**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| ***DEMERSAL/BENTHIC*** | | | | | | | | |
| Atlantic Cod (*Gadus morhua*)[b] | | | • | • | X | X | | Year-round, peak in winter and spring |
| Atlantic Halibut (*Hippoglossus hippoglossus*)[b] | | | • | • | | X | | Year-round |
| Atlantic Herring (*Clupea harengus*)[b] | • | | | | | X | X | Winter |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) | | | • | • | | | | October to May |
| Black Sea Bass (*Centropristis striata*)[b] | | | • | • | X | X | | Spring to summer; summer to fall |
| Cunner (*Tautogolabrus adspersus*) | | | • | • | | | X | Year-round, hibernate in mud over winter |
| Haddock (*Melanogrammus aeglefinus*)[b] | | | • | • | | X | | Winter and spring |
| Little Skate (*Leucoraja erinacea)* | | | • | • | X | X | | Year-round |
| Monkfish (*Lophius americanus*)[b] | | | SFEC* | • | X | X | | Summer to fall |
| Northern sea robin (*Prionotus carolinus*) | | | • | • | | X | | Spring through fall |
| Ocean Pout (*Macrozoarces americanus*) | • | • | • | • | X | X | X | Late summer to winter |
| Pollock (*Pollachius virens*) | • | • | • | • | | X | | Collected in November at BIWF |
| Red Hake (*Urophycis chuss*)[b] | | | • | | X | X | X | September to December<br>Collected from April to July at BIWF |
| Sand Lance (*Ammodytes americanus*) | • | • | • | • | | | X | Year-round |

**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| Scup (*Stenotomus chrysops*) | | | • | • | X | X | X | Juveniles: winter to spring; Adults: October to December |
| Sea Raven (*Hemitripterus americanus*) | • | • | • | • | | | | Collected Year-Round at BIWF |
| Smooth Dogfish (*Mustelus canis*) | | | • | • | | | | Fall to winter<br>Collected spring through fall at BIWF |
| Spiny Dogfish (*Squalus acanthias*) | | | • | • | X | X | | Fall to winter<br>Collected summer and fall at BIWF |
| Striped Bass (*Morone saxatilis*) | | | • | • | | X | | April to September |
| Summer Flounder (*Paralichthys dentatus*)[b] | | | SFEC* | • | X | X | | Winter to spring<br>Collected year-round at BIWF |
| Tautog (*Tautoga onitis*) | | | • | • | | X | X | Winter |
| Tilefish (*Lopholatilus chamaeleonticeps*) | | • | • | | | X | | Larvae: July to September; Juveniles: April to July |
| Whiting (*Merluccius bilinearis*)[b] | | | • | • | X | X | | Winter to spring |
| Windowpane Flounder (*Scophthalmus aquosus*)[b] | | | • | • | X | X | X | Summer to fall<br>Collected year-round at BIWF |
| Winter Flounder (*Pseudopleuronectes americanus*)[b] | • | • | • | • | X | X | X | Eggs/Larvae: winter to early spring; Juveniles and Adults: year-round |
| Winter Skate (*Leucoraja ocellate*) | | | • | • | X | X | | Summer and fall<br>Collected year-round at BIWF |
| Wolffish (*Anarhichas lupus*) | | | • | • | | | | November to June |

**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| Yellowtail Flounder (*Limanda ferruginea*)[b] | | | • | • | X | X | X | Year-round |
| ***PELAGIC*** | | | | | | | | |
| Albacore Tuna (*Thunnus alalunga*) | | | SFEC* | | X | X | | Summer to fall |
| Alewife (*Alosa pseudoharengus*) | | | • | • | | X | X | Mid July to October<br>Collected January to May at BIWF |
| American Eel (*Anguilla rostrata*) | | • | • | • | | X | | Juveniles or Adults: March through December.<br>One adult collected in April at BIWF |
| American Plaice (*Hippoglossoides platessoides*) | | • | SFEC* | SFEC* | X | X | | Year-round<br>Collected April to May at BIWF |
| American Shad (*Alosa sapidissima*) | | | • | • | | X | | Spring to summer |
| Atlantic Bonito (*Sarda sarda*) | | | • | • | | X | | Summer to fall |
| Atlantic Butterfish (*Peprilus triacanthus*) | SFEC* | SFEC* | SFEC* | • | E,L,J | X | X | Eggs/Larvae: July to September;<br>Juveniles/Adults: spring<br>Adults: Collected in summer and fall at BIWF |
| Atlantic Cod[c] | • | • | | | X | X | X | Winter and spring |
| Atlantic Halibut[c] | • | • | | | | X | X | Winter and spring |
| Atlantic Herring[c] | | • | • | • | X | X | X | Larvae: August to December;<br>Juveniles/Adults: spring and fall<br>Juveniles/Adults: Collected January to March at BIWF |

**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| Atlantic Mackerel (*Scomber scombrus)* | • | SFEC* | • | • | E,L | X | X | Eggs/Larvae: April to June; Juveniles/Adults: late summer to fall Juveniles/Adults: Collected January through February at BIWF |
| Atlantic Menhaden (*Brevoortia tyrannus*) | | | • | • | | X | X | Spring to summer |
| Atlantic silverside (*Menidia menidia*) | | | • | • | | | X | Late fall to early spring |
| Basking Shark (*Cetorhinus maximus*) | | | SFEC* | SFEC* | X | | | Summer to fall |
| Bay anchovy (*Anchoa mitchilli*) | SFEC | SFEC | SFEC | SFEC | | | X | Eggs and Larvae: spring, summer, fall<br>Juveniles and Adults: year-round<br>Populations expected to be low and more evident in the SFEC - NYS than the SFEC - OCS. |
| Black Sea Bass[c] | • | • | | | | X | X | July to September |
| Blueback Herring (*Alosa aestivalis*) | | | • | • | | X | X | Summer to winter<br>Collected in the winter at BIWF |
| Bluefin Tuna (*Thunnus thynnus*) | | SFWF * | • | • | X | X | | Spring to winter |
| Bluefish (*Pomatomus saltatrix*) | • | • | • | • | X | X | X | Eggs: March to May;<br>Larvae: June to August;<br>Juveniles collected in September, October, and December at BIWF<br>Adults: August to September; Adults collected in September, October, November, and May at BIWF |

**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| Blue shark (*Prionace glauca*) | | | • | • | X | | | June to November |
| Common Thresher Shark (*Alopias vulpinus*) | | | • | • | X | | | June to December |
| Conger Eel (*Conger oceanicus*) | | | • | • | | | | Collected November to June at BIWF |
| Dusky Shark (*Carcharhinus obscurus*) | | | • | | X | | | June to November |
| Haddock[c] | • | • | | | L | X | X | Winter and spring |
| Monkfish[c] | • | • | | | X | X | X | Summer to fall |
| Northern sea robin | • | • | | | | X | | Summer to fall |
| Red Hake[c] | • | • | | | X | X | X | May to December |
| Sandbar Shark (*Carcharhinus plumbeus*) | | | • | • | X | | | May to September |
| Sand Tiger Shark (*Carcharias taurus*) | | | SFEC* | | X | | | May to September |
| Shortfin Mako Shark (*Isurus oxyrinchus*) | | | • | SFEC* | X | | | June to December |
| Skipjack Tuna (*Katsuwonus pelamis*) | | | | SFEC* | X | X | | Year-round |
| Spot (*Leiostomus xanthurus*) | | | • | • | | X | | October to May |
| Summer Flounder[c] | • | • | | | X | X | X | Fall |
| Tiger Shark (*Galeocerdo cuvieri*) | | | • | SFWF* | X | | | May to September |
| Weakfish (*Cynoscion regalis*) | | | • | • | | X | X | Adults: June |
| White Shark (*Carcharodon carcharias*) | | | SFEC* | | X | | | Summer to fall |
| Whiting[c] | • | • | | | X | X | X | Year-round |

**Table 4.3-10. Economically and Ecologically Important Finfish Species in the SFWF and SFEC**

| Species | Eggs | Larvae | Juveniles | Adults | EFH | Commercial/ Recreational Importance | Prey Species | Potential Time of Year in Region a |
|---|---|---|---|---|---|---|---|---|
| Windowpane Flounder[c] | • | • | | | X | X | X | Spring |
| Winter Flounder[c] | | • | | | X | X | X | Winter to spring |
| Witch Flounder | • | • | | | X | X | X | Year-round |
| Yellowfin Tuna (*Thunnus albacares*) | | | SFEC* | SFEC* | X | X | | Year-round |
| Yellowtail Flounder[c] | • | • | | | X | X | X | March to August |

Sources:

Bohaboy et al., 2010; Cargnelli et al., 1999c; Cargnelli et al., 1999d; Cargnelli et al., 1999e; Chang et al., 1999; Collette and Klein-MacPhee, 2002; Collie et al., 2008; Collie and King, 2016; Cross et al., 1999; Curtice et al., 2016; Demarest, 2009; Fahay et al., 1999a; Fahay et al., 1999b; Fairchild, 2017; Fisheries Hydroacoustic Working Group, 2008; Florida Fish and Wildlife Conservation Commission, 2017; Florida Museum of Natural History, 2017; GARFO, 2016; Hasbrouck et al., 2011; Johnson et al., 1999a; Johnson et al., 1999b; Knickel, 2017; Lipsky, 2014; Malek, 2015; Malek et al., 2010; Malek et al., 2014; Massachusetts Department of Energy and Environmental Affairs, 2017; MA EOEEA, 2015; McBride et al., 2002; McGuire et al., 2016; Morse et al., 1999; Morton, 1989; NOAA, 2010, 2015, 2016a, 2017a, 2017b, and 2017c; North Carolina Department of Environment and Natural Resources: Division of Marine Fisheries, 2017; NEFSC, 2017; Northeast Ocean Data, 2017; Packer et al., 1999, 2003a, 2003b, and 2003c; Pereira et al., 1999; Petruny-Parker et al., 2015; Popper et al., 2014; Reid et al., 1999; Rooker et al., 2007; Scotti et al., 2010; Siemann and Smolowitz, 2017; Steimle et al., 1999a, 1999b, 1999c, 1999d, and 1999e; Studholme et al., 1999; USFWS, 2017; URI EDC, 1998a and 1998b; Wilber et al., 2017

[a] Time of year information obtained from sources listed in the reference section. When available, species presence based on survey information from the BIWF was provided from Wilber et al., 2017.

[b] This species also has life stages that are pelagic.

[c] This species also has life stages that are demersal.

Notes:

• - denotes that the life stage is potentially present in both the SFWF and SFEC

SFWF* – denotes that the life stage is potentially present only in the SFWF, according to EFH designations.

SFEC* – denotes that the life stage is potentially present only in the SFEC, according to EFH designations.

EFH column – X indicates EFH is designated for all life stages checked in that row. E, L, J, A indicates that only certain life stages have EFH. E=eggs, L=larvae, J=juveniles, A=adults

Many species listed in Table 4.3-10 have demersal life stages that are considered commercially or recreationally important in New England regional waters and have the potential to occur in the SFWF. Management for each species is dictated by state regulations for waters within 3 miles (4.8 km) of the coast and by federal regulations beyond 3 miles (4.8 km). Federal waters like those of the SFWF are managed under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Species such as Atlantic cod, black sea bass, scup, whiting, summer flounder, winter flounder, yellowtail founder, and winter skate are demersal species that are important to both the stability and resiliency of the local marine community, and have a large impact on federal fisheries (RICRMC, 2010). For more information about the commercial and recreational fishing activity within the SFWF (Section 4.6.5).

The Atlantic sturgeon, a federally listed demersal species, has a possible presence within the SFWF from October to May, when juveniles and adults return to the oceans after spawning occurs in estuarine and riverine environments, including the Hudson River. Atlantic sturgeon are discussed in further detail in the Threatened/Endangered Finfish section that follows.

Atlantic cod is a demersal species potentially present within the SFWF that is known to have spawning habitat within localized regions near the SFWF. Cod spawn in the winter and may demonstrate strong spawning site fidelity, returning to the same fine-scale bathymetric locations year after year (Hernandez et al., 2013; Siceloff and Howell, 2013). An active Atlantic cod spawning ground is identified in a broad geographical area that includes Cox Ledge (Zemeckis et al., 2014). Kovach et al. (2010) collected cod with an otter trawl on Cox Ledge and the majority collected were in spawning condition. These collections included 158 individuals in January 2007 and 118 individuals in April 2007.

In other studies, Atlantic cod was not among the consistently prevalent (top 25) species collected during multi-year sampling by otter trawl and beam trawl in areas that included Cox Ledge (Malek et al., 2014). Cod were collected in the SFWF area during fall sampling by Northeast Fisheries Science Center (NEFSC) from 1989 to 2002 and in the spring from 2003 to 2016. Groundfish distributions (including Atlantic cod) were assessed as low to medium densities by the vessel monitoring system (VMS; NOAA NMFS) within the SFWF (Section 4.6.5 of the COP).

DWW is conducting a hook and line survey to assess the potential for Atlantic cod spawning activity at the SFWF and at nearby designated areas during winter and spring of 2018. The hook and line survey will assess site-specific spawning activity by determining the maturation stage of collected adult Atlantic cod. Reports from this study will be compiled and presented as part of an overarching SFWF and SFEC fisheries survey and monitoring plan.

Fourteen of the species that have demersal life stages listed in Table 4.3-10 have designated EFH in the SFWF. Additional information regarding EFH is described in Appendix O.

***Pelagic Finfish in the South Fork Wind Farm***

Pelagic species occupy the surface to midwater depths (0 to 3,281 feet [0 to 1,000 m] depth) from the shoreline to the continental shelf and beyond. There are 33 ecologically or commercially important finfish species that have pelagic life stages listed in Table 4.3-9 potentially present within the regional area that contains the proposed SFWF. Some pelagic species potentially present within the region include Atlantic sea herring, blueback herring, alewife, and Atlantic mackerel (Petruny-Parker et al., 2015). Pelagic finfish species are characterized as estuarine, marine, and anadromous species. Estuarine species tend to reside nearshore, whereas marine species are found offshore in deeper waters. Anadromous species prefer both nearshore and offshore areas, but migrate up rivers to lower salinity environments for spawning. There are five pelagic species of anadromous fish that are potentially present within the region: American shad, alewife, blueback herring, Atlantic menhaden, and the Atlantic sea herring (BOEM, 2013; Scotti et al., 2010).

Some pelagic fish species migrate seasonally to the SFWF area. These migrations are often correlated with seasonal variation in water temperature. Seasonal variations in temperature and finfish migrations directly affect abundance of food and species of fish present (Bohaboy et al., 2010). Pelagic species are present nearshore and offshore in the warm season, and decline during the cold season (Scotti et al., 2010).

Certain pelagic species in federal waters are managed under the Atlantic Highly Migratory Species Fishery Management Plan (FMP). NMFS consults with and considers the comments of the Highly Migratory Species Advisory Panel when preparing and implementing FMPs or FMP amendments for Atlantic tuna, swordfish, billfish, and sharks. Species in Table 4.3-9 potentially present within the regional area that contains the proposed SFWF that are classified as highly migratory include: blue shark, common thresher shark, shortfin mako shark, and yellowfin tuna (NOAA, 2004).

Many species of finfish that have pelagic life stages within the regional area that contains the SFWF are considered commercially or recreationally important in federal waters. Twenty-one of the finfish species with pelagic life stages listed in Table 4.3-9 have designated EFH within the SFWF. For more information regarding designated EFH within the SFWF (Appendix O).

***Common Habitat Types of Species within the South Fork Wind Farm***

New England waters have diverse habitats that are defined by their temperature, salinity, pH, physical structure, biotic structure, depth, and currents. The unique combination of habitat characteristics shapes the community of finfish species that inhabit the area. Habitat varieties determine species, distribution, and predator/prey dynamics. Each habitat structure supports a community of finfish species that rely on the habitat to survive. Multiple factors directly affect spatial and temporal patterns of fish species. A summary of common habitat types for the finfish species that could potentially occur in the SFWF or SFEC is provided in Table 4.3-11.

As described in Section 4.3.2, the SFWF has a highly variable and patchy distribution of benthic habitats including sand sheets, sand with mobile gravel, and patchy cobbles and boulders on sand (Appendix N). Although sand sheets were the most common habitat type encountered during the benthic surveys, the heterogeneity of sediment types on small scales was high, with variable presence of gravel (i.e., granules, pebbles, cobbles, boulders) on sandy substrates characterizing much of the SFWF (Appendix H). The presence of cobbles and boulders at the SFWF was patchy and G&G survey data show that the highest density of boulders was found in the western and central portion of the SFWF (Appendix H).

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| ***DEMERSAL/BENTHIC*** | |
| Atlantic Cod | Juveniles: Cobble substrates both nearshore and offshore; wide temperature ranges.<br>Adults: On or near the bottom along rocky slopes of ledges; depths between 131 and 426 feet (40 and 130 m) but also midwater. |

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| Atlantic Halibut | Juveniles: Coastal areas 65 to 196 feet (20 to 60 m) deep; sandy bottom.<br>Adults: Areas at depths of 328 to 2,296 feet (100 to 700 m) over sand, gravel, or clay bottoms. |
| Atlantic sea herring | Eggs: Spawned at depths of 131 to 262 feet (40 to 80 m) on George's Bank on gravel (preferred); sand, rocks, shell fragments, aquatic macrophytes, and lobster pot structures. |
| Atlantic Sturgeon | Juveniles: In the wintertime, juveniles congregate in a deep-water habitat in estuaries. Most are found over clay, sand, and silt substrates.<br>Adults: Primarily a marine species that is found close to shore; however, it does migrate long distances. |
| Black Sea Bass | Juveniles: Collected at depths of 65 to 787 feet (20 to 240 m) in channel environments.<br>Adults: At depths of 98 to 787 feet (30 to 240 m) in shipwrecks, rocky and artificial reefs, mussel beds, and other structures along the bottom. |
| Cunner | All Life Stages: Coastwise fish that prefers eel grass, rock pools, or pilings at depths 13 to 23 feet (4 to 7 m). |
| Haddock | Adults: Pebble gravel bottom at depths of 131 to 492 feet (40 to 150 m). |
| Little Skate | All Life Stages: Sandy/gravely bottoms at a depth range of less than 233 to 298 feet (71 to 91 m). |
| Monkfish | Juveniles/Adults: Bottom habitat, sand/shell mix, gravel or mud along the continental shelf, depths 82 to 656 feet (25 to 200 m). |
| Northern sea robin | Juveniles and Adults: Smooth, hard-packed bottom. |
| Ocean Pout | All Life Stages: Bottom habitats with rocky shelter from the intertidal continental shelf to 656 feet (200 m) deep. |
| Pollock | All Life Stages: Schooling fish living at various depths from near the surface to at least 600 feet (182 m) deep. |
| Red Hake | Juveniles: Use of shells and substrate as shelter; found less than 393 feet (120 m) to low tide line. |
| Sand Lance | All Life Stages: Throughout water column over sandy substrates |
| Scup | Juveniles: Nearshore in sandy, silty-sand, mud, mussel beds, and eel grass at depths of 16 to 55 feet (5 to 17 m).<br>Adults: Soft, sandy bottom, near structures (ledges, artificial reefs, mussel beds) at a depth range less than 98 feet (30 m). |
| Sea Raven | All Life Stages: Prefer rocky ground; hard clay, pebbles, or sand from 300 to 630 feet (91 to 192 m) deep. |
| Smooth Dogfish | All Life Stages: Mostly nearshore but some have a depth range of 870 to 990 feet (145 to 165 m); prefer bottom habitats. |

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| Spiny Dogfish | All Life Stages: Collected over sand, mud, and mud-sand transitions at depths ranging from 3 to 1,640 feet (1 to 500 m); do not travel to maximum depths in the fall. |
| Striped Bass | All Life Stages: Open waters along rocky shores and sandy beaches. |
| Summer Flounder | Adults: Prefer sandy habitats; captured from shoreline to 82 feet (25 m) deep. |
| Tautog | All Life Stages: Require complex, structured habitats with a hard bottom substrate; depths of 82 to 989 feet (25 to 30 m). |
| Tilefish | All Life Stages: 262- to 590-foot (80- to 180-m) depth along the outer part of the continental shelf to upper part of continental shelf. |
| Whiting | Juveniles: Bottom habitats; all substrate types; depths of 65 to 885 feet (20 to 270 m).<br>Adults: Bottom habitats; all substrate types; depths of 98 to 1,066 feet (30 to 325 m). |
| Windowpane Flounder | Juveniles and Adults: Fine, sandy sediment; nearshore less than 246 feet (75 m) deep. |
| Winter Flounder | Eggs: Nearshore; mud to sand or gravel. Emerging evidence that spawning occurs offshore.<br>Larvae: Nearshore; fine sand to gravel.<br>Juveniles: 59 to 88 feet (18 to 27 m) deep; mud or sand-shell.<br>Adults: Mostly nearshore up to 98 feet (30 m) deep; mud, sand, cobble, rocks, or boulders substrate. |
| Winter Skate | All Life Stages: Prefer sandy or gravelly substrates; spring depths from 3 to 984 feet (1 to 300 m); fall depths from 3 to 1,312 feet (1 to 400 m). |
| Wolffish | All Life Stages: Occupy complex habitats with large stones or rocks at a depth range of 131 to 787 feet (40 to 240 m). |
| Yellowtail Flounder | Juveniles: Sand or sand and mud; depth range of 16 to 410 feet (5 to 125 m).<br>Adults: Sand or sand and mud; depth range of 32 to 1,181 feet (10 to 360 m). |
| ***Pelagic*** | |
| Albacore Tuna | All Life Stages: Deepwater habitats; depth range of 0 to 1,968 feet (0 to 600 m). |
| Alewife | Adults: Shorelines; shallower waters near estuaries. |
| American Eel | Larvae: Drift with Gulf Stream toward Atlantic Coast.<br>Juveniles: Glass eels and elvers migrate to brackish waters; some remain in marine waters.<br>Adults: Freshwater, coastal, and marine waters. |

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| American Plaice | Eggs and Larvae: Open waters; depth maximum 328 feet (100 m).<br>Juveniles and Adults: High concentrations around 328-feet (100-m) deep; prefer sand and gravel substrates. |
| American Shad | Juveniles: Nearshore open waters<br>Adults: Open ocean. |
| Atlantic Bonito | All Life Stages: Open waters both nearshore and offshore. |
| Atlantic Butterfish | Eggs: Surface waters along the edge of the continental shelf to estuaries and bays.<br>Larvae and Juveniles: Surface waters from continental shelf to bays.<br>Adults: Surface waters from depths of 885 to 1,377 feet (270 to 420 m). |
| Atlantic Cod | Eggs: Bays, harbors, offshore banks; float near water surface.<br>Larvae: Open ocean and continental shelf area. |
| Atlantic Halibut | Eggs: Offshore drift suspended in the water column.<br>Larvae: Nearshore areas near the water surface. |
| Atlantic Mackerel | Eggs: Shoreward side of the continental shelf; 32 to 1,066.27 feet (10 to 325 m) deep.<br>Larvae: Offshore waters and open bays; 32 to 426 feet (10 to 130 m) deep.<br>Juveniles: Nearshore areas; 164 to 229 feet (50 to 70 m) deep.<br>Adults: Offshore, 32 to 1,115 feet (10 to 340 m) deep. |
| Atlantic Menhaden | All Life Stages: Nearshore and offshore. |
| Atlantic sea herring | All Life Stages: High energy environments; gravel seafloors. |
| Atlantic silverside | Juveniles and Adults: Found at great depths offshore from late fall through early spring. In the summer, they are found along the shore, within a few feet of the shoreline along sandy or gravel shores. |
| Basking Shark | All Life Stages: Coastal and offshore; sometimes enters inshore bays. |
| Bay anchovy | Eggs/Larvae: Eggs are found throughout the water column, but tend to be concentrated near the surface. Larvae move upstream to lower salinity waters in the spring and then move to more saline waters in the fall.<br>Juveniles and Adults: shallow and moderately deep offshore waters, nearshore waters off sand beaches, open bays, and muddy coves. |
| Black Sea Bass | Eggs: Coastal, upper water column.<br>Larvae: Nearshore, mouths of estuaries, upper water column. |
| Blueback Herring | Adults: High energy environments; gravel seafloors. |
| Bluefin Tuna | All Life Stages: Nearshore and offshore. |

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| Bluefish | Eggs: Across continental shelf; transported further offshore.<br>Larvae: Near edge of continental shelf; associated with surface.<br>Juveniles: Nearshore; associated with surface.<br>Adults: Nearshore to offshore. |
| Blue Shark | All Life Stages: Nearshore and offshore, surface dwelling, concentrated near fishing activity. |
| Common Thresher Shark | Juveniles: Shallower waters over the continental shelf (less than 656 feet [200 m] deep) in areas of upwelling or mixing.<br>Adults: Present near and offshore, but more common nearshore, in areas of upwelling or mixing. |
| Conger Eel | All Life Stages: Near the coast line to the edge of the continental shelf, 50 to 142 fathoms deep |
| Dusky Shark | All Life Stages: Near and offshore. |
| Haddock | Eggs: Near the surface of water column.<br>Larvae: Depths of 32 to 164 feet (10 to 50 m) with a maximum depth of 492 feet (150 m). |
| Monkfish | Eggs: Surface waters in areas that have depths of 49 to 3,280 feet (15 to 1000 m).<br>Larvae: Pelagic waters in areas that have depths of 49 to 3,280 feet (15 to 1000 m). |
| Northern sea robin | Eggs and Larvae: Pelagic waters of the continental shelf. |
| Red Hake | Eggs: Water column within the inner shelf.<br>Larvae: Coastal waters less than 656 feet (200 m) in depth. |
| Sandbar Shark | All Life Stages: Waters on continental shelves, oceanic banks, and island terraces, but also found in harbors, estuaries, at the mouths of bays and rivers, and shallow turbid water. Mostly at 65 to 213 feet (20 to 65 m) deep. |
| Sand Tiger Shark | All Life Stages: Nearshore ranging in depths from 6 to 626 feet (2 to 191 m); inhabit surf zone, shallow bays, and rocky reefs, and deeper areas around the OCS. |
| Shortfin Mako Shark | All Life Stages: Various areas of the water column; ranging depths, maximum depth 2,427 feet (740 m). |
| Skipjack Tuna | All Life Stages: Epipelagic, oceanic species. |
| Spot | All Life Stages: Coastal, nearshore, and offshore continental shelf areas. |
| Summer Flounder | Eggs and Larvae: Nearshore areas within eel grass beds and pilings. |
| Tiger Shark | All Life Stages: Coastal, nearshore, and offshore continental shelf areas. |

**Table 4.3-11. Common Habitat Types for Finfish Species known to occur in the Region**

| Species | Habitat Type by Lifestage |
|---|---|
| Weakfish | All Life Stages: Nearshore, shallow waters along open sandy shores and estuaries. |
| White Shark | All Life Stages: Nearshore and offshore, mostly spotted near the surface. |
| Whiting | Eggs: Surface waters over continental shelf at depths of 164 to 492 feet (50 to 150 m).<br>Larvae: Surface waters over the continental shelf at depths of 164 to 426 feet (50 to 130 m). |
| Windowpane Flounder | Eggs and Larvae: Occupy multiple areas in water column less than 229-foot (70-m) depths. |
| Winter Flounder | Larvae: Both nearshore and offshore. |
| Witch Flounder | Eggs: Deep; pelagic waters 164- to 278-foot (50- to 85-m) depths.<br>Larvae: 0- to 820-foot (0- to 250-m) depths. |
| Yellowfin Tuna | All Life Stages: epipelagic, oceanic fish found in the upper 328 feet (100 m) of the water column. |
| Yellowtail Flounder | Eggs: Pelagic - near-surface continental shelf waters.<br>Larvae: Pelagic - mid-water column; movement limited to currents. |

Sources:
Auster and Stuart, 1986
Collette and Klein-MacPhee, 2002
Malek et al., 2016

### *Common Prey Species in the South Fork Wind Farm*

Finfish species depend on a system of multiple trophic levels. Both demersal/benthic and pelagic fish species consume fish, shellfish, planktonic organisms, and detritus. Shellfish, worms, copepods, and other invertebrates are predominant types of prey for finfish in New England. The most common vertebrate finfish prey include alewife, Atlantic menhaden, northern sand lance, and whiting. Common prey of juvenile and adult finfish species that could potentially occur in the SFWF or SFEC are summarized in Table 4.3-12. Invertebrate and shellfish prey species and their relationships with habitat are described further in Section 4.3.2.

