercial and recreational fishing interests. Review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts.												●		●	●		●	●	

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CFHFISH -02	**Develop and implement a Fisheries Communication and Outreach Plan. (Appendix O) The plan includes the appointment of a dedicated fisheries liaison as well as fisheries representatives who will serve as conduits for providing information to, and gathering feedback from, the fishing industry, as well as Project-specific details on fisheries engagements.**		●										●		●	●	●	●	●	
	Land Use and Coastal Infrastructure																			
LU-01	**Develop crossing and proximity agreements with utility owners prior to utility crossings.** (Crossing agreements in U.S. waters are supported by the International Cable Protection Committee (ICPC), which provides a framework for establishing cable crossing agreements.)		●						●								●	●	●	
	Navigation and Vessel Traffic																			
NAV-01	**Ocean Wind has engaged and will continue to engage with FAA and DOD with regards to potential effects to aviation and radar.**														●		●	●	●	
NAV-02	Site facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.												●		●		●	●	●	
NAV-03	**Select structures within the proposed Wind Farm Area will be equipped with strategically located Automatic Identification System (AIS) transponders.**														●			●	●	
NAV-04	**WTGs will be arranged in equally spaced rows on a northwest to southeast orientation to aid the safe navigation of vessels operating within the Wind Farm Area.**															●		●	●	
	Other Marine Uses																			
OUSE-01	**Evaluate geotechnical and geophysical survey results to identify existing conditions, existing infrastructure, and other marine uses. Areas of other marine uses will be avoided to the extent practicable, and Ocean Wind will coordinate with other users where avoidance is not practicable.**	●															●	●	●	●

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Visual																				
VIS-01	Address key design elements, including visual uniformity, use of tubular towers, and proportion and color of turbines.												●	●	●		●			●
VIS-02	Ocean Wind has used appropriate viewshed mapping, photographic and virtual simulations, computer simulation, and field inventory techniques to determine the visibility of the proposed project. Simulations illustrate sensitive and scenic viewpoints.												●	●	●		●			●
VIS-03	Seek public input in evaluating the visual site design elements of proposed wind energy facilities.												●	●	●		●			●
VIS-04	**Security lighting for onshore facilities will be downshielded to mitigate light pollution.**																●			

* APM numbers were assigned to allow easy reference to specific measures. Each APM number includes an abbreviation of general (GEN) or the most pertinent resource area (e.g., NAV for Navigation) along with a number.

** **Bold** items are beyond the requirements of or more specific than the BOEM BMPs.