**Table 4.3-12. Common Prey Species of Juvenile and Adult Finfish Species**

| Species | Prey Species |
|---|---|
| ***Demersal/Benthic*** | |
| Atlantic Cod | Benthic invertebrates |
| Atlantic Halibut | Whiting, sand lance, ocean pout, and alewife |
| Atlantic Sturgeon | Benthic invertebrates |
| Black Sea Bass | Invertebrates and zooplankton |

**Table 4.3-12. Common Prey Species of Juvenile and Adult Finfish Species**

| Species | Prey Species |
|---|---|
| Cunner | Pipefish, mummichog, and invertebrates |
| Haddock | Amphipods |
| Little Skate | Sand lance, alewife, herring, cunner, silversides, tomcod, and whiting |
| Monkfish | Sand lance and monkfish |
| Northern sea robin | Shrimp, crabs, amphipods, squid, bivalve mollusks, and segmented worms |
| Ocean Pout | Sand dollars |
| Pollock | Herring and crustacea |
| Red Hake | Crustaceans |
| Sand Lance | Plankton |
| Scup | Fish eggs and invertebrates |
| Sea Raven | Herring, lance, sculpins, tautog, whiting, and both sculpin and sea-raven eggs |
| Smooth Dogfish | Crustaceans, particularly lobsters |
| Spiny Dogfish | Squid and fish |
| Striped Bass | Menhaden, anchovy, spot, amphipods, and sand lance |
| Summer Flounder | Windowpane, winter flounder, northern pipefish, Atlantic menhaden, bay anchovy, red hake, whiting, scup, Atlantic silverside, American sand lance, bluefish, weakfish, mummichog, rock crabs, squids, and shrimp |
| Tautog | Copepods and shellfish |
| Tilefish | Crabs, squid, shrimp, shelled mollusks, annelid worms, sea urchins, sea cucumbers, and sea anemones |
| Whiting | Crustaceans |
| Windowpane Flounder | Invertebrates |
| Winter Flounder | Clams |
| Winter Skate | Smaller skates, eels, alewife, blueback herring, menhaden, smelt, sand lance, chub mackerel, butterfish, cunner, sculpins, whiting, and tomcod. |
| Wolffish | Mollusks and shellfish |
| Yellowtail Flounder | Invertebrates |

**Table 4.3-12. Common Prey Species of Juvenile and Adult Finfish Species**

| Species | Prey Species |
|---|---|
| ***PELAGIC*** | |
| Albacore Tuna | Longfin and shortfin squid and crustaceans |
| Alewife | Herring, eels, sand lance, cunners, and alewife |
| American Eel | Small fish of many varieties, shrimp, crabs, lobsters, and smaller crustacea |
| American Plaice | Sand dollars |
| American Shad | Various fish |
| Atlantic Bonito | Mackerels, menhaden, and sand lance |
| Atlantic Butterfish | Small fish, squid, and crustaceans |
| Atlantic Mackerel | Copepods and crustaceans |
| Atlantic Menhaden | Diatoms and crustaceans |
| Atlantic sea herring | Copepods |
| Atlantic silverside | Zooplankton, copepods, shrimp, amphipods, young squid, worms, insects, and algae |
| Basking Shark | Small crustaceans |
| Bay anchovy | Mysid shrimp, copepods, small crustaceans and mollusks, and larval fish |
| Blueback Herring | Zooplankton |
| Bluefin Tuna | Herring and eels |
| Bluefish | Invertebrates and crustaceans |
| Blue Shark | Herring, mackerel, spiny dogfish, and various others |
| Common Thresher Shark | Pelagic fish and squid |
| Conger Eel | Butterfish, herring, eels, and invertebrates |
| Dusky Shark | Various pelagic fish |
| Sandbar Shark | Menhaden and crustaceans |
| Sand Tiger Shark | Small sharks, rays, squid, and lobster |
| Shortfin Mako Shark | Mackerels, tuna, and bonito |
| Skipjack Tuna | Pelagic fish and invertebrates |
| Spot | Bristle worms, mollusks, crustaceans, and plant and animal detritus |
| Tiger Shark | Fish and squids |

**Table 4.3-12. Common Prey Species of Juvenile and Adult Finfish Species**

| Species | Prey Species |
|---|---|
| Weakfish | Crabs, amphipods, mysid and decapod shrimps, squid, shelled mollusks, and annelid worms, menhaden, butterfish, herring, scup, anchovies, silversides, and mummichog |
| White Shark | Fish, rays, squid, other sharks, and marine mammals |
| Yellowfin Tuna | Large pelagic fish and squids |

Sources:

Auster and Stuart, 1986
Collette and Klein-MacPhee, 2002
Florida Fish and Wildlife Conservation Commission, 2017
Florida Museum of Natural History, 2017
Knickel, 2017
NOAA, 2010
USFWS, 2017
URI EDC, 2017

### *Threatened and Endangered Fish*

There are two sturgeon species that could potentially occur within the SFWF area, the Atlantic sturgeon and the shortnose sturgeon; however, as indicated below, the shortnose sturgeon is extremely unlikely to be present in the SFWF area.

**Atlantic Sturgeon**

The Atlantic sturgeon is listed as endangered under the ESA and is the more common sturgeon species in the SFWF area. Within the United States, five distinct population segments (DPSs) of Atlantic sturgeon are identified by NMFS. The population of concern associated with the SFWF is the New York Bight DPS. Atlantic sturgeon is a large anadromous species that utilize rivers, bays, estuaries, coastal, and continental shelf waters during their life cycle. They can grow up to 14 feet (4.3 m) long and 800 pounds (370 kilograms) (Vladykov and Greely, 1963). Sturgeon are believed to be low-frequency hearing specialists (Popper et al., 2014). ANSI-accredited hearing thresholds, derived from Popper et al., (2014), categorize sturgeon as a fish species that has a swim bladder, but the swim bladder is not thought to play a role in hearing. For this category of fish, peak sound pressure levels ($L_{P,\mathrm{PK}}$) greater than 207 dB re 1µPa$^2$ have the potential to cause injury. Declines in stock began with intensive fisheries for caviar in the late 1800s, and further declines are attributed to damming of spawning rivers and degradation of water quality (see review in Hilton et al., 2016).

Estimated the abundance of age 0-1 Atlantic sturgeon in the Delaware River in 2014 was 3,656 individuals (Hale et al., 2016), which is similar in magnitude to age-1 estimates in the Hudson River for 1995 (Petersen et al., 2000). The Atlantic Sturgeon stock assessment (ASMFC, 2017) indicate that the all DPS stocks are depleted but recovering. It is estimated that biomass and abundance are currently higher than in 1998 (last year of available survey data) for the New York Bight DPS (75% average probability).

Adult Atlantic sturgeon in the New York Bight DPS travel upstream in spawning rivers along southern New England (e.g., Connecticut River), New York (e.g., Hudson River), and in the Delaware River in the spring and early summer (ASMFC, 1990, 2017). Historically, Atlantic sturgeon also spawned in the Taunton River (Massachusetts), however, their current status in this river is unknown (ASMFC, 2017). During this period, most spawning age adults will be found in natal rivers.

Adult Atlantic sturgeon travel upstream in spawning rivers along southern New England (e.g., Connecticut River) and New York (e.g., Hudson River) in the spring and early summer (ASMFC, 1990). During this period, most spawning age adults will be found in natal rivers. Adult Atlantic sturgeon live in coastal and offshore waters during the remainder of the year. Juvenile and sub-adult Atlantic sturgeon undergo yearly coastal foraging migrations after leaving their natal estuaries (Hilton et al., 2016). Within the SFWF area, many juvenile and adult Atlantic sturgeon have been captured in otter trawls and sink gill nets (Stein et al., 2004). Through an aggregation of commercial bycatch data, Stein et al. (2004) found the greatest occurrence of offshore Atlantic sturgeon in Massachusetts and Rhode Island waters to occur from November through May. Data from this study indicate that adult Atlantic sturgeon are found within the SFWF area. See Appendix P for additional species information.

**Shortnose Sturgeon**

Like the Atlantic sturgeon, the shortnose sturgeon is listed as endangered under the ESA and much of the distribution information is the same for the two species which co-occur in habitats along the Atlantic coast. In a 2010 Biological Assessment (Shortnose Sturgeon Status Review Team, 2010), shortnose sturgeon were described as spending less time in open ocean habitats and spawning farther upriver than Atlantic sturgeon. The Northeast shortnose sturgeon population uses freshwater habitat more than any of the other shortnose sturgeon populations (Kynard et al., 2016). They are considered more of an amphidromous species (defined as a species that spawns and remains in freshwater for most of its lifecycle but spends some time in saline water) rather than fully anadromous. Marine migrations do occur and individuals have been recorded traveling 87 miles (140 km) in 6 days when moving between rivers (Kynard et al., 2016). Because the shortnose sturgeon prefer freshwater and estuarine habitats, the potential for shortnose sturgeon to be present in the SFWF area is considered extremely unlikely. See Appendix P for additional species information.

**Giant Manta Ray**

The giant manta ray (*Manta birostris*) is listed as threatened under the ESA. The giant manta ray occurs in tropical, sub-tropical, and temperate waters (IUCN, 2018, NOAA, 2018). Their distribution in the Atlantic ranges from the Carolinas to Brazil and they are very rarely found in colder waters of the northwest Atlantic. Giant manta rays may reach disc widths of over 7 m (reviewed by IUCN [2018]).

Commercial fishing is the primary threat to the giant manta ray (NOAA, 2018). The species is targeted and caught as bycatch in several global fisheries throughout its range. Additionally, they are slow-growing, highly migratory animals with sparsely distributed and fragmented populations throughout the world. Regional population sizes are small (between 100 to 1,500 individuals) (IUCN, 2018; NOAA, 2018).

Giant manta rays undergo seasonal migrations, timing their visits to productive coastlines with regular upwelling, oceanic island groups, and offshore pinnacles and seamounts. They are generally found at depths below 10 m, although tagging studies indicate dives of up to 200 to 450 m (NOAA, 2018). They are often observed in estuarine waters, near oceanic inlets, potentially using these habitats as nursery grounds. The giant manta ray is commonly encountered on shallow reefs and is also occasionally observed in sandy bottom areas and seagrass beds (IUCN, 2018). Mantas have been reported as far north as Canada in the northeast Atlantic; however, its propensity for warmer waters makes its presence is unlikely in the SFWF.

***Essential Fish Habitat***

EFH is an important part of the MSFCMA regulations and is defined as: "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. 1802(10)). Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities. Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Spawning, breeding, feeding, or growth to maturity covers a species' full life cycle. EFH is described by the regional fishery management councils in amendments to FMPs and is approved by the Secretary of Commerce acting through NOAA Fisheries" (50 CFR 600.10).

EFH has been designated for a total of 27 finfish species that occur within the SFWF. These species and their EFH are further described in the EFH Assessment (Appendix O).

**South Fork Export Cable**

**SFEC – OCS and SFEC – NYS**

This section describes finfish resources (demersal and pelagic) within and surrounding the areas of the SFEC - OCS and SFEC - NYS. The affected environment in the SFEC for finfish is generally the same as described for the SFWF. Some differences in resources occur at lower water depths nearshore as described in more detail in the following sections. Benthic resources, including shellfish and habitat types, are described in Section 4.3.2. A thorough EFH Assessment for designated species in the SFWF and SFEC is provided as Appendix O.

Species of economic or ecological importance potentially present within the region of the SFEC are summarized in Table 4.3-9. As described for the SFWF, this table does not include every species that has the potential to occur in the SFEC, but focuses on those that are abundant, commercially or recreationally important, important prey species, or have designated EFH within the area of the SFEC.

Demersal and pelagic species that are ecologically and economically important are described in more detail in relation to proposed SFEC activities in the following sections.

***Demersal Finfish along the South Fork Export Cable Route***

Table 4.3-10 summarizes ecologically or commercially important finfish with demersal life stages potentially present within the regional area that contains the proposed SFEC. The species with demersal life stages that may reside within the areas of the SFEC may also reside in the SFWF area (see previous SFWF section).

Some demersal fish are seasonal visitors to the SFEC area, which spans both federal and state waters. Most demersal species are abundant in the cold season nearshore and offshore extending along the continental shelf, which is associated with the eastern portions of the SFEC, and decline in the region during the warmer months (Scotti et al., 2010). Two demersal species of anadromous fish are potentially present within the SFEC area: striped bass and Atlantic sturgeon (BOEM, 2013; Scotti et al., 2010).

Many finfish that have demersal life stages in Table 4.3-10 are considered commercially or recreationally important in New England and New York State waters. Fisheries in federal waters are managed under the MSFCMA. Portions of the SFEC route are within the boundaries of New York State waters. Fisheries in New York State waters are primarily managed by NYSDEC.

Black sea bass, bluefish, scup, and summer flounder are each individually managed under respective New York State Quota Distribution Programs. There is additional management for Atlantic cod, haddock, yellowtail flounder, American plaice, witch flounder, redfish, white hake, and pollock under the Groundfish Disaster Program (NYSDEC and NYSDOS, 2017). The Groundfish Disaster Program was put into effect because NYSDEC determined in 2013 that these fish stocks were headed towards collapse and needed to have drastic reductions to their fishing quotas. The Groundfish Disaster Program proposed protection to their habitats to continue to sustainably fish those species. Summer flounder and scup were the top two finfish species landed by pounds by commercial fishermen in New York State waters from the years 2008 to 2010 of all demersal species listed in Table 4.3-10 (Scotti et al., 2010). Species summarized in Table 4.3-10 as potentially occurring in the SFEC may be present within the areas of the SFEC and have a regional presence in New York State waters. More information about commercial and recreational fishing and their socioeconomics is described in Section 4.6.5.

Of the species that have demersal life stages listed in Table 4.3-10, 14 species have designated EFH in the SFEC. Additional information regarding EFH is described in Appendix O.

***Pelagic Finfish along the South Fork Export Cable Route***

Table 4.3-10 summarizes ecologically or commercially important finfish species with pelagic life stages that are potentially present within the regional area containing the proposed SFEC. Pelagic species are potentially abundant nearshore and offshore along the proposed SFEC route in the warm season, and decline during the cold season (Scotti et al., 2010).

There are five pelagic species of anadromous fish that are potentially present within the SFEC: American shad, alewife, blueback herring, Atlantic menhaden, and the Atlantic sea herring (BOEM, 2013; Scotti et al., 2010). Of the species with pelagic life stages potentially present in the SFEC, many are considered commercially or recreationally important within federal and New York State waters. The top two commercially fished finfish in 2010 in New York State waters by abundance were: Atlantic menhaden and American shad (Scotti et al., 2010). More detailed information regarding recreational and commercial important finfish species is described in Section 4.6.5. The following pelagic species listed in Table 4.3-9 are managed under the Atlantic Highly Migratory Species FMP: blue shark, common thresher shark, shortfin mako shark, and yellowfin tuna (NOAA, 2004). Additionally, 28 species in Table 4.3-9 with pelagic life stages have designated EFH within the region of the SFEC area. For more information regarding designated EFH within the SFEC (Appendix O).

***Common Habitat Types of South Fork Export Cable Species***

Much of the habitat characteristics along the SFEC route are as described in the SFWF section. As described in Section 4.3.2, all three benthic habitats (sand sheets, sand with mobile gravel, and patchy cobbles and boulders on sand) were observed along the SFEC route; however, their distribution varied with distance from the SFWF and as the SFEC route nears land in New York State waters, where waters are shallower than 25 feet (7 m). The SFEC route was dominated by sand sheet habitats with a few exceptions where this habitat type was interspersed with other habitat types.

The SFEC - OCS in areas immediately adjacent to the SFWF were more heterogenous than the remainder of the SFEC, with patchy cobble and boulder on sand habitats observed within 18.6 to 24.9 miles (30 to 40 km) of the SFWF. Sand with mobile gravel habitats were observed along the SFEC - OCS route between the SFWF and for about half the distance along the SFEC - OCS to due south of Block Island. These habitats were also present in the section of the SFEC - NYS south of Montauk Point and near the Hither Hills landing point within New York State waters. Within New York State waters, sand sheets were the predominant benthic habitat type, with mobile gravel present at one station, and sediment grain size was largely homogeneous. Sediment grain size was moderately variable on small scales along the SFEC - OCS, but most of the variability was between grain size classes within the overall sand category. Deposits of very fine silt, on the order of 6 inches (15 cm) thick, were observed overlying sand at two locations offshore of the Beach Lane SFEC - NYS landing location; one of these locations fell within New York State waters (see Section 4.3.2 for more detail).

A summary of common habitat types for finfish species that may occur in the SFWF and SFEC is provided in Table 4.3-10.

***Common Prey Species along the South Fork Export Cable Route***

Common prey of juvenile and adult species that potentially occur within the SFEC route options are described in Table 4.3-11.

***Threatened and Endangered Fish***

There are two sturgeon species that could potentially occur within the SFEC area, the Atlantic sturgeon and the shortnose sturgeon; however, as indicated below, the shortnose sturgeon is extremely unlikely to be present in the SFEC area. The giant manta ray is not expected at the SFEC.

**Atlantic Sturgeon**
General information regarding the life history and conservation status of Atlantic sturgeon can be found in the SFWF section. While information is sparse regarding the offshore habitat use of Atlantic sturgeon, there has been more extensive research conducted in recent years on coastal and estuarine movements of the species. A trawl study conducted by Dunton et al. (2015) along the south coast of Long Island, New York found that Atlantic sturgeon use the coastal areas along the entire region, with most individuals caught at depths less than 49 feet (15 m) and in areas of previously known aggregations. Data analyzed within this study also indicated that adult and juvenile Atlantic sturgeon are found further offshore as seen in commercial otter trawl and sink gill net bycatch databases. Spring was identified as the time of year with the greatest bycatch rates along the eastern end of Long Island. Data from the Dunton et al. (2015) trawl survey and the Northeast Fisheries Observer Program bycatch database indicate that Atlantic sturgeon are present along the SFEC. See Appendix P for additional species information.

**Shortnose Sturgeon**
General information regarding the life history and conservation status of shortnose sturgeon can be found in the SFWF section. Because the shortnose sturgeon prefers freshwater and estuarine habitats, the potential for shortnose sturgeon to be present in the SFEC area is considered extremely unlikely. See Appendix P for additional species information.

***Essential Fish Habitat***

Waters within the SFEC route have been designated as EFH for a total of 34 finfish species that are further described in the EFH Assessment (Appendix O).

#### 4.3.3.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the project have the potential to impact finfish species and EFH through both direct and indirect impacts, as discussed in the following sections. Neither the SFWF nor the SFEC is expected to have major long-term impacts to finfish or EFH resources during any of the project phases. An overview of the potential impacts to finfish and EFH associated with the Project is presented in Figure 4.3-8.

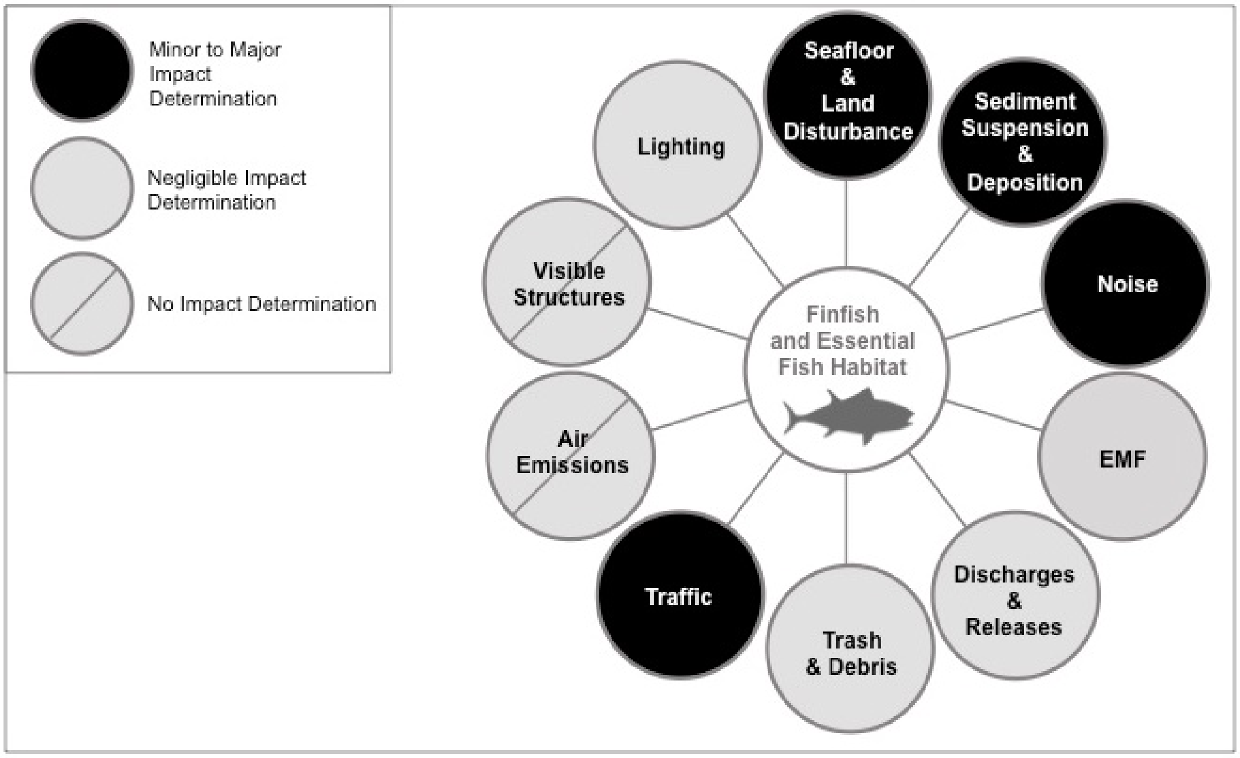


**Figure 4.3-8. IPFs on Finfish and Essential Fish Habitat**

IPFs associated with the construction, O&M, and decommissioning phases for the Project are described in Section 4.1. The phase of the project during which these IPFs will occur is also described in Section 4.1.

## South Fork Wind Farm

### *Construction*

Table 4.3-13 summarizes the level of impacts expected to occur to finfish and EFH during the construction and decommissioning phases of the SFWF. Decommissioning of the SFWF is included in Table 4.3-13 because the structures are expected to be removed and their removal will be accomplished by similar methods or result in similar impact areas as their installation. Additional details on potential impacts to finfish and EFH from the various IPFs during construction of the SFWF are described in the following sections.

**Table 4.3-13. IPFs and Potential Levels of Impact on Finfish and EFH for the SFWF during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/Demersal Early Life Stages[b] | Pelagic Early Life Stages[b] | Benthic/Demersal Later Life Stages[b] | Pelagic Later Life Stages[b] |
| Seafloor/Land Disturbance | Seafloor Preparation | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| | Pile Driving/Foundation Installation | Minor short-term direct | Negligible short-term direct | Minor short-term direct | Negligible short-term direct |
| | OSS platform installation | Minor short-term direct | Negligible short-term direct | Minor short-term direct | Negligible short-term direct |
| | SFWF inter-array cable installation | Minor short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Negligible short-term indirect |
| | Vessel anchoring (including spuds) | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Sediment Suspension and Deposition | | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Negligible short-term direct<br>Negligible long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Noise | Pile Driving | Moderate short-term direct | Moderate short-term direct | Moderate short-term direct | Moderate short-term direct |
| | Ship Noise, Trenching Noise, Aircraft Noise | Minor short-term direct | Minor short-term direct | Minor short-term direct | Minor short-term direct |
| Traffic | | See Seafloor disturbance, noise (ship, trenching, aircraft), sediment suspension and deposition, and lighting IPFs. | | | |

**Table 4.3-13. IPFs and Potential Levels of Impact on Finfish and EFH for the SFWF during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/Demersal Early Life Stages[b] | Pelagic Early Life Stages[b] | Benthic/Demersal Later Life Stages[b] | Pelagic Later Life Stages[b] |
| Lighting | | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct |
| Discharges and Releases [c] | | Negligible | | | |
| Trash and Debris [c] | | Negligible | | | |

[a] Maximum level of impact is the highest impact levels for direct or indirect effects. Long-term impacts were considered to have a higher potential for impacts than short-term impacts if within the same impact category.

[b] Early life stages include eggs and larvae. Later life stages include juveniles and adults.

[c] Supporting information on the negligible level of impact for the Discharges and Trash/Debris IPFs is provided in Section 4.1.

**Seafloor Disturbance**

IPFs associated with seafloor disturbance during construction of the SFWF has been split into seafloor preparation, pile driving/foundation installation, OSS platform installation, SFWF inter-array cable installation, and vessel anchoring (including spuds). In general, seafloor disturbance is expected to produce negligible to minor levels of direct and indirect impacts to species depending on the life stages present for each species. Other IPFs that are interrelated with seafloor disturbance such as pile driving noise and sediment suspension and deposition are discussed in subsequent sections. See Section 3.1.2.1 for the expected impact areas associated with each foundation type that may be used to support the WTGs and OSS and the impact area associated with the inter-array cable.

Of the species identified in Table 4.3-10 as possibly present at the SFWF, many have a completely pelagic life cycle, and many others have pelagic early life stages that are not dependent on benthic habitat. As such, modification or disturbance of the substrate is expected to have a ***negligible impact*** on the habitat or EFH of pelagic species, if present. There may be some impacts to finfish habitat and EFH of demersal/benthic species, including the federally endangered Atlantic sturgeon, resulting from the Project, but these are expected to be ***negligible to minor, localized, and short-term*** in nature.

Following completion of construction and during O&M of the SFWF, the substrates at the SFWF will fundamentally remain the same as pre-project conditions, and allow for the continued use by finfish species, including those with designated EFH. The exception is the conversion of soft substrate to hard substrate associated with the WTGs, scour protection, and protective armoring. As discussed in Section 4.3.2, benthic infauna and epifauna are expected to recolonize the area after sediment disturbance, allowing this area to continue to serve as foraging habitat for finfish species. The acreage range of benthic habitat that is expected to be affected by construction (Section 4.1) is small relative to the total area of available surrounding habitat and EFH, and impacts to finfish habitat and EFH during O&M are expected to be ***minor and short-term to long-term***.

**Seafloor Preparation**

Seafloor preparation activities at the SFWF during construction include removal of obstructions and debris within a 100-foot radius of the WTG installation location and along the route of the inter-array cable. A PLGR will be used to clear debris from the area prior to laying the inter-array cable.

Benthic/demersal early life stages of species that have suitable habitat at the SFWF are expected to experience ***minor, short, direct impacts*** from seafloor preparation and will most likely be subject to injury or mortality. While some mortality could occur to benthic/demersal early life stages, this impact is considered minor given the small area of impact. Benthic/demersal later life stages, including Atlantic sturgeon, are expected to experience ***minor to negligible, short-term, direct impacts*** because older life stages are more mobile and more likely to leave the area during seafloor preparation. However, individuals of these species may also experience limited injury or mortality. These impacts are only expected for finfish species that have benthic/demersal life stages associated with sand sheets, sand with mobile gravel, or patchy cobble and boulder on sand habitats. Those that are associated with fine-grained sediments (silt and clay) are expected to have negligible impacts as these are not expected to occur or only occur occasionally in the area. Areas with patchy cobble and boulder on sand habitat are expected to be largely avoided during activities. See Table 4.3-11 for a summary of common habitat types for finfish species that may occur in the SFWF.

Pelagic early and later life stages are generally more mobile and reside higher in the water column, so direct impacts associated with seafloor preparation are expected to be ***negligible and short-term***. These species are expected to either temporarily vacate the area or may drift through the area with limited potential to be present in the direct impact area.

Finfish are expected to move back into the area following the disturbance, but, habitat recovery from the grapnel runs and seafloor leveling may take up to 1 to 3 years to occur, during which habitat quality for benthic/demersal species may be decreased, resulting in a ***minor, long-term, indirect impact*** for species that use those habitats (BERR, 2008; BOEM, 2012; Guarinello et al., 2017). Indirect impacts associated with feeding may also occur; however, this will be dependent upon species. Feeding by some species may be disrupted if they temporarily avoid the area; this will primarily affect benthic species but may also have some impact on pelagic species. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation. See Table 4.3-12 for common prey species for the identified ecologically and economically important finfish species. This is expected to be a short-term minor indirect impact. Potential presence of the various species and different life stages throughout the year are identified in Table 4.3-10.

**Pile Driving/Foundation Installation**

Similar to seafloor preparation, installation of the foundations, piles, and/or associated scour protection (if necessary) are expected to result in ***minor, short-term, direct impacts*** to benthic/demersal early life stages of finfish and ***minor to negligible, short-term, direct impacts*** to benthic/demersal later life stages, including Atlantic sturgeon, that have preferred habitat at the SFWF (Tables 4.3-10 and 4.3-11). Pile driving and foundation installation could crush benthic/demersal species, particularly eggs and larvae, but also less mobile older life stages that do not vacate the area. ***Negligible, short-term, direct impacts*** are expected for pelagic early and later life stages because they are not expected to be at the bottom during work activities or subject to crushing or injury through placement of the materials.

**Offshore Substation Platform Installation**

Impacts associated with the installation of the OSS platform are expected to be similar to those described for Seafloor Preparation and Pile Driving/Foundation Installation.

**SFWF Inter-Array Cable Installation**

Direct impacts to the seabed associated with installation of the SFWF inter-array cable will take place within the area that had already been disturbed during the PLGRs which were discussed in the Seafloor Preparation section. Installation of the inter-array cable is expected to result in ***minor to negligible, short-term, direct impacts*** to benthic/demersal early and later life stages.

It is also expected to produce ***negligible to minor, short-term, direct impacts*** to early life stages and later life stages of smaller species because they may become impinged or entrained on the water pumps that will operate the mechanical/hydro-jet plow. Although the circulated seawater is released back into the ocean, it is assumed that all entrained eggs, larvae, and zooplankton will be killed. To assess the potential loss of fish and zooplankton related to this activity, an ichthyoplankton and zooplankton assessment was conducted using data from NOAA's Marine Resource Monitoring, Assessment and Prediction Program and their subsequent Ecosystem Monitoring (EcoMon) plankton sampling programs (Appendix O, Attachment 1). The results indicate that total estimated losses of zooplankton and ichthyoplankton related to entrainment from installation of the inter-array cable were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study region (Appendix O, Attachment 1). Therefore, impacts to early life stages of EFH species from entrainment caused by installation of the inter-array cable are expected to be ***negligible to minor and short-term***.

Because of the slow speed of the equipment and limited size of the impact area, it is expected that most mobile benthic/demersal and pelagic finfish will leave the area; however, eggs, larvae, and other slower moving species may be subject to injury or mortality. The inter-array cable may also require armoring, and the installation of this armoring is expected to result in ***minor, short-term, direct impacts***.

Similar to seafloor preparation, ***minor, long-term and short-term, indirect impacts*** for benthic/demersal species may include a longer period for prey species to recolonize the impact area resulting in reduced foraging habitat for finfish. ***Minor, short-term, direct impacts*** including a temporary feeding disruption during cable installation may occur; however, some species may also be attracted to the disturbance and increase feeding as inter-array cable installation may dislodge benthic prey species.

**Vessel Anchoring (Including Spuds)**

Impacts associated with vessel anchoring and the use of spuds during construction at the SFWF are expected to be similar to those discussed in the Seafloor Preparation and Pile Driving/ Foundation Installation section. Direct impacts are expected to be ***minor and short-term*** and associated with mortality and or injury of benthic/demersal early life stage species and benthic/demersal later life stage species with limited mobility. Faster moving benthic/demersal species, including Atlantic Sturgeon, and pelagic species are expected to temporarily vacate the impact area associated with the spuds, anchor, or area swept by the anchor chain. The extent of the impacts will vary depending on the vessel type, number of vessels, and duration onsite, and as these numbers increase, the associated impact areas will also increase. ***Long-term, indirect impacts*** will be associated with habitat disturbance and associated recovery time from the areas impacted by the vessel anchors, spuds, and areas swept by anchor chains.

**Sediment Suspension and Deposition**

Increases in sediment suspension and deposition during construction can result from seafloor disturbance associated with foundation placement and inter-array cable installation as well as vessel traffic. Direct impacts associated with increased sediment suspension and deposition are expected to be ***negligible or minor and short-term in nature***. Indirect impacts associated with increased suspended sediment and deposition include changes in habitat and species composition after sediments have settled out. These impacts are expected to result in ***negligible to minor long-term, indirect impacts*** for benthic early and later life stages and ***negligible, short-term indirect impacts*** for pelagic early and later life stages as described in more detail below. Vessel mooring or anchoring activity resulting in sediment suspension is expected to be limited to areas of seafloor immediately adjacent to the spuds or anchors. For mechanical/hydro-jet plow installation activities, a sediment transport study was completed that estimated the suspended sediment concentrations, sediment transport, and resulting sediment deposition that may result from mechanical/hydro-jet plow installation of the inter-array cable (Appendix I).

**Temporary Increase in Total Suspended Solids**

In order to estimate the extent of potential impacts from sediment suspension generated by mechanical/hydro-jet plow installation, a modeling simulation was conducted on a representative section of the inter-array cable which indicated that the maximum modeled TSS concentration from SFWF inter-array cable installation is 100 mg/L. Water column concentrations of 100 mg/L are predicted to extend up to 131 feet (40 m) from the mechanical/hydro-jet plow and TSS concentrations are predicted to return to ambient levels (less than 10 mg/L) within 18 minutes (0.3 hour) from the conclusion of mechanical/hydro-jet plow trenching. Modeling also indicates that elevated TSS concentrations are expected to remain very close to the seabed and that plumes are not predicted to extend vertically beyond 3 to 9 feet (1 to 3 m) of the mechanical/hydro-jet plow at any time during the simulation (Appendix I).

Increases in sediment suspension could result in impacts to finfish including abrasion of gill membranes and respiration impairment, impairment of feeding, inhibition of migratory movements, and mortality of early life stages. Juvenile and adult life stages will likely temporarily avoid the area of increased TSS, resulting in behavioral changes such as changes in foraging behavior. However, given the limited extent and duration of the elevated TSS based on the predictive modeling described above, these impacts are expected to be ***negligible to minor*** to benthic/demersal species because they will be ***short-term*** and highly localized. Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (DOI-MMS, 2009). Direct impacts to pelagic species are expected to be ***negligible*** as older life stages will likely leave the area and not be affected by increased suspended sediment and early life stages are expected to have tolerance for short-term increases in suspended sediment.

Sediments are expected to come out of suspension quickly after the impact occurs, returning pelagic habitat to pre-impact conditions in a short-time frame, resulting in a ***negligible, short-term, indirect impact*** for pelagic early and later life stages. Indirect impacts to benthic/demersal species from a potential change in habitat composition are described in the Sediment Deposition section below.

**Sediment Deposition**

A modeling simulation was also conducted on a representative section of the inter-array cable to predict sediment deposition extent and depth resulting from installation of the inter-array cable. The model predicted that sediment deposition resulting from the installation of the inter-array cable will be limited to the area immediately adjacent to the burial route, typically, extending no more than 196 feet (60 m) from the cable-laying track. The maximum predicted deposition thickness is estimated to be 0.4 inch (10 mm) and limited to within 26 feet (8 m) from the burial route, covering an estimated cumulative area of 0.1 acre (0.04 ha) (Appendix I). Direct sediment deposition impacts to finfish are considered to be ***short-term, localized,*** and ***minor*** because of the limited extent of sedimentation predicted by the model.

In the localized area of impact, these direct impacts could involve mortality through sediment deposition and smothering of early benthic/demersal life stages of finfish and limited injury or mortality of later benthic/demersal life stages. Sediment deposition on eggs or larvae may result in smothering, potentially resulting in mortality (DOI-MMS, 2007). However, most older stages of finfish, including Atlantic sturgeon, are expected to temporarily vacate the area to avoid the increased sedimentation.

Indirect impacts associated with increased sediment deposition include potential changes in habitat composition and species composition after sediments have settled out. This change is similar to what is described in the Seafloor Disturbance section above because habitat quality may be temporarily degraded and recolonization may take 1 to 3 years, depending upon the extent of the effects (BOEM, 2012). Given the localized extent of sediment deposition predicted by the model, the resulting impacts on benthic communities and habitat quality are expected to be ***negligible to minor*** and ***long-term*** for benthic early and later life stages. Sediment deposition is expected to result in ***no impact*** to pelagic early of later life stages.

**Noise**

Underwater acoustic modeling was conducted to evaluate various project-related construction sounds including pile driving, vibratory pile driving, and use of DPV thrusters for cable installation (Appendix J). Based on the acoustic modeling, an impact assessment specific to marine protected species was performed (Appendix P) including an evaluation of potential impacts on ESA-list Atlantic sturgeon. However, the results of these analyses are broadly applicable to fish and are discussed within the context of noise impacts in this section.

Direct impacts associated with noise during construction at the SFWF may occur during pile driving and DPV usage for installation of the inter-array cable, or associated with vessels and aircraft. Pile driving is expected to cause ***minor to moderate, short-term, direct impacts***, while the other sources of noise are expected to have ***negligible impacts***. Expected impacts from these activities are discussed separately in the following sections.

Hearing among fish vary among species and auditory physiology. Fishes hear sounds using pressure and particle motion and detect the motion of surrounding water (Popper et al., 2008). Fish with swim bladders are generally sensitive to pressure waves, while those that lack swim bladders are more sensitive to particle motion. Generally pelagic species have swim bladders, while benthic/demersal species like halibut, flounders, and soles do not have swim bladders. In addition, different fish species vary greatly in their hearing structures and auditory capabilities, and this may change during different life stages. There is a lack of knowledge about hearing capabilities of most fish species. This applies to sturgeon, which are known to have primitive swim bladders that are not connected to their inner ears. Anatomical and physiological variation makes it difficult to generalize about the impacts of noise on individual species (Thomsen et al., 2006).

The short duration of potential impacts of noise during the construction, operation, and decommissioning of wind farms can be split into the following general categories (Thomsen et al., 2006):

1. Temporary or permanent hearing damage or other physical injury or mortality;

2. Behavioral responses; for example, the triggering of alarm reactions, causing fish to flee from interrupting activities necessary for survival and reproduction, and potentially inducing stress in the fish; or
3. Masking acoustic signals, which may serve as communication among individuals, or may provide information about predators or prey.

There is only limited data on mortality in response to anthropogenic noises and it is not clear whether death or injury only occurs in close proximity to a sound source (Hawkins et al., 2014). Overall, it is more likely that fish will experience sublethal impacts that increase the possibility for delayed mortality (Hawkins et al., 2014). Because most construction sound sources produce LF sounds that are within the sensitive hearing range of most fish, the potential for fish to experience temporary threshold shifts (TTS), masking, and behavioral impacts are a higher likelihood.

Behavioral responses (e.g., fleeing or avoidance) to active acoustic sound sources are the most likely direct effects for most fish resources exposed to noise during SFWF construction. Fewtrell and McCauley (2012) found that fish exhibited alarm responses to air gun noise at levels exceeding 147 to 151 dB re 1 micropascal (µP) sound exposure limit (SEL). The potential for masking or behavioral response may exist at a large and variable distance from a sound source, depending on the ambient background noise level and the frequency and amplitude characteristics of the propagated sound.

There are two accepted sources for defining acoustics thresholds in fish: Popper et al. (2014) and the NOAA Greater Atlantic Regional Fisheries Office (GARFO; 2016) pile driving acoustic tool. The Popper et al. (2014) injury peak level ($L_{pk}$) value (207 dB re 1 µPa) is nearly identical to the $L_{pk}$ injury value (206 dB re 1 µPa) used in the GARFO (2016) acoustic tool, as described in Table 4.3-14. However, the exposure thresholds (LE) for fish injury differ by 27 dB between the two references, demonstrating the continued uncertainty in the understanding of acoustic criteria in fish.

**Table 4.3-14. Acoustic Criteria and Thresholds for Injury (Level A) and Behavior (Level B) for Fish (derived from Popper et al., 2014)**

| Group | Impulsive Signals | | | | | Non-Impulsive Signals | |
|---|---|---|---|---|---|---|---|
| | *Mortality or Mortal Injury* | | *Recoverable Injury* | | *TTS* | *Recoverable Injury* | *TTS* |
| | $L_E$ (dB) | $L_{pk}$ (dB) | $L_E$ (dB) | $L_{pk}$ (dB) | $L_E$ (dB) | $L_{pk, 48h}$ (dB) | $L_{pk, 12h}$ (dB) |
| Fish without swim bladder | >219 | > 213 | >216 | > 213 | >186 | -- | -- |
| Fish with swim bladder not involved in hearing | 210 | > 207 | 203 | > 207 | >186 | -- | -- |
| Fish with swim bladder involved in hearing | 207 | > 207 | 203 | > 207 | 186 | 170 | 158 |

$L_E$ = sound exposure level (dB re 1 µPa$^2$·s); $L_{pk}$ = peak sound pressure (dB re 1 µPa); $L_{p,12h}$ = root mean square sound pressure (dB re 1 µPa) for 12 hours continuous exposure; $L_{p,48h}$ rms sound pressure (dB re 1 µPa) for 48 hours continuous exposure TTS = temporary threshold shift.,

-- = not applicable

**Pile Driving Noise**

Noise generated by pile driving (both vibratory and impact) has the potential for direct impacts on finfish species, particularly those with swim bladders. While noise generated by both types has the potential to elicit behavioral responses, pile driving has the greatest potential to cause harassment or injury through the generation of intense underwater sound pressure waves and particle motion. For instance, in-water pile driving for bridge construction has resulted in high underwater sound pressures that have proved lethal to fishes, and sturgeon in particular (Thalheimer et al., 2014, Popper et al., 2016). Noise generated from pile-driving (vibratory and impact hammering) and vessel operations could affect finfish. Laboratory pile driving studies showed swim bladder damage in Chinook salmon and documented barotrauma injuries in other species (Halvorsen et al., 2012).

Direct impacts associated with these intense sound pressure waves and particle motion may include changes in fish behavior and injury or mortality caused by rupturing swim bladders or by internal hemorrhaging. Noise from pile driving can also cause fish to be temporarily stunned, which might make them more susceptible to predation. These noise-generating activities also have the potential to interrupt migration patterns of finfish through the area because they may avoid elevated noise levels. Impacts associated with pile driving noise are expected to be ***short-term and moderate*** with finfish returning to the area after the noise-generating activity has been completed as described in more detail below.

SEL for fish have been set for impulse sounds such as pile driving at peak and cumulative levels and are presented in Table 4.3-13. Peak levels are the sound levels in dB associated with a single pile strike - defined as the level assessed to cause injury with one strike. Cumulative levels are the total energy received through a pile driving event (generally the energy received over an entire day of pile driving).

If fish are exposed to the peak or cumulative SEL at or above the 206-dB level identified in the table above, they may be injured, killed, or experience a permanent threshold shift (PTS) or TTS, which means that fish lose all or part of their hearing range on a permanent or temporary basis. Popper et al. (2005) found the effects from even substantial TTS to have worn off for fish within 18 hours of exposure. However, hearing loss, even if temporary, could render the fish unable to respond to environmental sounds that indicate the presence of predators or that allow the location of prey or potential mates (Popper and Hastings, 2009).

Behavioral responses to the construction noise are expected to occur where noise levels exceed the $L_p$ 150 dB re 1 μPa affect fish reproduction and population levels if biologically important activities such as migration, feeding, and spawning are interrupted (Thomsen et al., 2006). While studies have generally found that effects on fish decrease the further from the source of the sound, this effect is not straightforward. In some cases, sound levels may be higher at greater distances from the source from propagation through the seabed and sound reflections from objects (Hastings and Popper, 2005).

Elevated noise levels are expected to cause some fish species to temporarily vacate the area, causing a temporary disruption in feeding, mating, and other essential activities. Less mobile species and benthic early life stages are expected to be more susceptible to noise effects than more mobile species as they will not be able to leave the area as quickly (Gill and Kimber, 2005). Atlantic sturgeon, the only endangered finfish species found within the SFWF, have been shown to avoid pile-driving activities in the Hudson River, and based on this, they were not expected to be exposed to the cumulative SEL (Krebs et al., 2016). The same avoidance response is expected if they should be present during pile driving activities at the SFWF because this species is highly mobile.

Fish species also make a variety of sounds, many of which are used for mating or communication purposes, and sounds associated with construction of the SFWF may mask these sounds. As the sounds associated with pile driving may be audible over great distances, the masking of these fish sounds may have implications on mating and other behaviors (Thomsen et al., 2006). This potential for disruption may be influenced by the type of noises that fish make. Species that communicate using only a single sound may experience negligible impacts because pile driving pulses are very short in duration, while species with complex communications may experience more disruption (Thomsen et al., 2006). This masking effect may be magnified if pile driving is occurring at multiple locations at the same time.

Little is known about particle motion effects on finfish, and unlike sound pressure waves, no criteria to assess effects associated with particle motion have been established. It is expected that particle motion associated with pile driving will have similar effects as pressure waves with fish exhibiting behavioral responses such as temporarily vacating the impact area. Excess particle motion may also mask communication and could cause permanent or temporary damage to sensory structures.

**Mechanical/hydro-jet Plow, Vessel, and Aircraft Noise**

Sounds created by mechanical/hydro-jet plows, vessels, or aircraft are continuous or nonimpulsive sounds, which have different characteristics underwater and impacts on marine life. Limited research has been conducted on underwater noise from mechanical/hydro-jet plow. Generally, the noise from this equipment is expected to be masked by louder sounds from vessels, especially DP vessels. Also, as most noise generated by these pieces of equipment will be below the sediment surface and associated with the high-pressure jets, noise levels are not expected to result in injury or mortality to finfish, but may cause finfish to temporarily vacate the area. The duration of noise at a given location will be short, as the installation vessel will move at approximately 0.06 to 0.47 mile per hour (0.1 to 0.75 km per hour) and will occur over a very short period at any given location along the inter-array cable route. ***Minor, short-term, direct impacts*** are expected from mechanical/hydro-jet plow installation noise.

Helicopters will be used to a limited extent for emergency transport between the WTGs and shore after an offshore landing pad has been constructed. Underwater noise associated with helicopters is generally brief as compared with the duration of audibility in the air (Richardson et al., 1995). Because of this, ***direct impacts*** to finfish are expected to be ***short-term and negligible***.

Vessel noise may also cause finfish to temporarily vacate the area. However, vessel noise is widely regarded as the predominant anthropogenic noise in the ocean. Research indicates that the direct effects of vessel noise will not cause mortality or body tissue injuries in adult fish (Hawkins et al., 2014). Vessel sound source levels have been shown to cause several different effects in behavior, TTS, auditory masking, and blood chemistry. The most common behavioral responses are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al., 2002; Handegard and Tjøstheim, 2005; Sarà et al., 2007; Becker et al., 2013). Laboratory and field studies have demonstrated several other behaviors that are influenced by vessel noise. For example, several studies have noted changes in time spent burrowing or using refuge, time spent defending or tending to nests and eggs (Picciulin et al., 2010; Bruintjes and Radford, 2013), intraspecific aggression and territoriality interactions (Sebastianutto et al., 2011; Bruintjes and Radford, 2013), foraging behavior (Purser and Radford, 2011; Bracciali et al., 2012; Voellmy et al., 2014a, 2014b), vocalization patterns (Picciulin et al., 2008, 2012), and overall frequency of movement (Buscaino et al., 2009). These studies also demonstrated that the behavioral changes generally were temporary or that fish habituated to the noises. Some studies noted changes in the blood chemistry of several fish species (e.g., European sea bass, gilthead seabream, red drum, spotted sea trout) in response to vessel noise (Buscaino et al., 2009; Spiga et al., 2012).

Auditory masking and TTS in fish exposed to vessel noise has been demonstrated in a few studies. Auditory thresholds have been shown to increase by as much as 40 dB when fish are exposed to vessel noise playbacks (Wysocki and Ladich, 2005; Vasconcelos et al., 2007; Codarin et al., 2009). The degree of auditory masking or TTS generally depends on the hearing sensitivity of the fish, the frequency, and the noise levels tested (Wysocki and Ladich, 2005). The impact of auditory masking and TTS indicate that vessel noise can lower the ability of fish to detect biologically relevant sounds. However, the effects were found to be temporary and hearing abilities returned to normal. Finfish in the vicinity of SFWF construction vessels may be impacted by vessel noise but the duration of noise at a given location will be short and will occur over a very short period at any given location in the SFWF area or between ports and the SFWF. Therefore, ***minor, short-term direct*** impacts to finfish are expected because of most construction vessel noise.

The dominant vessel sound during SFWF construction will occur during inter-array cable installation. A DPV will be utilized during SFWF inter-array cable and SFEC lay activities. Inter-array cable lay activities are estimated to be completed over approximately 15 to 20 days between the WTGs. According to the acoustical impact analysis provided in Appendix P, the zone of acoustic influence for behavioral impacts to fish during DPV use would be approximately 12 acres (5 ha). The zone of acoustic influence for injury would be concentrated right at the DPV itself. Fish within this ensonified area over the brief duration of DPV use may experience noise that may temporarily alter their behavior. However, impacts of this magnitude are expected to be ***short-term*** and ***minor.***

**Traffic**
Impacts associated with vessel traffic during SFWF construction are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections above.

**Lighting**
Artificial lighting during construction at the SFWF will be associated with navigational and deck lighting on vessels from dusk to dawn. Reaction of finfish to this artificial light is highly species-dependent and may include attraction and/or avoidance of an area.

Artificial lighting may disrupt the diel vertical migration patterns of fish and this may affect species richness and community composition (Nightingale et al., 2006; Phipps, 2001). It could also increase the risk of predation and disruption of predator/prey interactions and result in the loss of opportunity for dark-adapted behaviors including foraging and migration (Orr et al., 2013). Because of the limited area associated with the artificial lighting used on project vessels relative to the surrounding unlit areas, the impacts are expected to be ***negligible and short-term*** for benthic early life stages and ***negligible or minor*** for benthic later life stages and pelagic early and later life stages during construction.

**Trash and Debris**
The release of trash and debris into offshore waters potentially may occur from any on-water activities. Certain types of trash and debris could be accidentally lost overboard during construction, with subsequent effects to finfish. In compliance with existing federal regulations, the amount of trash and debris dumped offshore would be minimal as only accidental loss of

trash and debris is anticipated, some of which could sink to the seafloor. Affected fish species were not fully assessed in the NOAA marine debris summary (2014) but are known to be greatly impacted by derelict fishing gear and are likely affected similarly by other marine debris. It is likely that ingestion and entanglement impacts are not fully realized because of the inaccessibility of affected fish.

Vessel operators, crew, and personnel present on offshore structures are required to comply with the requirements of federal regulations regarding safe disposal of trash and debris. In addition, USCG and EPA regulations require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.The SFWF's compliance with laws and regulations as well as BSEE NTL 2015-G03 will avoid or reduce the potential for impacts from trash and debris on the environment.

Therefore, taking into account the USCG and EPA regulations as well as BOEM guidance, trash and debris from construction and operational activities will not be released into the marine environment. Debris would consist only of isolated items that were accidentally lost overboard. In addition, sturgeon are very sparsely distributed in the SFWF and SFEC areas; therefore, debris ingestion and entanglement impacts on finfish are expected to be ***negligible***.

***Operations and Maintenance***

Table 4.3-15 summarizes the level of impacts expected to occur to finfish and EFH during the O&M phases of the SFWF. Minor impacts and long-term impacts during O&M are largely associated with the presence of the SFWF. Additional details on potential impacts to finfish and EFH from the various IPFs during O&M are described in the following sections.

**Table 4.3-15. IPFs and Potential Levels of Impact on Finfish and EFH for the SFWF during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact[a] | | | |
|---|---|---|---|---|---|
| | | Benthic/Demersal Early Life Stages[b] | Pelagic Early Life Stages [b] | Benthic/Demersal Later Life Stages[b] | Pelagic Later Life Stages [b] |
| Seafloor Disturbance | Foundation | Minor long-term indirect | Minor long-term indirect | Minor long-term indirect | Minor long-term indirect |
| | OSS platform | Minor long-term indirect | Minor long-term indirect | Minor long-term indirect | Minor long-term indirect |
| | SFWF inter-array cable | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Minor long-term indirect |

**Table 4.3-15. IPFs and Potential Levels of Impact on Finfish and EFH for the SFWF during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact[a]<br>Benthic/Demersal Early Life Stages[b] | Pelagic Early Life Stages [b] | Benthic/Demersal Later Life Stages[b] | Pelagic Later Life Stages [b] |
|---|---|---|---|---|---|
| | Vessel anchoring (including spuds) | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Sediment Suspension and Deposition | | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Negligible short-term direct<br>Negligible long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Noise | Ship Noise and Aircraft Noise, | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct |
| | WTG Operational Noise | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct |
| Electromagnetic Field | | Negligible | Negligible | Negligible | Negligible |
| Traffic | | See Seafloor disturbance, noise, sediment suspension and deposition, and lighting IPFs. | | | |
| Lighting | | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct |
| Discharges and Releases [c] | | Negligible | | | |
| Trash and Debris [c] | | Negligible | | | |

[a] Maximum level of impact is the highest impact levels for direct or indirect effects. Long-term impacts were considered to have a higher potential for impacts than short-term impacts if within the same impact category.

[b] Early life stages include eggs and larvae. Later life stages include juveniles and adults.

[c] Supporting information on the negligible level of impact for the Discharges and Trash/Debris IPFs is provided in Section 4.1.

**Seafloor Disturbance**

Impact producing factors associated with seafloor disturbance during O&M of the SFWF have been split into foundation, OSS platform, SFWF inter-array cable, and vessel anchoring (including spuds). See Section 3.1.2.1 for the expected impact areas associated with each foundation type that may be used to support the WTGs and OSS and the impact area associated with the inter-array cable.

**Foundations**

The presence of the foundations and associated scour protection (if necessary) is expected to result in ***minor, long-term indirect impacts*** to finfish because of the conversion of existing sand or sand with mobile gravel habitat to hard bottom. This is expected for all life stages of benthic/demersal and pelagic finfish species that are associated with these habitats. This conversion to hard bottom habitat may trigger an effect known as a "reef effect" which could result in both ***minor impacts*** for some species but could also benefit some species. Species such as Atlantic halibut, haddock, monkfish, smooth and spiny dogfish, and windowpane flounder that spawn or lay eggs on, occur on, or feed on species that are present in soft bottom habitat or sand with mobile gravel habitat are expected to have a ***minor impact*** as available habitat in the area will decrease. While those species such as Atlantic cod, black sea bass, red hake, scup, tautog, and wolf fish that prefer harder bottom habitat are expected to ***benefit*** from this activity. For further information on common habitat types by species (Table 4.3-11). However, this effect is expected to be small based on the expected size of habitat conversion at each WTG relative to the available sand and sand with mobile gravel habitat.

Habitat conversion is expected to cause a ***long-term, minor, indirect impact*** resulting in a shift in species assemblages towards those found in rocky reef/rock outcrop habitat, this is known as the "reef effect" (Wilhelmsson et al., 2006; Reubens et al., 2013). This effect is also well known from other anthropogenic structures in the sea, such as oil platforms, artificial reefs piers, and shipwrecks (Claudet and Pelletier, 2004; Wilhelmsson et al., 2006; Seaman, 2007; Langhamer and Wilhelmsson, 2009). The impact is expected to be minor because both soft and hard bottom habitats are already present in and around the SFWF. Data collected as part of the G&G survey at the SFWF (Appendix H) indicate that sand sheet habitat is not a limiting habitat in the region, and that numerous hard bottom boulder habitats are also present within the area. As a result, the conversion of a small area of sand sheet habitat to hard bottom habitat is unlikely to result in perceptible changes to the benthic community outside of the immediate area impacted.

Species composition and abundance of finfish is expected to be influenced by the type of foundation used. At wind farms with gravity base structure foundations in Europe, Reubens et al. (2013) found higher cod and pouting (*Trisopterus luscus*) abundances near the foundations compared to surrounding sandy habitat, and the overall health of these species did not differ between sandy areas and the wind farm. Cod exhibited high site fidelity at turbines in the summer and fall, then emigrated from the wind farm in the winter (Reubens et al., 2013). Similarly, at wave energy foundations in Sweden, fish abundances including cod, flounder (*Platichthys flesus*), eelpout (*Zoarces viviparus*), and eel (*Anguila anguilla*) were significantly higher near the foundations than on surrounding soft bottom habitat (Langhamer and Wilhelmsson, 2009; Bergström et al., 2013). Overall, increases in abundance of certain finfish have been observed around WTG foundations at most wind farms that were built in soft-bottom habitat (Bergström et al., 2014).

Wind farms with steel monopile foundations showed a species-dependent effect with some species having higher abundance and some having lower abundance post wind farm installation. At the Horns Rev wind farm, 7 years after construction fish densities decreased at both the wind farm and control sites, indicating inter-annual variation in fish populations more strongly influenced abundances than any attraction effect of the wind farm (Leonhard et al., 2011). This study also revealed that fish aggregated around the wind farm during daylight hours, then migrated to deeper water at night. Fish species diversity was also found to be higher close to the turbines and this diversity was primarily driven by species that prefer hard bottom (Leonhard et al., 2011; Stenberg et al., 2015).

At the offshore wind farm Egmond aan Zee, a tagging study of sole (*Solea vulgaris*) and cod revealed that sole were neither attracted to nor avoided the wind farm turbines (Winter et al., 2010). All sampled cod were juveniles and they were strongly attracted to the monopiles, but individual behavior varied greatly, with some using spatial scales larger than the wind farm, while others stayed within the wind farm for months, moving among the WTGs. In addition, sole, whiting (*Merlangius merlangus*), and striped red mullet (*Mullus surmuletus*) abundances increased and lesser weever (*Echiichthys vipera*) abundances decreased within the wind farm when compared to baseline sampling. Cod were observed on the scour protection rocks 2 years after construction.

At the FINO 1 platform in the German Bight portion of the North Sea, fish were most densely congregated near the anchorages of jacket foundations (Krone et al., 2013). The anchorage section of the foundation structure was more structurally complex than junctions higher in the water column, which had lower fish abundances.

Similar offshore structures like oil and gas platforms have been found to exhibit a reef effect with increased abundance of larval and juvenile fish. This increased abundance may be because the structures extend throughout the water column, making it more likely that juvenile or larval fish encounter and settle on them (RICRMC, 2010). There may also be less predation on small fish in midwater habitats, so they can safely hide in the structure at a variety of depths (Love et al., 2003). In addition, at these structures, fish can take advantage of the shelter provided while also being exposed to stronger currents created by the structures, which generate increased feeding opportunities and decreased potential for predation (Wilhelmsson et al., 2006). A similar effect is expected for the WTGs regardless of foundation type.

Overall, any adverse or beneficial direct impacts associated with the foundations and scour protection will be limited to the immediate vicinity of the individual WTG or foundation, while the vast majority of the SFWF area will not be impacted. In addition, the existing sand and sand with mobile gravel habitat is not expected to be a limiting factor for finfish in the area. Any "reef effect" observed will be limited to the immediate vicinity of that structure and will not cover the entire area where the SFWF is located.

**SFWF Inter-Array Cable**

Benthic life stages are expected to experience ***minor, short-term, direct impacts*** and pelagic life stages are expected to experience ***negligible, short-term, direct impacts*** if the inter-array cable requires maintenance that will expose it. Maintenance of the inter-array cable is considered a nonroutine event and is not expected to occur with any regularity. Impacts associated with exposing the inter-array cable are expected to be similar but less frequent to those described for the construction/installation phase. The presence of the inter-array cable is expected to have ***negligible impacts*** to finfish because the cable will be buried beneath the seabed. However, some areas of the inter-array cable may require armoring which may result in ***minor, long-term indirect impacts*** through conversion to hard bottom as described in the Foundation section.

**Vessel Anchoring (Including Spuds)**

Vessels are not expected to anchor during O&M activities unless the inter-array cable or WTGs require maintenance. Impacts associated with potential vessel anchoring during operation are expected to be similar to those discussed in the Seafloor Preparation and Pile Driving/Foundation Installation section for the construction phase.

**Sediment Suspension and Deposition**

Increases in sediment suspension and deposition during O&M will primarily result from vessel anchoring and any maintenance activities that will require exposing the inter-array cable. Both activities are expected to be nonroutine events and not expected to occur with any regularity. Sediment suspension and deposition impacts resulting from vessel activity during SFWF O&M are expected to be similar to vessel-related sediment suspension and deposition impacts described for the construction phase.

**Noise**

Direct impacts from noise during SFWF O&M may occur associated with vessels, aircraft, and operational noise at the WTGs.

**Vessel and Aircraft Noise**

Impacts from vessel and aircraft noise during SFWF O&M are expected to be similar to impacts described in the construction phase.

**WTG Operational Noise**

The underwater noise produced by wind turbines are within the hearing ranges of fish. Depending on the noise intensity, such noises could disturb or displace fish within the surrounding area or cause auditory masking (DOI-MMS, 2007). Noise levels are not expected to result in injury or mortality and finfish may become habituated to the operational noise (Thomsen et al., 2006; Bergström et al., 2014). A recent study also found no difference in the residency times of juvenile cod around monopiles between periods of turbine operation or when turbines were out-of-order. This study also found that sandeels (*Ammodytes marinus* and *Ammodytes tobianus*) did not avoid the wind farm (Lindeboom et al., 2011). In a similar study, the abundance of four of the most commonly occurring species, cod, eel, shorthorn sculpin (*Myoxocephalus scorpius*), and goldsinny wrasse (*Ctenolabrus rupestris*), were found to be higher near WTGs, indicating potential noise effects from operation did not override the “reef effect.” Avoidance of WTGs was not observed in this study either (Bergström et al., 2013).

With generally low noise levels generated by the WTGs, fish would be impacted only at close ranges, within approximately 328 feet (100 m) (Thomsen et al., 2006). Thomsen et al (2006) reviewed the findings of observations of fish behaviors in proximity to an operational turbine and found varying results from no perceived changes in swimming behavior (European eels); and both increased and decreased catch rates of cod within 328 feet (100 m) of turbines. As a result, direct impacts associated with long-term noise during WTG operation are expected to be ***negligible***.

**Electromagnetic Field**

The inter-array cable will be shielded. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas, but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012).

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the SFWF inter-array cable and SFEC was performed and results are included in Appendix K. These modeling results were compared to published studies available in the scientific literature on the sensitivity of marine species to EMF. The modeling results and scientific literature analysis indicates that the EMF associated with the operational buried inter-array cable or SFEC will not be detected by bony fish, elasmobranch, or invertebrate species. Given that the calculated values are below the thresholds of detection reported in the scientific literature, behavioral effects impacting regional abundances and distributions of such species are not expected.

Additional field data from 50-Hz submarine cable sites and offshore windfarms support this conclusion, indicating no distributional or behavioral effects on resident fish, elasmobranchs, or invertebrates. It should be noted that these conclusions are in line with the findings of a previous comprehensive review of the ecological impacts of Marine Renewable Energy (MRE) projects, where it was determined that "to date there has been no evidence to show that EMFs at the levels expected from MRE devices will cause an effect (whether negative or positive) on any species" (Copping et al., 2016). Given these findings and the findings presented in Appendix K, no adverse impacts from EMF are expected to affect finfish or EFH within the SFWF or SFEC.

**Traffic**
Impacts associated with vessel traffic during SFWF O&M are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections above.

**Lighting**
Artificial lighting during O&M will be associated with O&M vessels, the WTGs, and the OSS. Reaction of finfish to artificial light and potential impacts to finfish from artificial light is described under the Lighting section for the construction phase. Lighting on the WTG foundations and the OSS will be coordinated with the USCG to ensure it meets appropriate safety standards and to minimize potential impacts on marine organisms. Because of the limited area associated with the artificial lighting at each WTG, the OSS, and project vessels relative to the surrounding unlit areas, the impacts are expected to be ***negligible, long-term*** during operation.

***Decommissioning***

Decommissioning of the SFWF is expected to have similar impacts as construction of the WTGs, OSS, and inter-array cable. After removal, the area is expected to return to pre-project conditions.

### South Fork Export Cable

### SFEC – OCS and SFEC – NYS

***Construction***

Table 4.3-16 summarizes the level of impacts expected to occur to finfish and EFH during the construction and decommissioning phases of the SFEC. Decommissioning of the SFEC is included in Table 4.3-16 because the structures are expected to be removed and their removal will be accomplished by similar methods or result in similar impact areas as their installation. Additional details on potential impacts to finfish and EFH from the various IPFs during construction of the SFEC are described in the following sections.

**Table 4.3-16. IPFs and Potential Levels of Impact on Finfish and EFH for the SFEC during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/ Demersal Early Life Stages [b] | Pelagic Early Life Stages [b] | Benthic/ Demersal Later Life Stages [b] | Pelagic Later Life Stages [b] |
| Seafloor/Land Disturbance | Seafloor Preparation | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |

**Table 4.3-16. IPFs and Potential Levels of Impact on Finfish and EFH for the SFEC during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/ Demersal Early Life Stages [b] | Pelagic Early Life Stages [b] | Benthic/ Demersal Later Life Stages [b] | Pelagic Later Life Stages [b] |
| | Pile Driving/ Cofferdam Installation | Minor short-term direct | Negligible short-term direct | Minor short-term direct | Negligible short-term direct |
| | SFEC installation | Minor short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Negligible short-term indirect |
| | Vessel anchoring (including spuds) | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Sediment Suspension and Deposition | | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Negligible short-term direct<br>Negligible long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Noise | Vibratory Pile Driving | Minor short-term direct | Minor short-term direct | Minor short-term direct | Minor short-term direct |
| Noise | Ship Noise, Trenching Noise, Aircraft Noise | Minor short-term direct | Minor short-term direct | Minor short-term direct | Minor short-term direct |
| Traffic | | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct |
| Lighting | | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct |
| Discharges and Releases [c] | | Negligible | | | |
| Trash and Debris [c] | | Negligible | | | |

[a] Maximum level of impact is the highest impact levels for direct or indirect effects. Long-term impacts were considered to have a higher potential for impacts than short-term impacts if within the same impact category.

[b] Early life stages include eggs and larvae. Later life stages include juveniles and adults.

**Table 4.3-16. IPFs and Potential Levels of Impact on Finfish and EFH for the SFEC during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/ Demersal Early Life Stages [b] | Pelagic Early Life Stages [b] | Benthic/ Demersal Later Life Stages [b] | Pelagic Later Life Stages [b] |

[c] Supporting information on the negligible level of impact for the Discharges and Trash/Debris IPFs is provided in Section 4.1.

**Seafloor Disturbance**

IPFs associated with seafloor disturbance during construction of the SFEC has been split into seafloor preparation, pile driving, SFEC installation, and vessel anchoring (including spuds). In general, seafloor disturbance is expected to produce ***negligible to minor, direct and indirect impacts*** to species depending on the life stages present for each species. Other IPFs that are interrelated with seafloor disturbance such as pile driving noise and sediment suspension and deposition are discussed in subsequent sections. See Section 4.1 for the expected impact areas associated with the SFEC cable and HDD cofferdam.

Similar to the SFWF, the construction and decommissioning of the SFEC is not expected to have major long-term impacts on finfish or designated EFH. Many of the species identified in Table 4.3-10 as possibly present at the SFEC have a completely pelagic lifestyle, and many other species have pelagic early life stages and are not dependent on benthic habitat. As such, modification or disturbance of the substrate is expected to have a negligible adverse impact on the habitat or EFH of pelagic species, if present. See Section 4.1 for the expected acreage of benthic habitat that will be affected by construction of the SFEC. There may be some adverse impacts to finfish habitat and EFH of demersal/benthic species resulting from the Project, but because of the small acreage relative to the total area of surrounding finfish habitat and EFH, these are expected to be ***negligible to minor, localized, and short-term*** in nature.

Following completion of construction and during O&M of the SFEC, the substrates at the SFEC are expected to fundamentally remain the same as pre-project conditions. Benthic infauna and epifauna are expected to recolonize the disturbed areas, allowing them to continue to serve as foraging habitat for finfish species, including those with designated EFH. The exception is the conversion of sand and sand with mobile gravel substrate to hard bottom associated with the protective armoring for discrete portions of the SFEC. However, because of the small acreage associated with this conversion relative to the total area of available surrounding finfish habitat and EFH, these impacts to finfish habitat and EFH are expected to be ***minor, short-term and long-term***.

**Seafloor Preparation**

Seafloor preparation activities at the SFEC during construction include removal of obstructions prior to installing the SFEC. A PLGR will be used to clear debris from the area prior to laying the SFEC. Impacts associated with seafloor preparation are expected to be similar to those described for the SFWF; however, no seafloor leveling is expected for the SFEC.

**Pile Driving/Cofferdam Installation**

Physical impacts to finfish from SFEC cofferdam installation consisting of sheet pile or gravity cell as similar to those described for SFWF pile/foundation installation.

**SFEC Installation**
Impacts associated with installation of the SFEC are expected to be similar to those described for the SFWF inter-array cable.

In addition, as described in the SFWF construction section, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained during installation of the SFEC. An ichthyoplankton and zooplankton assessment was conducted to analyze the potential loss of fish and zooplankton related to this activity (Appendix O, Attachment 1). The results indicate that total estimated losses of zooplankton and ichthyoplankton related to entrainment from installation of the longest potential SFEC route were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study region (Appendix O, Attachment 1). Therefore, impacts to early life stages of EFH species from entrainment caused by installation of the SFEC are expected to be negligible to minor and short-term.

**Vessel Anchoring (Including Spuds)**
Impacts associated with vessel anchoring and the use of spuds during construction of the SFEC are expected to be similar to those described for the SFWF.

**Sediment Suspension and Deposition**
Increases in sediment suspension and deposition during construction of the SFEC can result from seafloor disturbance caused by vessel anchoring, installation of the SFEC, and limited excavation required at the cofferdam. Direct impacts associated with increased sediment suspension and deposition are expected to be ***negligible or minor and short-term in nature***. Indirect impacts associated with increased suspended sediment and deposition include changes in habitat and species composition after sediments have settled out. These impacts are expected to result in ***negligible to minor, long-term, indirect impacts*** for benthic early and later life stages and ***negligible short-term indirect impacts*** for pelagic early and later life stages as described in more detail below. Vessel mooring or anchoring activity resulting in sediment suspension is expected to be limited to areas of seafloor immediately adjacent to the spuds or anchors. For mechanical/hydro-jet plow installation at the SFEC - OCS and SFEC - NYS, and excavation at the cofferdam, a sediment transport study was completed that estimated the suspended sediment concentrations, sediment transport, and resulting sediment deposition that may result from these activities (Appendix I).

**Temporary Increase in TSS**
In order to estimate the extent of potential impacts from sediment suspension generated by mechanical/hydro-jet plow installation of the SFEC, a modeling simulation of the burial of the SFEC was conducted. A summary of the modeling results specific to the SFEC - OCS and SFEC - NYS is summarized below.

**SFEC – OCS Installation**
The modeling results indicate that the maximum modeled TSS concentration from SFEC - OCS installation is 1,347 mg/L. The highest TSS concentrations are predicted to occur in locations where the hydro-jet plow passes over pockets of finer sediments (e.g., between VC-217 and VC-220, and again between VC-235 and the end of the route –Appendix I), but concentrations above 30 mg/L otherwise remain within approximately 328 feet (100 m) of the source during the simulation. Water column concentrations of 100 mg/L or greater are predicted to extend up to 1,115 feet (340 m) from the mechanical/hydro-jet plow and TSS concentrations are predicted to return to ambient levels (less than 10 mg/L) in 1.4 hours after the conclusion of mechanical/hydro-jet plow trenching. Modeling also indicates that elevated TSS concentrations are expected to remain very close to the seabed and that plumes are not predicted to extend

vertically beyond 3 to 9 feet (1 to 3 m) of the mechanical/hydro-jet plow at any time during the simulation (Appendix I).

**SFEC – NYS Installation**
The modeling results indicate that the maximum modeled TSS concentration from SFEC - NYS installation is 578 mg/L. Water column concentrations of 100 mg/L or greater are predicted to extend up to 394 feet (120 m) from the mechanical/hydro-jet plow and TSS concentrations are predicted to return to ambient levels (less than 10 mg/L) in 1.3 hours after the mechanical/hydro-jet plow crosses into federal waters. Modeling also indicates that elevated TSS concentrations are expected to remain very close to the seabed and that plumes are not predicted to extend vertically beyond 3 to 9 feet (1 to 3 m) of the mechanical/hydro-jet plow at any time during the simulation (Appendix I).

**Cofferdam Installation**
A modeling simulation of suction dredging and side-casting at the HDD exit point for the sea-to-shore transition was also conducted. The maximum predicted TSS concentration from suction dredging at the HDD site is 562 mg/L. Water column concentrations of 100 mg/L or greater are predicted to extend up to 476 feet (145 m) from the source and TSS concentrations are predicted to return to ambient levels (less than 10 mg/L) in 1.1 hours after the conclusion of suction dredging.

Potential impacts to finfish from increases in sediment suspension are similar to those described for the SFWF. Given the limited extent and duration of the elevated TSS based on the predictive modeling described above, these impacts are expected to be ***negligible to minor*** to benthic/demersal species because they will be ***short-term and highly localized***. Direct impacts to pelagic species are expected to be ***negligible*** as older life stages will likely leave the area and not be affected by increased suspended sediment and early life stages are expected to have tolerance for short-term increases in suspended sediment.

Sediments are expected to come out of suspension quickly after the impact occurs, returning pelagic habitat to pre-impact conditions in a short-time frame, resulting in a ***negligible, short-term, indirect impact*** for pelagic early and later life stages. Indirect impacts to benthic/demersal species from a potential change in habitat composition are described in the Sediment Deposition section below.

**Sediment Deposition**
The model (Appendix I) also predicted sediment deposition extent and depth resulting from installation of the SFEC. A summary of the modeling results specific to the SFEC - OCS and SFEC - NYS is summarized below.

**SFEC – OCS Installation**
The model predicted that sediment deposition resulting from installation of the SFEC - OCS will be limited to the area immediately adjacent to the burial route, typically, extending no more than 328 feet (100 m) from the cable-laying track. The maximum predicted deposition thickness is estimated to be 0.45 inches (11.4 mm). Sedimentation at or above 0.4 inch (10 mm) extends a maximum of 29.5 feet (9 m) from the burial route and covers a cumulative area of 4.3 acres (1.72 ha) of the seabed (Appendix I).

**SFEC – NYS Installation**
The model predicted that sediment deposition resulting from installation of the SFEC - NYS will also be limited to the area immediately adjacent to the burial route as described above. The maximum predicted deposition thickness is estimated to be 0.39 inch (9.9 mm). Sedimentation at

or above 0.4 inch (10 mm) extends a maximum of 29.5 feet (9 m) from the burial route and covers a cumulative area of 4.3 acres (1.72 ha) of the seabed (Appendix I).

**Cofferdam Installation**

A modeling simulation of suction dredging and side-casting at the HDD exit point for the sea-to-shore transition was also conducted. The model predicted that sedimentation will be limited to the area immediately adjacent to the exit pit (within 656 feet [200 m] of the source). Unlike previous scenarios where sediment is resuspended along a linear path, the dredge and side-cast operation occurs from a single point within the model domain. For this reason, the deposit is thicker, but is far more limited in extent. The maximum predicted deposition thickness is 12.5 inches (31.8 cm). Sedimentation at or above 10 mm extends a maximum of 177 feet (54 m) from the side-cast point and covers a cumulative area of only 1.38 acres (0.56 ha) of the seabed (Appendix I).

Potential Impacts to finfish from increases in sediment deposition are similar to those described for the SFWF. Direct impacts from sediment deposition to finfish are considered to be ***short-term, localized,*** and ***minor*** because of the limited extent of sedimentation predicted by the model. Indirect impacts are expected to be ***negligible to minor and long-term*** for benthic early and later life stages. Indirect impacts from sediment deposition are expected to result in ***no impact*** to pelagic early of later life stages.

**Noise**

The primary sources of underwater sound during SFEC construction that pose risks of impacts to fish are vibratory hammer pile driving for the sheet pile cofferdam and DPV use for SFEC installation. The potential underwater acoustic impacts on fish were addressed in the discussion about the SFWF inter-array cable. ***Minor, short-term behavioral impacts*** to fish within the ensonified area of approximately 12 acres (0.05 $km^2$) around the DPV along the cable route would be expected.

The sheet pile cofferdam installation differs from the main SFWF installation in several ways. The location is close to shore, the duration of the installation is estimated to be short (roughly 12 to 24 hours), and the source type is nonimpulsive, versus impulsive for the SFWF pile driving. According to the acoustical impact analysis provided in Appendix P, the zone of acoustic influence for behavioral impacts to fish during vibratory hammering would be approximately 445 acres (1.8 $km^2$). The zone of acoustic influence for injury would be concentrated right at the cofferdam and vibratory hammering. Fish within this ensonified area over the brief duration of vibratory hammering may experience noise that may temporarily alter their behavior. However, impacts of this magnitude are expected to be ***short-term*** and ***minor.***

**Traffic**

Impacts associated with vessel traffic during construction of the SFEC are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections above.

**Lighting**

Artificial lighting during construction of the SFEC will be associated with navigational and deck lighting on vessels from dusk to dawn. Reaction of finfish to this artificial light is highly species-dependent and may include attraction and/or avoidance of an area. Because of the limited area associated with the artificial lighting used on project vessels relative to the surrounding unlit areas, the effects are expected to be ***negligible and short-term*** for both benthic and pelagic early and later life stages during construction. Additional information on impacts to finfish from artificial lighting are similar to those described for the SFWF.

***Operations and Maintenance***

Table 4.3-17 summarizes the level of impacts expected to occur to finfish and EFH during the O&M phases of the SFEC. ***Minor and long-term impacts*** during O&M are associated with the presence of the SFEC and associated cable armoring. Additional details on potential impacts to finfish and designated EFH from the various IPFs during O&M are described in the following sections.

**Table 4.3-17. IPFs and Potential Levels of Impact on Finfish and EFH for the SFEC during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/Demersal Early Life Stages [b] | Pelagic Early Life Stages [b] | Benthic/Demersal Later Life Stages [b] | Pelagic Later Life Stages [b] |
| Seafloor Disturbance | Cofferdam | No impact | No impact | No impact | No impact |
| | SFEC | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Minor long-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Minor long-term indirect |
| | Vessel anchoring (including spuds) | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Sediment Suspension and Deposition | | Minor short-term direct<br>Minor long-term indirect | Negligible short-term direct<br>Negligible short-term indirect | Negligible short-term direct<br>Negligible long-term indirect | Negligible short-term direct<br>Negligible short-term indirect |
| Ship and Aircraft Noise | | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct | Negligible short-term direct |
| Electromagnetic Field | | Negligible | Negligible | Negligible | Negligible |
| Lighting | | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct | Negligible long-term direct |
| Discharges and Releases [c] | | Negligible | | | |
| Trash and Debris [c] | | Negligible | | | |

[a] Maximum level of impact is the highest impact levels for direct or indirect effects. Long-term impacts were considered to have a higher potential for impacts than short-term impacts if within the same impact category.

[b] Early life stages include eggs and larvae. Later life stages include juveniles and adults.

**Table 4.3-17. IPFs and Potential Levels of Impact on Finfish and EFH for the SFEC during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact [a] | | | |
|---|---|---|---|---|---|
| | | Benthic/Demersal Early Life Stages [b] | Pelagic Early Life Stages [b] | Benthic/Demersal Later Life Stages [b] | Pelagic Later Life Stages [b] |

[c] Supporting information on the negligible level of impact for the Discharges and Trash/Debris IPFs is provided in Section 4.1.

**Seafloor Disturbance**

IPFs associated with seafloor disturbance during O&M of the SFEC has been split into cofferdam, SFEC, and vessel anchoring (including spuds). See Section 3.2.3 for a description of the SFEC construction.

**Cofferdam**

The cofferdam will be a temporary structure used during construction only. Therefore, no conversion of habitat is expected and ***no long-term, indirect impacts*** associated with pile driving of the cofferdam is expected.

**South Fork Export Cable**

Benthic life stages are expected to experience ***minor, short-term, direct impacts*** and pelagic life stages are expected to experience ***negligible, short-term, direct impacts*** if the SFEC requires maintenance that will expose it. Maintenance of the SFEC is considered a nonroutine event and is not expected to occur with any regularity. Impacts associated with exposing the SFEC are expected to be similar but less frequent to those described for the construction/installation phase. The presence of the SFEC is expected to have ***negligible impacts*** to finfish because it will be buried beneath the seabed. However, some areas of the SFEC may require armoring which is expected to result in ***minor, long-term, indirect impacts*** through conversion to hard bottom, as described in the Foundation section for the SFWF.

**Vessel Anchoring (Including Spuds)**

Vessels are not expected to anchor during O&M activities unless the SFEC requires maintenance. Impacts associated with potential vessel anchoring during O&M of the SFEC are expected to be similar to those described for the SFWF.

**Sediment Suspension and Deposition**

Increases in sediment suspension and deposition during O&M of the SFEC will primarily result from vessel anchoring and any maintenance activities that will require exposing the SFEC. Both activities are expected to be nonroutine events and not expected to occur with any regularity. Sediment suspension and deposition impacts resulting from vessel activity during O&M of the SFEC are expected to be similar to vessel-related sediment suspension and deposition impacts described for the SFEC construction phase, but less frequent and at a smaller scale.

**Noise**

Direct impacts to finfish associated with noise during O&M of the SFEC may occur associated with vessels and aircraft. Impacts from vessel and aircraft noise during O&M of the SFEC are expected to be similar to those described for the SFWF.

**Electromagnetic Field**

EMF impacts to finfish from the SFEC are expected to be similar to those described for the inter-array cable at the SFWF.

**Lighting**
Artificial lighting during O&M of the SFEC will be associated with O&M vessels. Reaction of finfish to artificial light and potential impacts to finfish from artificial light is as described under the Lighting section for the SFEC construction phase.

***Decommissioning***
Decommissioning of the SFEC is expected to have similar impacts as construction. The area is expected to return to pre-project conditions.

### Threatened and Endangered Finfish

As described in the Affected Environment section, the endangered Atlantic sturgeon has the potential to occur in the SFWF and SFEC areas. It is extremely unlikely for the endangered shortnose sturgeon to occur in either the SFWF or SFEC area.

Potential impacts on the Atlantic sturgeon would not be materially different from impacts on other fish species described in the previous sections. No spawning habitat will be affected because Atlantic surgeon spawn in hard-bottom, freshwater habitats. Seasonal migratory patterns allow the potential for Atlantic sturgeon to be present in the SFWF construction area; however, they are not expected to be a regular visitor or occupant in large numbers. IPFs for Atlantic sturgeon include seafloor disturbance, sediment suspension and deposition, noise, traffic (i.e., physical disturbance and risk of collisions), and trash and debris (i.e., ingestion and entanglement). Impacts resulting from these IPFs are described again in direct relevance to potential impacts to the Atlantic sturgeon. Appendix P includes discussion of those impacts.

### 4.3.3.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to finfish and essential fish habitat.

- The SFWF and SFEC - Offshore will minimize impacts to important habitats for finfish species.
- Installation of the SFWF inter-array cable and SFEC - Offshore will occur via a mechanical/hydro-jet plow. Compared to open cut dredging/trenching, this method will minimize sediment disturbance and alteration of demersal finfish habitat.
- The SFWF inter-array cable and SFEC - Offshore will be buried to a target depth of 4 to 6 feet (1.2 to 1.8 m).
- Siting of the SFWF and SFEC - Offshore were informed by site-specific benthic habitat assessments and Atlantic cod spawning surveys.
- DWSF is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction.
- A plan for vessels will be developed prior to construction to identify no-anchor areas inside the MWA to protect sensitive areas or other areas to be avoided.
- DWSF will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).

## 4.3.4 Marine Mammals

The description of the affected environment and assessment of potential impacts for marine mammals were developed by reviewing current public data sources related to marine mammals, including state and federal agency-published papers and databases, published journal articles, online data portals and mapping databases, and correspondence and consultation with federal and state agencies. A description of the marine mammals with the potential to occur within the SFWF and SFEC is provided in this section, followed by an evaluation of potential Project-related impacts. In support of this impact evaluation, DWSF has completed a comprehensive underwater acoustic modeling effort (Appendix J) and a detailed impact assessment for marine mammals, sea turtles, and sturgeon (Appendix P).

### 4.3.4.1 Affected Environment

**Regional Overview**

Thirty-nine species of marine mammals inhabit the regional waters upon the Western North Atlantic OCS, including 6 Mysticetes (baleen whales), 28 Odontocetes (toothed whales, dolphins, and porpoise), 4 Phocids (earless or true seals), and 1 species of Sirenia (manatees). All 39 species are protected under the MMPA; 6 species are also protected under the federal ESA. See Appendix P for additional information on listed species. Table 4.3-18 summarizes the marine mammal species potentially present within the Western North Atlantic OCS, including the relative occurrences for each species within the region. The table also includes each species' conservation status, including the designation as a 'strategic stock,' as defined by the MMPA. A species that is a strategic stock meets the following criteria: the population experiences a level of human-caused mortality that exceeds the potential biological removal level; the population is declining and is likely to be listed as a threatened species under the ESA, based on the best available information; or the population is listed as a threatened marine mammal species under the ESA or is designated as depleted under the MMPA. Nonstrategic stock is defined as any marine mammal stock that does not match the strategic stock criteria.

**Table 4.3-18. Marine Mammals in the Western North Atlantic OCS**

| Common Name | Scientific Name | Conservation Status | Seasonal Presence | Occurrence in Region[a] |
|---|---|---|---|---|
| ***BALEEN WHALES (ORDER MYSTICETI)*** | | | | |
| ***Family Balaenopteridae*** | | | | |
| Blue Whale | *Balaenpotera musculus* | Endangered | Summer | Rare |
| Fin Whale | *Balaenoptera physalus* | Endangered | Year-round | Common |
| Humpback Whale | *Megaptera novaeangliae* | Nonstrategic | Year-round | Common |
| Minke Whale | *Balaenoptera acutorostrata* | Nonstrategic | Spring and summer | Common |
| North Atlantic Right Whale | *Eubalaena glacialis* | Endangered, Strategic | Year-round | Common |
| Sei Whale | *Balaenoptera borealis* | Endangered | Spring and summer | Regular |

**Table 4.3-18. Marine Mammals in the Western North Atlantic OCS**

| Common Name | Scientific Name | Conservation Status | Seasonal Presence | Occurrence in Region[a] |
|---|---|---|---|---|
| ***TOOTHED WHALES (SUBORDER ODONTOCETI)*** | | | | |
| ***Family Physeteridae*** | | | | |
| Sperm Whale | *Physeter macrocephalus* | Endangered | Summer | Common |
| ***Family Kogiidae*** | | | | |
| Dwarf Sperm Whale | *Kogia sima* | Nonstrategic | Summer | Rare[d] |
| Pygmy Sperm Whale | *Kogia breviceps* | Strategic | Summer | Rare[d] |
| ***Family Ziphiidae*** | | | | |
| Blainville's Beaked Whale | *Mesoplodon densirostris* | Strategic | All year | Rare |
| Cuvier's Beaked Whale | *Ziphius cavirostris* | Strategic | All year | Rare |
| Gervais' Beaked Whale | *Mesoplodon europaeus* | Strategic | All year | Rare |
| Sowerby's Beaked Whale | *Mesoplodon bidens* | Strategic | All year | Rare |
| True's Beaked Whale | *Mesoplodon mirus* | Strategic | All year | Rare |
| ***Family Delphinidae*** | | | | |
| Atlantic Spotted Dolphin | *Stenella frontalis* | Nonstrategic | Year-round | Regular |
| Atlantic White-sided Dolphin | *Lagenorhynchus acutus* | Nonstrategic | Fall and winter | Common |
| Clymene Dolphin | *Stenella clymene* | Nonstrategic | Randomly | Hypothetical |
| Common Bottlenose Dolphin | *Tursiops truncata* | Dependent on stock:<br>• Western North Atlantic Offshore = Protected<br>• Western North Atlantic, northern migratory coastal = Depleted<br>• Coastal, Northern Migratory = Depleted and Strategic | Winter, spring, and summer | Common |
| False Killer Whale | *Pseudorca crassidens* | Nonstrategic | Randomly | Rare |
| Fraser's Dolphin | *Lagenodelphis hosei* | Nonstrategic | Randomly | Data deficient |

**Table 4.3-18. Marine Mammals in the Western North Atlantic OCS**

| Common Name | Scientific Name | Conservation Status | Seasonal Presence | Occurrence in Region[a] |
|---|---|---|---|---|
| Killer Whale | *Orcinus orca* | Nonstrategic | Randomly | Rare |
| Long-finned Pilot Whale | *Globicephala melas* | Nonstrategic | Spring | Common |
| Melon-headed Whale | *Peponocephala electra* | Nonstrategic | Randomly | Hypothetical |
| Northern Bottlenose Whale | *Hyperoodon ampullatus* | Nonstrategic | Randomly | Hypothetical |
| Pan-tropical Spotted Dolphin | *Stenella attenuata* | Nonstrategic | Randomly | Rare |
| Pygmy Killer Whale | *Feresa attenuata* | Nonstrategic | Randomly | Hypothetical |
| Risso's Dolphin | *Grampus griseus* | Strategic | All year | Common |
| Rough-toothed Dolphin | *Steno bredanensis* | Nonstrategic | Randomly | Rare |
| Short-beaked Common Dolphin | *Delphinus delphis* | Nonstrategic | All year | Common |
| Short-finned Pilot Whale | *Globicephala macrorhynchus* | Nonstrategic | Spring | Rare |
| Spinner Dolphin | *Stenella longirostris* | Nonstrategic | Randomly | Hypothetical |
| Striped Dolphin | *Stenella coeruleoalba* | Nonstrategic | All year | Rare or Regular |
| White-beaked Dolphin | *Lagenorhynchus albirostris* | Nonstrategic | All year | Regular |
| ***Family Phocoenidae*** | | | | |
| Harbor Porpoise | *Phocoena* | Strategic | All year | Common |
| ***ORDER CARNIVORA*** | | | | |
| ***Family Phocidae*** | | | | |
| Gray Seal | *Halichoerus grypus* | Nonstrategic | Winter, spring, and summer | Common |
| Harbor Seal | *Phoca vitulina concolor* | Nonstrategic | All year | Common |
| Harp Seal | *Phagophilus groenlandicus* | Nonstrategic | Winter, spring, and summer | Common |
| Hooded Seal | *Cystophora cristata* | Nonstrategic | Summer and fall | Regular |

**Table 4.3-18. Marine Mammals in the Western North Atlantic OCS**

| Common Name | Scientific Name | Conservation Status | Seasonal Presence | Occurrence in Region[a] |
|---|---|---|---|---|
| ***Order Sirenia*** | | | | |
| West Indian Manatee | *Trichechus manatus* | Endangered | Unknown | Rare |

Sources: Hayes et al., 2017; Tetra Tech EC, Inc., 2012; Kenney and Vigness-Raposa, 2010; NOAA, 2016; NOAA, 2011-2016; Kraus et al., 2016; BOEM, 2012; AECOM, 2017, Waring et al., 2012, and Waring et al. 2013

[a] Based on occurrence within OSAMP Study Area: Common = greater than 100 records, Regular = 10–100 records, Rare = fewer than 10 records, Hypothetical = the remote possibility to occur in the region at some time (Kenney and Vigness-Raposa, 2010).

Cetaceans are composed of two separate groups: Mysticetes (baleen whales) and Odontocetes (toothed whales, dolphins, and porpoise). The Odontoceti all possess teeth, and generally feed on fish and invertebrates. The Mysticeti possess large baleen filtration systems instead of teeth, which they use to sieve smaller prey out of the water. Their prey usually consists of zooplankton and small schooling fish. Both groups migrate over large distances between feeding and breeding areas. The toothed whales, dolphins, and porpoises are generally found in large, stable pods throughout their lives. Baleen whales are known to maintain small, unstable groups or remain as solitary individuals when not breeding (Wilson and Ruff, 1999). The larger species of whales are capable of very deep dives, and the smaller species generally dive to shallower depths. Cetaceans inhabit all the world's oceans, and can be found in coastal, estuarine, and pelagic habitats, including the SFWF area (Hayes et al., 2017).

The various seal species (Pinnipeds) inhabit the cooler waters of the northeast and frequent the waters and inland areas around Long Island. Pinnipeds are composed of three families: Odobenidae (the walrus), Otariidae (eared seals, including sea lions and fur seals), and Phocidae (earless seals). Phocidae are the most diverse and widespread pinnipeds and are the only family of seals with the potential to occur within the SFWF and SFEC. Historically, Long Island's seal species typically included harbor and gray seals, which are relatively abundant in these waters from late fall until late spring. In recent years, arctic species, such as harp, hooded, and ringed seals, that were once extremely rare for Long Island have been sighted (CRESLI, 2017). West Indian manatees (Sirenian) have also been sighted in the region; however, their occurrences are extremely rare. They typically occur in the southeastern United States, which is the northern limit of their range (Lefebvre et al., 2001).

Appendix P provides additional information on the biology, habitat use, abundance, distribution, and the existing threats to the marine mammals that are common to the region and have the potential to occur in the SFWF and SFEC.

**South Fork Wind Farm**

The marine mammal species that could potentially occur within the SFWF area include the following (Kraus et al., 2016; Tetra Tech EC, Inc., 2012; NOAA, 2016; AECOM, 2017):

ESA-listed species:

- Blue whale
- Fin whale
- North Atlantic right whale

- Sei whale
- Sperm whale

Non-ESA listed:

- Humpback whale
- Minke whale
- Atlantic spotted dolphin
- Atlantic white-sided dolphin
- Pygmy sperm whale
- Common bottlenose dolphin
- Long-finned pilot whale
- Risso's dolphin
- Short-beaked common dolphin
- Striped dolphin
- White-beaked dolphin
- Harbor porpoise
- Gray seal
- Harbor seal
- Harp seal
- Hooded seal

Five species of large whales listed under the ESA are known to occur in the Western North Atlantic and may also occur in the waters where the SFWF is located. It is understood that these species are highly migratory and do not spend extended periods of time in a localized area. The blue whale is observed more frequently in the north near the Gulf of the St. Lawrence or in the winter out beyond the OCS in deeper waters, so their presence within the SFWF is considered rare (NOAA, 2016). Therefore, they are not included in the assessment of potential impacts.

The remaining species listed in Table 4.3-18 have documented ranges outside the SFWF and SFEC, usually in warmer or deeper waters. The potential occurrence of these species in the SFWF and SFEC is extremely low, and they are not considered for the following impact evaluation.

**South Fork Export Cable**

Of the ESA-listed marine mammal species expected to occur within the SFWF, fin whale, North Atlantic right whale, and sperm whale could also occur along the SFEC, but are more likely found in deeper, offshore waters, except in the rare case of a stranding along the Long Island shoreline. As described in more detail in Appendix P, seasonal aggregations of these species have been recorded in the waters south of Block Island and Martha's Vineyard near the SFEC - OCS route. Sei whale and blue whale are rare to the SFEC - OCS and SFEC – NYS, as they are associated with deeper waters along the continental shelf edge (Waring et al., 2016).

Of the non-ESA listed marine mammal species discussed for the SFWF, some could also occur along the SFEC, with a greater likelihood of occurrences in the deeper waters of the SFEC - OCS. Species such as Atlantic spotted dolphin, long-finned pilot whale, Risso's dolphin, striped dolphin, white-beaked dolphin, harp seal, and hooded seal are considered rare visitors to the waters between the SFWF and Long Island. However, in the nearshore areas of the SFEC - NYS, humpback whale, minke whale, Atlantic white-sided dolphin, bottlenose dolphin, short-beaked dolphin, harbor porpoise, gray seal, and harbor seal are documented in sightings and stranding records along the southern reaches of Long Island, Block Island, and nearshore waters. Appendix P provides a more detailed description of potential occurrences of non-ESA listed marine mammals along the SFEC.

Seasonal densities for species are used as an indicator of presence or absence and relative abundance in the vicinity of the SFWF and SFEC. For marine mammals, Roberts et al. (2016) established cetacean species densities using habitat suitability modeling that was based on long-term population assessment surveys conducted by state and federal entities. These densities were calculated by averaging the seasonal densities for all 38.6 square miles (100 $km^2$) of habitat density rasters established by Roberts et al. (2016) that fell inside or immediately adjacent to the boundaries of the North Lease Area (OCS-A 0486). The seasonal densities derived from the monthly habitat density data for marine mammal species expected in the SFWF area are provided in Table 4.3-19. Pinniped densities are derived from the Strategic Environmental Research and Development Program (SERDP)/Navy OPAREA Density Estimates (NODE) for the Atlantic model (DoN, 2007).

**Table 4.3-19. Estimated Marine Mammal Species Densities for the North Lease Area (OCS-A 0486)**

| Common Name | Scientific Name | Spring Density (animals/km2) | Summer Density (animals/km2) | Fall Density (animals/km2) | Winter Density (animals/km2) |
|---|---|---|---|---|---|
| **Sperm Whale**[a] | *Physeter macrocephalus* | 0.0000903 | 0.0000892 | 0.0000516 | 0.0000587 |
| Risso's Dolphin | *Grampus griseus* | 0.0000009 | 0.0000056 | 0.0000049 | 0.0000016 |
| Long-finned Pilot Whale | *Globicephala melas* | 0.0015364 | 0.0015364 | 0.0015364 | 0.0015364 |
| Atlantic White-sided Dolphin | *Lagenorhynchus acutus* | 0.0126859 | 0.0125246 | 0.0165055 | 0.0250780 |
| Common Dolphin | *Delphinus delphis* | 0.0318832 | 0.0559083 | 0.0606305 | 0.0214570 |
| Bottlenose Dolphin | *Tursiops truncatus* | 0.0038167 | 0.0194380 | 0.0209580 | 0.0078848 |
| Harbor Porpoise | *Phocoena* | 0.0582297 | 0.0057588 | 0.0070329 | 0.0631460 |
| **Fin Whale**[a] | *Balaenoptera physalus* | 0.0021156 | 0.0023273 | 0.0019074 | 0.0021711 |

**Table 4.3-19. Estimated Marine Mammal Species Densities for the North Lease Area (OCS-A 0486)**

| Common Name | Scientific Name | Spring Density (animals/km2) | Summer Density (animals/km2) | Fall Density (animals/km2) | Winter Density (animals/km2) |
|---|---|---|---|---|---|
| **Sei Whale**[a] | *Balaenoptera borealis* | 0.0001945 | 0.0000528 | 0.0000037 | 0.0000935 |
| Minke Whale | *Balaenoptera acutorostrata* | 0.0004741 | 0.0004627 | 0.0003255 | 0.0006353 |
| Humpback Whale | *Megaptera novaeangliae* | 0.0009731 | 0.0014995 | 0.0019871 | 0.0008451 |
| **North Atlantic Right Whale**[a] | *Eubalaena glacialis* | 0.0113534 | 0.0000538 | 0.0001096 | 0.0003484 |
| Harbor Seal[b] | *Phoca vitulina* | 0.0974300 | 0.0000000 | 0.0974300 | 0.0974300 |
| Gray Seal[b] | *Halichoerus grypus* | 0.1411600 | 0.1411600 | 0.1411600 | 0.1411600 |

[a] Common names in bold text indicate whales protected under the ESA (16 U.S.C. Ch. 35 § 1531 et seq.)

[b] Seal densities derived from SERDP/ NODE for the Atlantic model (DoN, 2007).

### 4.3.4.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the SFWF and SFEC have the potential to impact marine mammals, as presented on Figure 4.3-9. The IPFs with potential to result in negligible and greater impacts on marine mammals are evaluated in this section.

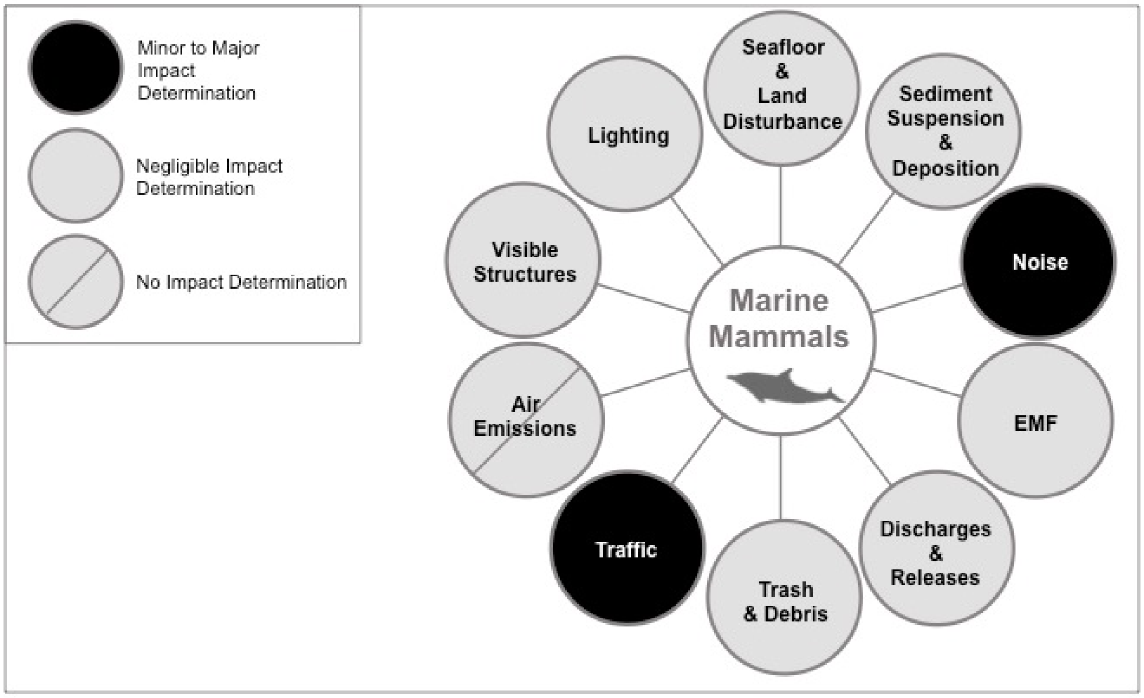


**Figure 4.3-9. IPFs on Marine Mammals**

**South Fork Wind Farm**

This section summarizes the assessment of potential impacts on marine mammals detailed in Appendix P. The primary IPFs associated with the SFWF that could impact marine mammals are underwater noise from construction and vessel traffic, in the case of vessel strikes and entanglement in vessel anchor lines. The potential impacts associated with each phase of the SFWF are addressed in the following sections.

***Construction***

Table 4.3-20 summarizes the level of impacts expected to occur to marine mammals during the construction and decommissioning phases of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-20. IPFs and Potential Levels of Impact on Marine Mammals at the SFWF during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Seafloor/Land Disturbance | Seafloor Preparation | Negligible short-term localized |
| | Foundation Installation | Negligible short-term localized |
| | Vessel Anchoring | Negligible short-term localized |
| | Inter-array Cable Installation | Negligible short-term |
| Sediment Suspension and Deposition | | Negligible short-term localized |
| Noise | Pile driving | Minor to Major short-term |
| | Equipment Uses | Minor to Major short-term |
| | Vessel traffic | Negligible to Minor short-term |
| Discharges and Releases | | Negligible indirect |
| Trash and Debris | | Negligible indirect |
| Traffic | Increased Vessels | Minor to Moderate short-term |
| | Entanglement | Negligible short-term |
| Lighting | Navigational and Deck Lighting | Negligible short-term |

**Seafloor and Land Disturbance**

During construction, seafloor disturbances would be associated with seafloor preparation, foundation installation, vessel anchoring, and cable installation. Some limited benthic habitat conversion will occur, as described in Section 4.3.2. Marine mammals occurring in the SFWF would likely be transiting the area in search of prey species, which would rarely be benthic species. In the unlikely event that marine mammals forage on the seafloor in the SFWF and could be displaced from those areas because of SFWF construction, the impacts would be ***negligible*** because they are limited to those few impacted individuals and not groups or populations of marine mammals. The conversion of seabed habitat will be relatively minor when compared to the large expanse of similar habitat available in the region so that marine mammals would find comparable benthic habitat for feeding or resting.

**Sediment Suspension and Deposition**

As discussed in Section 4.1 and again in Section 4.2.2, SFWF inter-array installation will result in short-term, localized increases in sedimentation close to the seafloor and several feet up and outward into the water column (i.e., increased turbidity). Because of the short-term and localized increases in turbidity and decreases in water quality from SFWF inter-array cable installation, ***negligible impacts*** would be anticipated to the few marine mammals that may be located near the cable installation activities. As discussed in the next section, underwater construction noise is likely to repel marine mammals from the area before they are impacted by increased turbidity.

**Noise**

Underwater noise is the primary construction-related IPF that could impact marine mammals if they are present in the area at the time of SFWF construction. Dependent on many factors, as detailed in the underwater acoustic assessment (Appendix J) and marine mammal impact assessment (Appendix P), elevated underwater SPLs can cause physiological impacts or behavioral modifications on marine mammals. Noise will be generated during the construction phase of the SFWF from pile driving, equipment uses, and vessel traffic. Pile driving and DP vessel thruster usage are identified as the activities that would likely have the greatest potential for impacts on marine mammals. As discussed in the IPF section (Section 4.1), above water noise during construction would result in ***negligible impacts*** to marine mammals. Therefore, the potential for above water noise impacts to marine mammals is not further discussed in the assessment.

Not all marine mammals have identical hearing capabilities or are equally susceptible to noise-induced hearing loss. Therefore, they have been delineated into five functional hearing groups based on their similarities in hearing. The five groups include (1) low-frequency cetaceans (LFCs) (Mysticetes), (2) mid-frequency cetaceans (MFC) (Odontocetes), (3) high-frequency cetaceans (HFC) (true porpoises), (4) Phocid pinnipeds in water (PPW) (true seals), and (5) Otariid pinnipeds (OW) (sea lions and fur seals). Otariid pinnipeds do not occur in the North Atlantic; therefore, they are not further discussed in this assessment. Table 4.3-21 defines the generalized hearing ranges for each hearing group (NMFS, 2016).

**Table 4.3-21. Marine Mammal Hearing Groups**

| Hearing Group | Species or Taxonomic Groups (Relevant Species Examples) | Generalized Hearing Range[a] |
|---|---|---|
| LFC | Baleen whales (e.g., fin whale, North Atlantic right whale, sei whale) | 7 Hz to 35 kilohertz (kHz) |
| MFC | Dolphins, toothed whales (e.g., sperm whale), beaked whales, bottlenose dolphins | 150 Hz to 160 kHz |
| HFC | True porpoises (e.g., harbor porpoise) | 275 Hz to 160 kHz |
| PPW | True seals (e.g., harbor seal, gray seal) | 50 Hz to 86 kHz |
| OW [b] | Sea lions and fur seals | 60 Hz to 39 kHz |

Source: NMFS, 2016.

[a] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on an approximate 65 dB threshold from normalized composite audiogram, with the exception for lower limits for LFC (Southall et al., 2007) and PPW (approximation).

[b] OW do not occur in the North Atlantic or the SFWF and SFEC.

The MMPA defines harassment in two levels: Level A and Level B. Level A is defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; and Level B is defined as any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavior patterns, including migration, breathing, nursing, breeding, feeding, or sheltering, but does not have the potential to injure a marine mammal or marine mammal stock (NMFS, 2016).

NOAA (2016) further defines regulatory criteria in protecting marine mammals by setting hearing thresholds. These acoustic thresholds (i.e., TTS and PTS) are used to help assess and quantify exposures from the proposed activities.

Table 4.3-22 provides the underwater acoustic thresholds levels for impulsive and nonimpulsive sounds associated with PTS onset (Level A Harassment) for marine mammals found in the North Atlantic (NMFS, 2016). A description of the impulsive and nonimpulsive sound sources associated with the Project are provided in Appendix J.

**Table 4.3-22. Summary of NOAA-NMFS PTS Onset Acoustic Thresholds**

| Hearing Group | Impulsive | Nonimpulsive |
|---|---|---|
| LFC | $L_{pk,flat}$: 219 dB<br>$L_{E,LF,24h}$: 183 dB | $L_{E,LF,24h}$: 199 dB |
| MFC | $L_{pk,flat}$: 230 dB<br>$L_{E,MF,24h}$: 185 dB | $L_{E,MF,24h}$: 198 dB |
| HFC | $L_{pk,flat}$: 202 dB<br>$L_{E,HF,24h}$: 155 dB | $L_{E,HF,24h}$: 173 dB |
| PPW | $L_{pk,flat}$: 218 dB<br>$L_{E,PPW,24h}$: 185 dB | $L_{E,PPW,24h}$: 201 dB |

Source: NMFS, 2016.

Notes:

Listed are PTS Onset Thresholds (Received Level) with dual metric acoustic thresholds for impulsive sounds. Use whichever results in the largest isopleth for calculating PTS onset. If a nonimpulsive sound has the potential of exceeding the peak SPL thresholds associated with impulsive sounds, these thresholds should also be considered.

Peak sound pressure ($L_{pk}$) has a reference value of 1 µPa, and cumulative sound expose level ($L_E$) has a reference value of 1 $\mu Pa^2 s$.

In this table, thresholds are abbreviated to reflect American National Standards Institute (ANSI) standards. However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this technical guidance. Hence, the subscript "flat" is included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LFC, MFC, HFC, and PPW) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

The NMFS' 2016 *Technical Guidance for Assessing the Effects of Anthropogenic Sound in Marine Mammal Hearing* has provided TTS for marine mammals. Table 4.3-23 outlines the acoustic threshold limits for Level B for marine mammals.

**Table 4.3-23. Level B Acoustic Thresholds for Marine Mammals Possibly Transiting the SFWF and SFEC**

| Criterion | Acoustic Threshold (SELcum) |
|---|---|
| Possible Behavioral Disruption (for impulsive SPL) | 160 dB |
| Possible Behavioral Disruption (for continuous SPL) | 120 dB |

Source: NMFS, 2016

SELcum = sound exposure level cumulative

**Impulse Sound – Impact Pile-driving**

Potential acoustical impacts on marine mammals because of pile driving is the primary impact addressed in this assessment. Underwater acoustic modeling was conducted to estimate the impacts from construction-related, noise-producing activities, such as pile driving, vibratory pile driving, and dynamically positioning vessel thrusters. Appendix J provides predicted sound propagation distances based on key operational variables associated with the SFWF and SFEC design envelope, such as: hammer type, pile type, pile schedule (hammer energy/number of strikes), season, geographic location, and implementation of noise mitigation (i.e., sound attenuation) measures. Sound attenuation systems are discussed in the context of possible protection measures that will be implemented by DWSF during construction. They are also explained in the context of underwater acoustic modeling in Appendix J and Appendix P.

The minimum and maximum acoustic isopleth distances produced by modeled pile-driving scenarios (impulsive sounds) were summarized for all potential pile-driving operations. Results for the distances to Level A and Level B isopleths for nonattenuated pile installation over a single 24-hour period are presented in Table 4.3-24.

**Table 4.3-24. Minimum and Maximum Ranges to Acoustic Criteria Threshold Produced during Modeled Pile-driving Scenarios without Sound Attenuation Applied**

| Distances to Level A Thresholds | | | | Distances to Level B Thresholds | | |
|---|---|---|---|---|---|---|
| Pile Installation with No Sound Attenuation (0 dB) | | | | | | |
| Faunal Group | Minimum | Maximum | | Faunal Group | Minimum | Maximum |
| LFC $L_{E,24hr}$ | 10,951 feet<br>3,338 m | 20,361 feet<br>6,206 m | | LFC $L_{p,}$ Weighted | 6,096 feet<br>1,858 m | 26,499 feet<br>8,077 m |
| MFC $L_{E,24hr}$ | 0 feet<br>0 m | 184 feet<br>56 m | | MFC $L_{p,}$ Weighted | 1,394 feet<br>425 m | 9,918 feet<br>3,023 m |
| HFC $L_{pk}$ | 16 feet<br>5 m | 2,461 feet<br>750 m | | HFC $L_{p,}$ Weighted | 820 feet<br>250 m | 8,570 feet<br>2,612 m |
| PPW $L_{E,24hr}$ | 581 feet<br>177 m | 1,562 feet<br>476 m | | PPW $L_{p,}$ Weighted | 3,596 feet<br>1,096 m | 14,521 feet<br>4,426 m |

Where the ranges to the thresholds provide approximations of the distances from the noise-producing activity (pile driving) where marine mammals may be exposed to noise levels of concern, the zone of influence (ZOI) is the areal extent of the isopleth that reaches the selected threshold. The ZOI is a parameter applied to predict the potential impacts to species because it encompasses the habitats where species conduct their activities. In this way, species' occupation and use of the ZOI is a much better predictor of potential impacts rather than discrete distances to specific thresholds. The ZOIs for each of the marine mammal faunal groups are provided in Table 4.3-25. ZOIs are provided based on modeled scenarios with no noise mitigation (attenuation) in place.

**Table 4.3-25. Zones of Influence for Marine Mammal Faunal Groups**

| LFC | | | | MFC | | | |
|---|---|---|---|---|---|---|---|
| Level A (injury) | | Level B (behavior) | | Level A | | Level B | |
| Min | Max | Min | Max | Min | Max | Min | Max |
| 35.0 | 121.0 | 10.8 | 204.9 | 0.0 | 0.0 | 0.6 | 28.7 |
| HFC | | | | PPW | | | |
| Level A | | Level B | | Level A | | Level B | |
| Min | Max | Min | Max | Min | Max | Min | Max |
| 0 | 1.8 | 0.2 | 21.4 | 0.1 | 0.7 | 3.8 | 61.5 |

Note: All units in $km^2$.

Based on the exposure estimates, impacts to marine mammals during pile driving for the SFWF would likely be ***minor*** with a few seasonal exceptions where impacts could be a ***major***. For example, the risk of acoustic exposures to North Atlantic right whales is very high during spring; however, outside of spring, the risk of exposure to North Atlantic right whales is very low. The implementation of noise mitigation capable of achieving 6 or 12 dB noise reductions during pile driving reduces the exposure risk to minimal for most species (Appendix P).

**Nonimpulsive Sound – Vessel Noise**

The noise from Project-related vessel traffic is expected to be similar to existing vessel-related underwater noise levels in the area. Thus, it is presumed that individual or groups of marine mammals in the area are familiar with various and common vessel-related noises and will not be further impacted by Project-related vessel traffic. The use of DP cable-laying vessels for the SFWF inter-array cable and SFEC is an exception. The dominant underwater noise source on the DPV is due to cavitation on the propeller blades of the thrusters (e.g., Leggat et al., 1981). The noise power from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed. The noise from the DP thrusters is nonimpulsive and typically more dominant than mechanical or hydraulic noises from the cable trenching equipment.

Hydroacoustic modeling of nonimpulsive (continuous) sounds from DP thruster operations and vibratory hammer (discussed in the following section for SFEC construction) use was conducted to represent DP cable-laying vessel use for both the SFWF inter-array and SFEC cable-laying at two representative locations: offshore and nearshore. The results of the modeling are presented in Appendix J. Table 4.3-26 shows the average distances to Level A and Level B thresholds for marine mammal functional hearing groups along the SFEC corridor and inter-array cable routes. Table 4.3-27 shows the ZOI based on the ranges provided in Table 4.3-27.

**Table 4.3-26. Maximum Distances to Regulatory Acoustic Thresholds, Averaged across Seasons, during Operation of Thrusters on a Dynamically Positioned Vessel along the Cable Lay Route**

| Faunal Group | Distances (m) to Level A (Physiological) Thresholds | Distances (miles [km, nm]) to Level B (Behavioral) Thresholds |
|---|---|---|
| LFC $L_{E,24hr}$ | 112 | 14 (734, 12.2) |
| MFC $L_{E,24hr}$ | 35 | 14 (734, 12.2) |
| HFC $L_{pk}$ | 103 | 14 (734, 12.2) |
| PPW $_{LE,24hr}$ | 50 | 14 (734, 12.2) |

**Table 4.3-27. Maximum Zone of Acoustic Influence Produced by Continuous Sounds from Dynamically Positioned Cable-laying Vessel Operations and Vibratory Hammer Pile Driving**

| Faunal Group | Zone of Acoustic Influence (km2) for Level A and Physiological | Zone of Acoustic Influence (km2) for Level B and Behavior |
|---|---|---|
| ***DP Cable-laying Vessel operations*** | | |
| LFC | 0.03 | 681 |
| MFC | 0.003 | 681 |
| HFC | 0.03 | 681 |
| PPW | 0.007 | 681 |
| ***Vibratory Hammer Pile Driving*** | | |
| LFC | 6.7 | 4,246.4 |
| MFC | 0 | 4,246.4 |
| HFC | 0.01 | 4,246.4 |
| PPW | 0.03 | 4,246.4 |

The impact of underwater continuous sound from the SFWF inter-array installation on marine mammals is expected to be ***short-term*** and ***negligible*** to ***minor***. If impacts to marine mammals from DP occur, then they will not be extensive or severe because of the relatively low density of mammals expected to occur in the region and the short duration of the activity (i.e., 30 to 40 days of cable-laying in the SFWF). Those few individuals exposed to noise levels over the Level B threshold might experience short-term disruption of communication or echolocation from auditory masking; behavior disruptions; or limited, localized, and short-term displacement from ensonfied areas around the vessels.

**Discharges and Releases, / Trash and Debris**

During construction of the SFWF, sanitary and other waste fluids, trash, and miscellaneous debris will be generated but properly managed in accordance with federal and state laws. Accidental discharges, releases, and disposal do represent a risk factor to marine mammals because they could potentially ingest or become entangled in debris, causing lethal or injurious impacts. As explained in Sections 4.1.5. and 4.1.6., the total quantities of hazardous and nonhazardous materials would be small and strictly managed. An OSRP (Appendix D) has been developed describing the procedures to be employed when responding to an oil spill, or the substantial threat of an oil discharge from any SFWF or SFEC component. DWSF and its contractors will also maintain SPCC plans during construction. Therefore, impacts on marine mammals from discharges, releases, trash, and debris are considered ***negligible*** because of the low likelihood of such routine and accidental events.

**Vessel Traffic – Strikes**

Short-term construction vessel traffic will occur over a 1- to 2-year period. Project-related vessel traffic will slightly increase vessel traffic within the area, but the number of vessels that operate for SFWF construction and decommissioning is expected to be a ***negligible*** addition to the normal traffic in the region (Appendix X, SFWF Navigational Safety Risk Assessment). Vessel collisions with marine mammals is not uncommon, and if they were to occur, would likely result in animal injury or death.

Vessel strikes happen when either whales or vessels fail to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a collision include vessel speed, vessel size and type, and visibility. Whale strikes have been reported at vessel speeds of 2 to 51 knots, and lethal or severe injuries are most likely to occur at speeds of 14 knots or more. Vessel types involved include Navy vessels, container and cargo ships, freighters, cruise ships, and ferries. Generally, the larger the vessel size (262 feet [80 m] or more), the more likely a collision will result in fatal or severe injuries (DOI-MMS, 2007).

Whale species that are most frequently involved in vessel collisions include fin whale, North Atlantic right whale, humpback whale, minke whale, sperm whale, sei whale, gray whale, and blue whale (Dolman et al., 2006). Smaller cetaceans and pinnipeds are also at risk of vessel strikes; however, these species tend to be more agile power simmers and are more capable of avoiding collisions with oncoming vessels (DOI-MMS, 2007).

Construction vessel traffic will result in a relatively ***short-term*** and ***localized impact*** around the SFWF, increasing the volume and movement of vessels in the SFWF. Large work vessels for foundation and WTG installation will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly and over a short distance between work locations. Transport vessels will travel between several ports and the SFWF over the course of the construction period. These vessels will range in size from smaller crew transport boats to tug and barge vessels. Dependent on the time of year, the Project-related increase in vessel traffic will be ***negligible*** when compared to other vessel operations within the area.

To mitigate marine mammal vessel strikes, BOEM and NOAA will expect DWSF to abide by vessel strike avoidance measures based on NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008). Adherence to these provisions would further reduce the risk of associated vessel strikes or disturbance to marine mammals that might result from the proposed SFWF construction activity. It is not anticipated that the SFWF would cause a significant increase in frequency of vessel collisions to marine mammals; therefore, impacts caused by construction vessels would be considered ***minor***. However, because of low population estimates for threatened and endangered whale species that may occur in the area, vessel collisions could be detrimental to their population; therefore, impacts to ESA-listed species would be considered ***moderate***.

Entanglement of marine mammals can occur from the Project vessel traffic if lines, cables, or other tethered gear are placed in the water. However, since the only lines that will potentially be deployed would be steel anchor lines that will be under significant tension and short-term, it would be highly unlikely that marine mammals would become entangled. Therefore, the expected impact to marine mammals from entanglement would be ***negligible***.

**Lighting**

Artificial lighting during SFWF construction will be associated with navigational and deck lighting on vessels from dusk to dawn. It is likely that reaction of marine mammals to this artificial light is species-dependent and may include attraction or avoidance of an area. Because of the limited area associated with the artificial lighting used on Project vessels relative to the surrounding unlit areas, the impacts are expected to be ***negligible*** and ***short-term*** for marine mammals during construction.

### *Operations and Maintenance*

Table 4.3-28 summarizes the level of impacts expected to occur to marine mammals during the O&M phase of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-28. IPFs and Potential Levels of Impact on Marine Mammals at the SFWF during Operation and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Noise | Continuous Mechanical Noise | Minor to Moderate long-term |
| Traffic | Collision | Negligible short-term localized |

**Seafloor Disturbance**

The installation of the foundations and resulting conversion of existing sandy bottom to hard bottom habitat may produce a "reef effect" that will attract benthic and pelagic fish species similar to those found in rocky/reef outcrop habitat (Wilhelmsson et al., 2006; Reubens et al., 2007). This could potentially lead to an increased number of marine mammals using this habitat for foraging. Russel et al (2014) observed harbor and grey seals displaying concentrated foraging efforts around windfarms with site fidelity indicating successful foraging behavior. Impacts from the conversion of habitat to hard bottom would have measurable but not adverse impacts on only a few marine mammal species and are therefore expected to be ***negligible, long-term*** and ***indirect*** based on the pre-defined impact characterizations in Section 4.

**Underwater Noise**

Operating WTGs produce mechanical noise that transmits underwater through the towers and pilings, resulting in *continuous* underwater sounds. The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions (Miller et al., 2010). Underwater noise from turbines has been measured within the hearing frequency of marine mammals; but at the anticipated levels, the impacts would be limited to audibility and perhaps some degree of behavioral response or auditory masking, (DOI-MMS, 2007). Behavioral responses include changes in foraging, socialization, or movement, while auditory masking could impact foraging and predator avoidance. Estimated underwater sound levels are summarized in Section 4.1.3, which reference sources that WTG sounds that have been documented to range from 90 to 128 dB re 1 μPa in relative proximity (150 to 350 feet [46 to 107 m]) to operational turbines.

It is presumed that although wind turbine noise during O&M will persist for longer periods of time and impact more species, compared to noise produced by construction (DOI-MMS, 2007), the impacts to marine mammals during O&M will be smaller than during the construction phase (Scheidat et al., 2011). Studies conducted on the harbor seal indicate that abundance may be reduced during the construction phase, but that population sizes during the operational phase can return to preconstruction levels (Vellejo et al., 2017).

Additionally, Scheidat et al. (2011) indicated that harbor porpoise population sizes can be higher within wind farms compared to reference areas. Reasons for this may be an increased food supply (Vellejo et al., 2017) or habituation to the noise produced from turbines (Teilmann and Carstensen, 2012). Operational wind turbines sampled are only audible to harbor porpoises at distances of 207 feet (63 m) or less (English et al., 2017). While underwater noise during O&M is anticipated to result in ***minor*** impacts to marine mammals, if long-term avoidance behaviors by marine mammals result in potential abandonment of feeding grounds or migratory routes near the SFWF, then ***long-term, minor*** to ***moderate impacts*** could be expected.

**Electromagnetic Field**

Available evidence for marine mammals and sea turtles does not indicate that these species are capable of detecting the magnetic fields associated with the Project’s 60-Hz AC cables. In particular, marine mammal surveys conducted at offshore windfarm sites indicate no adverse long-term impacts to these species. Appendix K has a more detailed discussion about the potential impacts of EMF on marine mammals. EMF is expected to be present near the cable, and marine mammals must surface to breathe. So, such behavior is expected to limit time spent near cables. Furthermore, the broad scale of marine mammal migrations and the generally low density of individuals within a given area are also expected to lower the likelihood that individuals will regularly encounter the cable route and Project-associated EMF. This broad distribution and movement means that the SFWF represents a small portion of the available habitat for migratory marine mammals. ***Negligible impacts*** from EMF during O&M are expected.

**Vessel Traffic**

The potential impacts of vessel collision during O&M on marine mammals would be less than those identified in the construction phase of the SFWF because the volume of vessel traffic will be much less than traffic experienced during construction, and negligibly contribute to existing vessel traffic in the area. Vessel strike impacts during SFWF O&M are anticipated to be ***negligible***.

### *Decommissioning*

During decommissioning activities, marine mammals could be impacted by underwater noise generated by the dismantling of the WTGs and potential collisions with the decommissioning vessels. Decommissioning would conceptually reverse the sequence of construction steps to dismantle or remove the SFWF. Decommissioning activities resulting in underwater noise and vessel traffic are expected to be less intensive than the activities associated with the construction phase of the Project. A more detailed description of decommissioning activities is provided in Section 3.1.5. Impacts to marine mammals would be considered ***negligible***.

## South Fork Export Cable

Construction, O&M, and decommissioning activities associated with the SFEC have the potential to impact marine mammals. This section summarizes the potential impacts on marine mammals from activities associated with the SFEC. IPFs that could have potential impacts include underwater noise and vessel traffic. Impacts associated with each phase of the SFEC are addressed in the following sections.

### SFEC - OCS and SFEC - NYS

#### *Construction*

Table 4.3-29 summarizes the level of impacts expected to occur to marine mammals during the construction and decommissioning phases of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-29. IPFs and Potential Levels of Impact on Marine Mammals at the SFEC during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Noise | Installation of Cable | Minor to Moderate short-term |
| | Vibratory Hammering of Sheet Piles for Cofferdam | Negligible short-term |
| EMF | Cable | Negligible short-term localized |
| Traffic | Increased Vessels | Negligible short-term |

**Underwater Noise**
As described for the SFWF inter-array cable, the impacts of underwater noise generated from Project construction vessels on marine mammals are expected to be ***short-term*** and ***negligible***. ***Short-term, minor*** *to* ***moderate*** behavioral impacts can also occur during SFEC installation if marine mammals are within the ZOI of the nonimpulsive sound generated by the DP thrusters. However, the likelihood of measurable impacts to marine mammals is low because SFEC installation will occur over a relatively short timeframe (i.e., less than 30 to 40 days); and depending on the time of year of installation, few marine mammals would be expected in the region. As the cable-laying operation enters SFEC - NYS waters, the likelihood of impact decreases with the lower occurrence of marine mammals in nearshore waters, with the possible exception of some dolphins, porpoises, and seals, which may be found closer to shore on a seasonal basis.

Construction of a cofferdam will be required for the nearshore SFEC connection and will require vibratory hammering of sheet piles. This construction method differs from the pile driving associated with the SFWF foundations in several ways. The location is close to shore, the duration of the installation is estimated to be short (roughly 12 to 24 hours), and the source type is nonimpulsive, compared to impulsive for the SFWF pile driving. From a marine mammal impact perspective, nonimpulsive noise generated by the DP and vibratory hammer is viewed through the same regulatory thresholds as explained in both Appendices J and P and discussed in the SFWF section. Therefore, marine mammal impacts from vibratory hammering of sheet piles for the SFEC cofferdam are expected to be ***short-term*** and ***negligible***.

**Traffic**
The potential impacts of vessel traffic on marine mammals would be similar to those discussed above for the SFWF; however, the occurrence of impacts would be less likely because fewer vessels are required for SFEC installation. As the SFEC installation activity approaches the

landing site in the SFEC - NYS, few marine mammals are expected in the area because of the shallow water.

***Operations and Maintenance***

Table 4.3-30 summarizes the level of impacts expected to occur to marine mammals during the O&M phase of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-30. IPFs and Potential Levels of Impact on Marine Mammals at the SFEC during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Traffic | Collision | Negligible short-term localized |
| EMF | | Negligible localized |

**Traffic**
The potential impacts of vessel collision will be similar to those identified in the SFWF.

**Electromagnetic Fields**
The potential EMF impacts from the SFEC on marine mammals is similar to that described for the SFWF inter-array cable. Impacts to marine mammals relating to the EMF emitted from the SFEC will be ***negligible*** because of the low density of marine mammals in the water, their habit of surfacing for air, and the relatively narrow corridor occupied by the SFEC.

**Discharges and Releases / Trash and Debris**
The potential for exposure and impacts will be similar to those identified in the SFWF, and impacts on marine mammals from discharges, releases, trash, and debris are considered ***negligible*** because of the low likelihood of such routine and accidental events.

***Decommissioning***

Impacts expected to marine mammals would be similar to impacts during installation, assuming that similar vessels are used for the removal activity.

### 4.3.4.3 Potential Environmental Protection Measures

The implementation of noise mitigation capable of achieving 6 or 12 dB noise reductions during pile driving reduces the exposure risk to minimal for most species. Environmental protection measures will be implemented to minimize impacts on marine mammals to the maximum extent possible, including the use of noise attenuation and ramp-up, soft-start, and shutdown pile-driving procedures. DWSF will consider the use of technically and commercially feasible noise attenuation technology. More on marine mammal impact mitigation is presented at the end of this section.

Several environmental protection measures will reduce potential impacts to marine mammals.

- Exclusion and monitoring zones for marine mammals will be established for pile driving activities and HRG survey activities.
- Mitigation measures will be implemented for pile driving and HRG survey activities. These measures will include soft-start measures, shut-down procedures, marine mammal monitoring protocols, and use of qualified and NOAA-approved protected species observers, as appropriate.

- Pile driving activities will not occur at the SFWF from November 1 – April 30 to minimize potential impacts to the North Atlantic right whale.
- Vessels will follow NOAA guidelines for marine mammal strike avoidance measures, including vessel speed restrictions.
- All personnel working offshore will receive training on marine mammal awareness and marine debris awareness.
- DWSF will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).
- The SFWF inter-array cable and SFEC - Offshore will be buried to a target depth of 4 to 6 feet (1.2 to 1.8 m).

DWSF intends to comply with federal regulations and guidelines to avoid and minimize impacts to marine mammals and has identified several potential measures based on protocols and procedures that have been successfully implemented for similarly approved offshore projects for marine mammals and other protected marine species.

## 4.3.5 Sea Turtles

The description of the affected environment of sea turtles, including documentation of regional occurrences and Project-related impact evaluation provided in this section, are based on the most recent literature and studies available that focus on renewable energy sites in the Mid-Atlantic and New England regions, including the Massachusetts Wind Energy Area (WEA), RI-MA WEA, OSAMP area, and the New York Offshore Planning Area. Studies encompassing these areas that were used for this assessment include the NOAA NEFSC's Atlantic Marine Assessment Program for Protected Species (AMAPPS) (Palka, 2010, 2011, 2012, 2013, 2014, and 2015), and the *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles* (Kraus et al., 2016), Remote Marine and Onshore Technology surveys for NYSERDA (Normandeau, 2016a, 2016b, 2017a, 2017b, 2017c, and 2018) and a technical report *Marine Mammals and Sea Turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound and Nearby Waters: An Analysis of Existing Data for the Rhode Island Ocean Special Management Area Plan* (Kenney and Vigness-Raposa, 2010). In support of the sea turtle impact evaluation, DWSF has completed a comprehensive underwater acoustic modeling effort (Appendix J) and a detailed impact assessment for marine mammals, sea turtles, and sturgeon (Appendix P).

### 4.3.5.1 Affected Environment

**Regional Overview**

There are four sea turtle species that are commonly found throughout the continental shelf and slope waters of the northwest Atlantic Ocean. These species are the green sea turtle (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). A fifth species, hawksbill sea turtle (*Eretmochelys imbricata*), may potentially occur within the region. However, it is considered extremely rare because this species is commonly found in tropical waters and coral reef habitats (GARFO, 2017). The first four species are listed as endangered or threatened. The USFWS and NMFS share the responsibility for sea turtle recovery under the authority of the ESA.

### South Fork Wind Farm

Table 4.3-31 lists the sea turtles that may occur within the vicinity of the SFWF because they are documented within the regional waters of the Western North Atlantic OCS. See Appendix P for additional information on listed species.

**Table 4.3-31. Sea Turtles That Occur within the Regional Waters of the Western North Atlantic OCS**

| Species | Status[a] | Presence[b] | Species Occurrence in the SFWF[c] |
|---|---|---|---|
| Green Sea Turtle (North Atlantic DPS) | Threatened | May to November | Unlikely |
| Kemp's Ridley Sea Turtle | Endangered | May to November | Unlikely |
| Leatherback Sea Turtle | Endangered | May to November | Likely |
| Loggerhead Sea Turtle (Northwest Atlantic Ocean DPS) | Threatened | May to November | Likely |

[a] ESA

[b] GARFO, 2017

[c] Kraus et al., 2016; Palka, 2010, 2011, 2012, 2013, 2014, 2015, and 2016; Palka et al., 2016; and Normandeau, 2016a, 2016b, 2017a, 2017b, 2017c, and 2018

### South Fork Export Cable

### SFEC – OCS and SFEC - NYS

In offshore and the coastal waters of New York, four species of sea turtles, loggerhead, green sea turtle, Kemp's ridley, and leatherbacks, have been documented (Morreale et al., 1992). Many of these reports are of cold-stunned or stranded sea turtles found along the Long Island, New York coastline.

The northeast coast, including areas around Long Island, contains a variety of marine habitats that are suitable for these sea turtles, such as shallows, enclosed waters of the Peconic, and the southern bays and the deeper waters of Long Island Sound and the Atlantic Ocean (Burke et al., 1993). Table 4.3-32 summarizes the sea turtles that could potentially occur within the SFEC - OCS and SFEC – NYS, while Table 4.3-33 summarizes the estimated seasonal densities of these species. See Appendix P for additional information on listed species.

**Table 4.3-32. Sea Turtles Occurring within the SFEC - OCS and SFEC - NYS**

| Species | Status [a] | Presence [b] | Species Occurrence – SFEC - OCS [c] | Species Occurrence – SFEC - NYS [c] |
|---|---|---|---|---|
| Green Sea Turtle (North Atlantic DPS) | Threatened | May to November | Unlikely | Unlikely |
| Kemp's Ridley Sea Turtle | Endangered | May to November | Unlikely | Likely |
| Leatherback Sea Turtle | Endangered | May to November | Likely | Likely |
| Loggerhead Sea Turtle (Northwest Atlantic Ocean DPS) | Threatened | May to November | Likely | Likely |

**Table 4.3-32. Sea Turtles Occurring within the SFEC - OCS and SFEC - NYS**

| Species | Status [a] | Presence [b] | Species Occurrence – SFEC - OCS [c] | Species Occurrence – SFEC - NYS [c] |
|---|---|---|---|---|

[a] ESA

[b] GARFO, 2017

[c] Kraus et al., 2016; Palka, 2010, 2011, 2012, 2013, 2014, 2015, and 2016; and Normandeau, 2016a, 2016b, 2017a, 201b, 2017c, and 2018

**Table 4.3-33. Estimated Seasonal Density for Leatherback Turtles for the SFWF and SFEC**

| Common Name | Scientific Name | Spring Density (number per km$^2$) | Summer Density (number per km$^2$) | Fall Density (number per km$^2$) | Winter Density (number per km$^2$) |
|---|---|---|---|---|---|
| Leatherback Sea Turtle | *Dermochyles coriacea* | 0.0000000 | 0.0063 | 0.038 | 0.0000000 |

Notes:

Leatherback sea turtle density derived from Kraus et al., 2016.

### 4.3.5.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the SFWF and SFEC have the potential to impact sea turtles depending on when and where impact-producing activities occur. A review of the IPFs for sea turtles associated with the SFWF and SFEC is presented on Figure 4.3-10. The IPFs with potential to result in negligible impacts on sea turtles are discussed in this section and in detail in Appendix P.

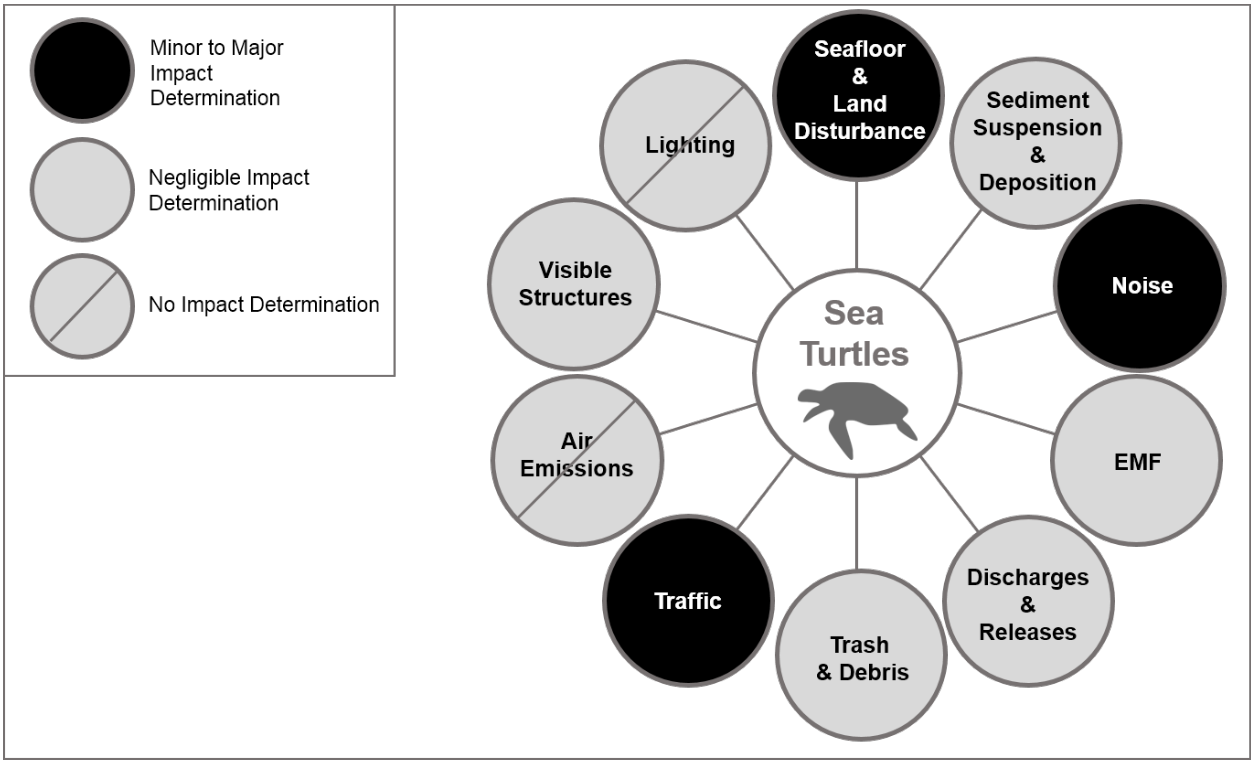


**Figure 4.3-10. IPFs on Sea Turtles**

### South Fork Wind Farm

This section provides an overall assessment of potential impacts on sea turtles from the SFWF that is further explored in Appendix P. The primary IPFs associated with the SFWF that will result in minor to moderate impacts to sea turtles are underwater noise from construction and vessel traffic. Other IPFs considered but anticipated to have negligible impacts to sea turtles are seafloor disturbance, sediment suspension and deposition, EMFs, discharges and releases, trash and debris, and visible structures. The potential impacts associated with each phase of the SFWF are addressed separately in the following sections.

#### *Construction*

Table 4.3-34 provides a summary of the IPFs and potential levels of impact on Sea Turtles during Construction and Decommissioning.

**Table 4.3-34. IPFs and Potential Levels of Impact on Sea Turtles at the SFWF during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Seafloor/Land Disturbance | Seafloor Preparation | Negligible short-term localized |
| | Foundation Installation | Negligible short-term localized |
| | Vessel Anchoring | Negligible short-term |
| | Inter-array Cable Installation | Negligible short-term |
| Sediment Suspension and Deposition | | Negligible short-term localized |
| Noise | Pile Driving | Minor to Moderate short-term |

**Table 4.3-34. IPFs and Potential Levels of Impact on Sea Turtles at the SFWF during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| | Equipment Uses | Negligible short-term |
| | Vessel Traffic | Negligible short-term |
| Discharges and Releases | | Negligible |
| Trash and Debris | | Negligible |
| Traffic | Collision | Minor to Moderate short-term localized |
| | Entanglement | Negligible short-term |

**Seafloor Disturbance**

During construction, seafloor disturbances will be associated with seafloor preparation, foundation installation, vessel anchoring, and cable installation. Benthic habitat conversion will occur as described in Section 4.3.2. Sea turtles occurring in the SFWF will likely be transiting the area in search of prey species, some of which could be benthic species. In the unlikely event that leatherback or loggerhead sea turtles forage on the seafloor in the SFWF and could be displaced from those areas because of SFWF construction, the impacts will be ***negligible*** because they are limited to those few impacted individuals and not groups or populations of turtles. The conversion of seabed habitat will be relatively minor when compared to the large expanse of similar habitat available in the region, so sea turtles will find comparable benthic habitat for feeding or resting.

The construction of the SFWF will create hard-bottom habitats as discussed in Section 4.3.2 that will benefit sea turtles. Sea turtles have been observed within the vicinity of offshore structures, such as oil platforms (i.e., visible structures). High concentrations of sea turtles have been reported around these oil platforms NRC, 1996). During a surface survey at a platform off the coast of Galveston, Texas, approximately 170 sightings were reported (Gitschlag, 1990). Sea turtles use these offshore structures as areas to rest, seek refuge, and feed (NRC, 1996). It is estimated that offshore petroleum platforms in the Gulf of Mexico, provided an additional 2,000 square miles (5,180 $km^2$) of hard bottom habitat (Gallaway, 1981). For sea turtles visiting the SFWF mainly in the summer and fall, created habitat could result in a benefit to those individual turtles.

**Sediment Suspension and Deposition**

As discussed in Section 4.1 and again in Section 4.2.2, SFWF construction activities will result in short-term, localized increases in sedimentation in the water column (i.e., increased turbidity) and consequent impacts to the quality of the water column. Because of the relatively low anticipated densities of sea turtles in the SFWF, and the momentary and localized increases in turbidity and decreases in water quality from SFWF inter-array cable installation, ***negligible impacts*** are anticipated to the few leatherback or loggerhead sea turtles occurring near the cable installation activities.

**Noise**

Sea turtles may be impacted by underwater sounds produced during the construction of the SFWF, both physiologically and behaviorally. Impacts of sound on sea turtles are largely unknown because of a lack of information on hearing capabilities and behavioral responses to sound. However, what data are available suggest that sea turtles can detect and behaviorally respond to acoustic stimuli (Dow Piniak et al., 2012a). A detailed explanation of underwater noise impacts on sea turtles is provided in Appendix P, with an overview of the primary issues provided in this section.

A few experimental studies have been conducted on the hearing capabilities of green sea turtles, loggerhead sea turtles, Kemp's ridley sea turtles, and leatherback sea turtle; however, the frequency ranges vary per species. Based on Bartol et al. (1999), juvenile loggerheads respond to click stimuli with a mean threshold of -10.8 dB re 1-gram (g) rms ± 2.3 dB standard deviation (SD). The hearing range from tone bursts was 250 to 750 Hz. The lowest frequency tested was 250 Hz, with a mean threshold of -23.3 dB re: 1 g rms ± 2.3 dB SD.

Bartol and Ketten (2006) measured the auditory evoked potentials (AEPs) of two Atlantic green sea turtles and six sub-adult Pacific green turtles. Sub-adults were found to respond to stimuli between 100 and 500 Hz, with a maximum sensitivity of 200 and 400 Hz. Juveniles responded to stimuli between 100 and 800 Hz, with a maximum sensitivity between 600 and 700 Hz.

Martin et al. (2012) recorded the AEPs of one adult loggerhead sea turtle. The loggerhead responded to frequencies between 100 and 1131 Hz, with greatest sensitivity between 200 and 400 Hz. This limited research indicates that sea turtles are capable of hearing LF sounds with some variation depending on size, age, and species.

In two separate studies conducted in 2012, Dow Piniak et al. recorded AEPs of turtles in air and underwater. Dow Piniak et al. (2012b) found that the AEPs of juvenile green turtles were between 50 and 1600 Hz in water, and 50 and 800 Hz in air; with ranges of maximum sensitivity between 50 and 400 Hz in water, and 300 and 400 Hz in air. Sensitivity decreased sharply after 400 Hz in both media. Dow Piniak et al. (2012a) found that hatchling leatherback sea turtles responded to stimuli between 50 and 1200 Hz in water, and 50 and 1600 Hz in air. The maximum sensitivity was between 100 and 400 Hz in water, and 50 and 400 Hz in air. These studies show that turtle hearing is more suited to underwater than in air.

Limited research has been conducted on the physiological impacts of underwater or in-air sound on sea turtles, and very few data are available on the behavioral responses of sea turtles to sound. The few studies that are available only examine the behavioral responses of loggerhead and green sea turtles to underwater sound produced by seismic guns. Behavioral responses observed during seismic surveys included avoiding the source of the sound (O'Hara and Wilcox, 1990), startled reactions (DeRuiter and Doukara, 2012), and increased swimming speed (McCauley et al., 2000). Other possible behavior responses could include increased surfacing time and decreased foraging. McCauley et al. (2000), reported that source levels of 166 dB re 1 µPa rms were required to induce behavioral reactions of sea turtles.

GARFO provides behavioral and physiological thresholds for ESA-listed species in the Greater Atlantic Region (GARFO, 2016). Table 4.3-35 outlines the recommended acoustic thresholds for sea turtles, which are used as the basis for the noise impact assessment presented in Appendix P.

**Table 4.3-35. Physiological and Behavioral Threshold Criteria for Sea Turtles**

| Faunal Group | Injury Criteria Metric | Injury Threshold | Behavior Criteria Metric | Behavior Threshold |
|---|---|---|---|---|
| Sea Turtles | rms SPL $L_p$ | 180 dB re 1 µPa | rms SPL $L_p$ | 166 dB re 1 µPa |

Source: GARFO, 2016

Underwater noise is the primary construction-related IPF that could impact sea turtles if they are present in the area at the time of SFWF construction. Underwater acoustic modeling was conducted to estimate the impacts produced from construction-related, noise-producing activities, such as pile driving, vibratory pile driving, and DPV thrusters. Dependent on many factors as detailed in the underwater acoustic modeling study (Appendix J) and sea turtle impact assessment (Appendix P), elevated underwater SPLs may impact sea turtles. Noise will be generated during the construction phase of the SFWF from pile driving, equipment uses, and vessel traffic. Pile driving and DPV thruster usage are identified as the activities that will likely have the greatest potential for impacts on sea turtles. As discussed in the IPF section (Section 4.1), above-water noise impacts on marine mammals and sea turtles during construction will result in negligible impacts because sea turtle exposures to underwater noises are more probable and impact-producing by comparison. Therefore, the potential for above-water noise impacts to sea turtles is not further discussed in this assessment of impacts.

**Impulse Sound – Impact Pile-driving**

Potential acoustical impacts on sea turtles because of pile driving is the primary concern addressed in this impact discussion. Appendix J provides predicted sound propagation distances based upon key construction variables with the SFWF and SFEC, such as hammer type, pile type, pile schedule (hammer energy and number of strikes), season, geographic location, and implementation of noise mitigation (i.e., noise attenuation) measures.

The minimum and maximum acoustic isopleth distances produced by modeled pile driving scenarios (impulsive sounds) were summarized. Results for the distances to injury and behavior isopleths for nonattenuated pile installation over a single 24-hour period are presented in Table 4.3-36.

**Table 4.3-36. Minimum and Maximum Ranges to Acoustic Criteria Thresholds Produced During Modeled Pile Driving Scenarios Without Sound Attenuation Applied**

| Distances to physiological thresholds | | | | Distances to behavior thresholds | | |
|---|---|---|---|---|---|---|
| Pile installation with no noise attenuation (0 dB) | | | | | | |
| Faunal Group | Minimum | Maximum | | Faunal Group | Minimum | Maximum |
| Sea Turtle (LP) | 259 feet (79 m) | 5,827 feet (1,776 m) | | Sea Turtle LP, Flat | 2,605 feet (794 m) | 14,534 feet (4,430 m) |

Where the ranges to the thresholds provide approximations of the distances from the sound-producing activity (pile driving) where sea turtles may be exposed to noise levels of concern, the ZOI is the areal extent of the isopleth that reaches the threshold. The ZOI is a parameter applied to predict the potential impacts to species because it encompasses the habitats in which species conduct their activities. In this way, species' occupation and use of the ZOI is a much better predictor of potential impacts rather than discrete distances to specific thresholds. The ZOIs for sea turtles are provided in Table 4.3-37. ZOIs are provided based on modeled scenarios with no noise mitigation (attenuation).

**Table 4.3-37. Zone of Influence for Sea Turtles Produced by the Radial Threshold Distances for Pile Driving Scenarios with Sound Attenuation Applied**

| Measure | Physiological | | Behavior | |
|---|---|---|---|---|
| Attenuation | Minimum | Maximum | Minimum | Maximum |
| 0 dB | 0.0 | 10 | 2 | 62 |

| | | | | |
|---|---|---|---|---|
| 6 dB | 0.0 | 3 | 0.2 | 29 |
| 12 dB | 0.0 | 0.5 | 0.0 | 14 |

Note: Units are in km$^2$.

Impacts to sea turtles from pile driving during the SFWF are ***short-term*** and likely to be ***minor,*** with a few seasonal exceptions where impacts could be a ***moderate*** considering the ESA-listed status of sea turtles and their seasonable occurrence in the SFWF. Exposure risk will be minimized for most species with the implementation of noise attenuation systems and other marine protected species impact avoidance and minimization measures, as discussed at the end of this section.

**Nonimpulsive Sound**

Commercial and recreational vessels can have varying SPLs dependent on the overall size, engine, propeller size, and configuration. These vessels can create LF noises that can be detected by turtles (Dow Piniak et al., 2012a). While the SPLs created may not directly damage hearing, the presence of vessels within sea turtle habitat may mask important auditory cues (Dow Piniak et al., 2012a). The additional noise from Project-related vessel traffic above the existing vessel-related underwater noise level is not expected to be a significant, and the presumption is that individual sea turtles in the SFWF are familiar with various and common vessel-related noises, particularly within trafficked areas of the SFWF and nearby shipping lanes.

The use of DPVs for laying the SFWF inter-array cable and SFEC is expected to be a significant vessel-related underwater noise source. The dominant underwater noise source on DPVs is because of cavitation on the propeller blades of the thrusters (e.g., Leggat et al., 1981). The noise power from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed. The noise from the DPV thrusters is expected to be more dominant than mechanical or hydraulic noises from the cable trenching equipment.

The hydroacoustic modeling calculations for DPV thruster operations presented in Appendix J include two representative locations, offshore and nearshore, for cable laying operations. These calculations are meant to be representative for DPV usage for both the SFWF inter-array and SFEC cable laying. Table 4.3-38 shows the ranges to regulatory thresholds for sea turtles along the SFEC corridor and inter-array cable routes.

**Table 4.3-38 Maximum Distances to Regulatory Acoustic Thresholds for Sea Turtles, Averaged Across Seasons, During Operation of Thrusters on a Dynamically Positioned Vessel Along the Cable Lay Route**

| Faunal Group | Distances (feet [m]) to Injury Thresholds | Distances (feet [m]) to Behavior Thresholds |
|---|---|---|
| Sea Turtle $L_P$ | 0 | 164 (50) |

Where the ranges to the thresholds provide approximations of the distances from the sound-producing activity (DPV usage) where sea turtles may be exposed to noise levels of concern, the ZOI is the areal extent of the isopleth that reaches the selected threshold. The ZOI is a parameter applied to predict the potential impacts to species because it encompasses the habitats where species conduct their activities. In this way, species' occupation and use of the ZOI is a much better predictor of potential impacts rather than discrete distances to specific thresholds. The estimated ZOIs for sea turtles are provided in Table 4.3-39.

The estimated ZOIs are very small areas around the activity, so when factoring the estimated sea turtle density presented in Table 4.3-33, the estimated number of acoustic threshold exposures for injury and behavior from 1 day of DPV use along the SFWF inter-array cable is zero. Section 5 of Appendix J explains the implications of the work being done in different seasons, but there is no seasonal variation to the estimated exposures from DPV usage.

**Table 4.3-39. Maximum Zone of Acoustic Influence for Sea Turtles Produced by Dynamically Positioned Vessel Operations**

| Faunal Group | Zone of Acoustic Influence (acre [km$^2$]) for Injury | Zone of Acoustic Influence (acre [km$^2$]) for Behavior |
|---|---|---|
| Sea Turtle | 0 (0) | 1.7 (0.007) |

If impacts occur to sea turtles from Project-related vessel noise, including DPV, then they will not be extensive or severe, but could include short-term disruption and displacement of individuals of any species, from localized areas around the vessels. The impacts of underwater sound generated from most Project construction vessels on sea turtles is expected to be ***short-term, negligible*** because of the low density of sea turtles in the area, but allowing for the considerable range of disruptive sound generated by the DPV during cable laying.

**Discharges and Releases / Trash and Debris**

During construction of the SFWF, sanitary and other waste fluids, trash, and miscellaneous debris will be generated but properly managed in accordance with federal and state laws. Accidental discharges, releases, and disposal do represent a risk factor to sea turtles because they could potentially ingest or become entangled in debris, causing lethal or injurious impacts. If sea turtles were to be exposed to an oil spill or a discharge of waste material, studies have indicated that respiration, skin, some aspects of blood chemistry and composition, and salt gland function could be significantly impacted (Vargo et al., 1986).

As explained in Sections 4.1.5. and 4.1.6., the total quantities of hazardous and nonhazardous materials will be small and strictly managed. An OSRP (Appendix D) has been developed describing the procedures to be employed when responding to an oil spill, or the substantial threat of an oil discharge from any SFWF or SFEC component. DWSF and its contractors will also maintain SPCC plans during construction. Therefore, impacts on sea turtles from discharges, releases, trash, and debris are considered ***negligible*** because of the low likelihood of such routine and accidental events.

**Vessel Traffic**

Sea turtles swimming or feeding at or near the surface of the water can be vulnerable to boat and vessel strikes. Propeller and collision injuries to sea turtles from boats or vessels are not uncommon (NOAA and USFWS, 1991). It is estimated that approximately 50 to 500 turtle mortalities per year in U.S. waters result from boat collisions (Plotkin, 1995). Vessel strikes happen when either turtles or vessels fail to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a collision include vessel speed, vessel size and type, and visibility.

SFWF construction vessels could potentially collide with sea turtles, which result in turtle injury or death. In the unlikely event that injury or death were to occur to one of the ESA-listed turtle species as a direct result of SFWF construction activities, these impacts will be considered ***moderate*** because of the conservation status of these species. Construction vessel traffic will be relatively short-term and localized around the SFWF where a concentrated increase in the volume and movement of vessels will occur. Large work vessels for foundation and WTG installation will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly and over short distances between work locations. Transport vessels will travel between several ports and the SFWF over the course of the construction period. These vessels will range in size from smaller crew transport boats to tug and barge vessels.

Dependent on the time of year, Project-related vessel traffic will slightly increase within the area, but the number of vessels that operate for SFWF construction and decommissioning is expected to represent a negligible addition to the normal traffic in the region (Appendix X, SFWF Navigational Safety Risk Assessment).

Entanglement of sea turtles can occur from Project vessels, especially from lines, cables, anchors, or other gear placed in the water. However, because the only lines that will potentially be deployed will be steel cables that will be under significant tension and short-term, it is highly unlikely that sea turtles will become entangled. Therefore, the expected impact to sea turtles from entanglement from SFWF construction activities will be ***negligible***.

***Operations and Maintenance***

Table 4.3-40 summarizes the level of impacts expected to occur to marine mammals during the construction and decommissioning phases of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-40. IPFs and Potential Levels of Impact on Sea Turtles at the SFWF during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Seafloor Disturbance | Foundations | Minor long-term indirect |
| Noise | Continuous Mechanical Noise | Negligible short-term localized |
| EMF | | Negligible localized |
| Traffic | Collision | Negligible localized |
| Discharges and Releases | | Negligible short-term |
| Trash and Debris | | Negligible short-term |

**Seafloor Disturbance**

The potential "reef effect" caused by the introduction of a new hard bottom habitat in this area is expected to attract numerous species of algae, shellfish, finfish and sea turtles to this site (Wilhelmsson et al., 2006; Reubens et al., 2013). For sea turtles, artificial reefs can provide multiple benefits including foraging habitats, shelter from predation and strong currents, and methods of removing biological build-up from their carapace (NRC 1996; Barnette 2017). The increased fish activity is also expected to attract commercial and recreational fishing to the area, which could pose an ***indirect*** threat to sea turtles through entanglement or ingestion of fishing gear. Greater fishing effort around this site would increase the amount of equipment in the water increasing the risk of sea turtles ingesting or becoming entangled in this discarded equipment (Barnette 2017). Due to the current status of local sea turtles and the likelihood of increased fishing effort around the windfarm, the potential impacts are anticipated to be ***minor*** and ***long-term.***

**Noise**

Operational WTGs have the potential to produce underwater sound levels of 90 to 115 dB at a distance of 351 feet (110 m) in moderate winds and frequencies of 20 to 1,200 Hz, with peak levels at 50, 160, and 200 Hz (Thomsen et al., 2006). Potential impacts from operational noise produced by the turbines may include avoidance of the SFWF, disorientation, and disruption of feeding behaviors (BOEM, 2007). In contrast to the short-term duration of construction activities, noise generated during normal operation will be long-term over the operational life of the Project (i.e., 25 to 30 years). Adults and juveniles have strong enough swimming abilities to avoid the operational noises of a wind project, but hatchlings passively traveling through a wind project on currents may not be able to actively leave, thus subjecting them to long-term exposure to turbine noise (BOEM, 2007). The impacts of long-term noise exposure on sea turtles is generally unknown; however, because the sound levels produced during operation are less than the behavioral and physiological thresholds for sea turtles, as outlined in Table 4.3-31, impacts to sea turtles are expected to be ***negligible***.

**Electromagnetic Field**

Sea turtles are highly migratory species and undergo trans-oceanic migrations during certain periods of their lives. Hatchlings swim from beaches into open ocean, juveniles migrate to and from seasonal habitats, and adults will leave feeding grounds to mate and migrate back to their natal beaches (Lohmann et al., 1999). To navigate and orient themselves, sea turtles are known to use the earth's magnetic fields. Sea turtles possess the ability to detect two different features of the geomagnetic field, including inclination angle and intensity (Lohmann and Lohmann, 1994). These fields vary across the earth's surface, and turtles can derive positional information from these fields.

It is theorized that sea turtles use these fields in two different ways (1) as a magnetic compass, for directional sense that enables them to establish a heading and maintain their course; and (2) for positional information, where turtles can approximate their position within the ocean (Lohmann and Lohmann, 1996). Multiple studies have demonstrated magneto-sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 microteslas (µT) and 29.3 to 200 µT for loggerheads and green turtles, respectively (Normandeau, 2011).

Despite the potential for sea turtle orientation to be impacted by specific magnetic fields, available evidence for sea turtles does not indicate that these species are capable of detecting the magnetic fields associated with the Project's 60-Hz AC cables. Luschi et al. (1996) placed magnets on the head of sea turtles to mask the earth's magnetic fields from the sea turtles. Results showed that sea turtles with the magnets were still capable of returning home; however, their routes were less direct than the control (Normandeau, 2011; Luschi et al., 1996). Appendix K provides a more detailed discussion about the potential impacts of EMF on sea turtles.

Sea turtles could encounter EMF from the SFWF inter-array cable if feeding on benthic organisms in the SFWF at the sediment surface above the cable. Because these species must surface to breathe, such behavior is expected to limit time spent near cables. Furthermore, the broad scale of sea turtle migrations and the generally low density of individuals within a given area are also expected to lower the likelihood that individuals will regularly encounter the cable route and Project-associated EMF. This broad distribution and movement means that the SFWF represents a very small portion of the available habitat for migratory sea turtles. The impact of EMF on sea turtles during O&M is anticipated to be ***negligible***.

**Traffic**

The potential impacts of vessel collision on sea turtles will be less than those identified in the construction phase of the SFWF because the infrequent vessel traffic that will negligibly contribute to existing vessel traffic in the area. Vessel strike impacts on sea turtles during SFWF O&M are anticipated to be ***negligible***.

***Decommissioning***

During decommissioning activities, sea turtles could be impacted by noise generated by the dismantling of the WTGs, collisions with the decommissioning vessels, and exposure to accidental release of hazardous materials or fuel spills. Decommissioning would conceptually reverse the sequence of construction steps to dismantle or remove the SFWF. Decommissioning activities resulting in underwater noise and vessel traffic are expected to be less intensive than the activities associated with the construction phase of the Project. Impacts to sea turtles during decommissioning are expected to be ***negligible***.

### South Fork Export Cable

Construction, O&M, and decommissioning activities associated with the SFEC have the potential to impact sea turtles. This section summarizes the potential impacts on sea turtles from activities associated with the SFEC. IPFs that could have more than negligible potential impacts include noise and vessel traffic. Impacts associated with each phase of the SFEC are addressed in the following sections.

### SFEC - OCS and SFEC - NYS

***Construction***

Table 4.3-41 summarizes the level of impacts expected to occur to marine mammals during the construction and decommissioning phases of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-41. IPFs and Potential Levels of Impact on Sea Turtles at the SFEC during Construction and Decommissioning**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Seafloor/Land Disturbance | Cable Installation | Negligible short-term localized |
| Sediment Suspension and Deposition | | Negligible short-term localized |
| Noise | During Cable Lay | Negligible short-term |
| Discharges and Releases | | Negligible short-term |
| Trash and Debris | | Negligible short-term |

**Seafloor Disturbances**

Seafloor disturbance associated with installation of the SFEC may impact sea turtles. Impacts are considered ***short-term*** and ***negligible*** for similar reasons as described for seafloor disturbances from SFWF construction.

**Sediment Suspension and Deposition**

As previously discussed for SFWF construction, impacts to the few transiting individual sea turtles in the region that could be exposed to sediment suspension are expected to be ***localized, short-term,*** and ***negligible***.

**Noise**

As described for the SFWF, the impacts of underwater sound generated from Project construction vessels on sea turtles are expected to be short-term and negligible. ***Short-term, negligible impacts*** may also occur during SFEC installation because of the considerable range of potentially disruptive sound propagation generated by the DPV thrusters during cable laying, and because cable installation will occur over a relatively short time frame. Also, the likelihood decreases for sea turtles occurring in shallow waters as the cable laying operation enters New York State waters. Therefore, the risk of sea turtles exposed to DPV noise is lower close to shore.

Construction of a cofferdam will be required for the nearshore SFEC connection and will require vibratory hammering of sheet piles. This installation differs from the pile-driving at the SFWF because the location is close to shore, the duration of the installation is estimated to be short (roughly 12 to 24 hours), and the source type is nonimpulsive or continuous. Therefore, both the propagation characteristics of the sheet pile vibratory pile driving and the threshold criteria for sea turtles are different than for the pile driving for the foundation (Appendix P). Tables 4.3-42 and 4.3-43 summarizes the acoustic thresholds established for nonimpulsive sources for sea turtles. The threshold criteria tend to be lower than impulse sound criteria, and as such, produce larger isopleths.

**Table 4.3-42. Maximum Distances to Regulatory Acoustic Thresholds, Averaged Across Seasons, During Sheet Pile Installation Using Vibratory Hammering Over a 12-hour Period at SFEC Sea-to-Shore Offshore Transition Site**

| Faunal Group | Distances (feet [m]) to Injury Thresholds | Distances (feet [m]) to Behavior Thresholds |
|---|---|---|
| Sea Turtle | 102 (31) | 256 (78) |

**Table 4.3-43. Zone of Acoustic Influence in $km^2$ Produced by Vibratory Pile Driving**

| Faunal Group | Zone of Acoustic Influence (acres [$km^2$]) for Injury | Zone of Acoustic Influence (acres [$km^2$]) for Behavior |
|---|---|---|
| Sea Turtle | 0.7 (0.003) | 4.9 (0.02) |

**Discharges and Releases / Trash and Debris**

The potential for sea turtle exposure and impacts from routine and nonroutine discharges, releases, trash, and debris will be similar to those identified in the SFWF.

**Traffic**

The potential impacts of vessel traffic (collision or entanglement risk) on sea turtles will be less than those discussed for the SFWF because of the fewer anticipated vessels involved in SFEC construction.

### *Operations and Maintenance*

Table 4.3-44 summarizes the level of impacts expected to occur to sea turtles during the O&M phase of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-44. IPFs and Potential Levels of Impact on Sea Turtles at the SFEC during Operations and Maintenance**

| IPF | Potential Impact | Maximum Level of Impact |
|---|---|---|
| Traffic | Collision | Negligible short-term localized |
| EMF | | Negligible localized |
| Discharges and Releases | | Negligible short-term |
| Trash and Debris | | Negligible short-term |

**Traffic**
The potential impacts of vessel collision will be similar to those identified in the SFWF.

**Electromagnetic Fields**
The potential EMF impacts from the SFEC on sea turtles is similar to that described for the SFWF inter-array cable. Impacts to sea turtles relating to the EMF emitted from the SFEC will be ***negligible*** because of the low density of sea turtles in the water, their habit of surfacing for air, and the relatively narrow corridor occupied by the SFEC.

**Discharges and Releases / Trash and Debris**
The potential for exposure and impacts will be similar to those identified in the SFWF and are considered ***negligible*** because of the low likelihood of such routine and accidental events.

### *Decommissioning*

The impacts expected to sea turtles will be similar to impacts during installation, assuming that similar vessels are used for the activity.

### 4.3.5.3 Proposed Environmental Protection Measures

Environmental protection measures will be implemented to minimize impacts on sea turtles to the maximum extent possible, including the use of noise attenuation and ramp-up, soft-start, and shutdown pile-driving procedures. DWSF will consider the use of technically and commercially feasible noise attenuation technology.

- Exclusion and monitoring zones will be established for sea turtles during pile driving activities and HRG survey activities.
- Mitigation measures will be implemented for pile driving and HRG survey activities. These measures will include soft-start measures, shut-down procedures, marine mammal monitoring protocols, and use of qualified and NOAA-approved protected species observers, as appropriate.
- Vessels will follow NOAA guidelines for sea turtle strike avoidance measures, including vessel speed restrictions.

- All personnel working offshore will receive training on sea turtle awareness and marine debris awareness.
- DWSF will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).
- The SFWF inter-array cable and SFEC - Offshore will be buried to a target depth of 4 to 6 feet (1.2 to 1.8 m).

## 4.3.6 Avian Species

The description of the affected environment and assessment of potential impacts to avian species and their habitats was evaluated by reviewing survey results from land-based, ship-based, aerial, and radar surveys; online data modeling and mapping databases; and correspondence and consultation with federal and state agencies. Recent data on listed species include preliminary results of digital very high-frequency (VHF; nanotag) tracking studies funded through BOEM and boat-based bird surveys at the BIWF off the coast of Rhode Island. This project is the first offshore wind farm in the United States and is currently the only regional wind development site with both pre- and post-construction data. These results can help inform potential impacts to birds at the SFWF and other offshore wind projects in the region. Avian species within the potentially affected environment are described below, followed by an evaluation of potential project-related impacts. For more information regarding the avian species at the SFWF, see the SFWF Draft Avian and Bat Risk Assessment and Draft Avian and Bat Resources Technical Report, and the BIWF Post-Construction Avian Ship-based Survey in Appendix Q.

### 4.3.6.1 Affected Environment

**Regional Overview**

As described in BOEM’s Revised Environmental Assessment (BOEM, 2013), the Atlantic Coast along New York, Rhode Island, and Massachusetts is used by a variety of avian species for foraging, breeding, and migration. Water depth is likely the primary physical feature affecting bird species distribution in the marine environment, as this physical habitat characteristic limits where different species can successfully access food resources. However, other factors such as coastline character, substrate, water temperature, salinity, and currents all affect resource availability throughout the year and, consequently, seasonal bird species distribution and abundance. Major habitat types expected to be found within the SFWF and SFEC are described in Section 4.3. The nearshore open waters surrounding Montauk Point, New York, including Montauk Shoals and Endeavor Shoals, provide important seabird and wintering waterfowl habitat. Generally, as the distance from shore increases, bird abundance decreases (Paton et al., 2010; Winiarski et al., 2011; Geo-Marine Inc., 2010; and Menza et al., 2012).

State- and federally listed species documented or potentially present in the SFWF and portions of the SFEC − OCS, SFEC - NYS, and SFEC − Onshore include northern harrier (*Circus cyaneus*) (state threatened), bald eagle (*Haliaeetus leucocephalus*) (state threatened), piping plover (*Charadius melodus*) (federally threatened and state endangered), rufa red knot (*Calidris canutus rufa*) (federally threatened), least tern (*Sternula antillarum*) (state threatened), roseate tern (*Sterna dougallii*) (federally and state endangered), and common tern (*Sterna hirundo*) (state threatened). These species are discussed in the following sections.

For the purposes of this summary, “offshore” is defined as waters beyond a 3-nm (5.6 km) distance from land and ‘nearshore’ is within the 3-nm (5.6 km) distance from land.

**South Fork Wind Farm**

Offshore waters provide high-value foraging habitat for seabirds in locations with a varied resource base of forage fish, crustaceans, and mollusks. The SFWF will be located in deep water (approximately 108 to 125 feet (33 to 38 m) where there are no shoals, but fish, crustaceans, and other zooplankton are available at different depths. Benthic resources, including shellfish, and associated habitat types are described in Section 4.3.2.

Table 4.3-45 summarizes species present or potentially present within the SFWF. The table delineates timing, distribution, and status of avian groups expected to occur in the SFWF. Avian groups likely to use deeper offshore waters within the SFWF at least seasonally include loons (*Gavia spp.*), shearwaters (*Procellariidae spp.*), fulmars (*Procellariidae spp.*), storm-petrels (*Hydrobates pelagicus*), gannets (*Morus spp.*), seaducks (*Merginae spp.*), jaegers (*Stercorariidae spp.*), gulls (*Laridae spp.*), kittiwakes (*Rissa spp.*), terns (*Laridae spp.*), alcids (*Alcidae spp.*), and to a lesser extent, migrating shorebirds and land birds. Appendix Q includes additional details about the presence of these species groups. Shorebirds (except for phalaropes) are not expected to occur away from shore unless flying during migratory movements. Species that are state- or federally listed are described in more detail in relation to proposed SFWF activities in the following sections. See Appendix Q for additional information on listed species.

**Table 4.3-45 Timing, Distribution, and Status of Avian Species Groups That Have Potential to Occur in the SFWF**

| Species Group | Status | Seasonal Use | Peak Season | Primary Location | Status Offshore |
|---|---|---|---|---|---|
| Loons (*Gavia spp.*)<br>Common (*Gavia immer*)<br>Red-throated (*Gavia stellate*) | State special concern | Migrant, winter resident | Fall, winter | Nearshore, offshore | <br>Uncommon<br>Uncommon |
| Shearwaters (*Procellariidae spp.*)<br>Manx (*Puffinus puffinus*)<br>Great (*Puffinus gravis*)<br>Sooty (*Ardenna grisea*)<br>Cory's (*Calonectris borealis*)<br>Audubon's (*Puffinus iherminieri*) | <br>--<br>--<br>--<br>-- | Summer resident | Summer | Offshore | <br>Common<br>Abundant<br>Common<br>Abundant<br>Uncommon |
| Northern fulmars (*Fulmarus glacialis*) | -- | Winter resident | Fall, winter | Offshore | Uncommon |
| Storm-petrels (*Hydrobates pelagicus*)<br>Wilson's (*Oceanites oceanicus*)<br>Leach's (*Oceanodroma leucorha*) | <br>--<br>-- | Summer resident | Summer | Offshore | <br>Abundant<br>Uncommon |
| Northern gannets (*Morus bassanus*) | -- | Migrant, winter resident | Spring, fall, winter | Offshore | Common |
| Seaducks (*Merginae spp.*)<br>Common eider (*Somateria mollissima*)<br>Black scoter (*Melanitta americana*)<br>White-winged scoter (*Melanitta deglandi*)<br>Surf Scoter (*Melanitta perspicillata*)<br>Long-tailed duck (*Clangula hyemalis*) | <br>--<br>--<br>--<br>-- | Migrant, winter resident | Winter | Nearshore, offshore | <br>Uncommon<br>Uncommon<br>Uncommon<br>Uncommon<br>Uncommon |
| Jaegers (*Stercorariidae spp.*)<br>Parasitic (*Stercorarius parasiticus*)<br>Pomarine (*Stercorarius pomarinus*) | <br>--<br>-- | Migrant | Spring, fall | Offshore, nearshore | <br>Uncommon<br>Rare |

**Table 4.3-45 Timing, Distribution, and Status of Avian Species Groups That Have Potential to Occur in the SFWF**

| Species Group | Status | Seasonal Use | Peak Season | Primary Location | Status Offshore |
|---|---|---|---|---|---|
| Gulls (*Laridae spp.*)<br>Herring (*Larus argentatus*)<br>Great black-backed (*Larus marinus*)<br>Bonaparte's (*Chroicocephalus philadelphia*)<br>Laughing (*Leucophaeus atricilla*) | <br>--<br>--<br>--<br>-- | Breeder, migrant, winter resident | Year-round | Nearshore, offshore | <br>Common<br>Uncommon<br>Uncommon<br>Common |
| Black-legged kittiwakes (*Rissa tridactyla*) | -- | Migrant, winter resident | Winter | Offshore | Abundant |
| Terns (*Laridae spp.*)<br>Common (*Sterna hirundo*)<br>Roseate (*Sterna dougallii*)<br>Least (*Sternula antillarum*) | New York Threatened<br>Federal Endangered<br>New York Endangered<br>New York Threatened | Breeder, migrant | Summer | Nearshore, offshore | <br>Rare<br>Rare<br>Rare |
| Alcids (*Alcidae spp.*)<br>Razorbill (*Alca torda*)<br>Common murre (*Uria aalge*)<br>Thick-billed murre (*Uria lomvia*)<br>Atlantic puffin (*Fratercula arctica*)<br>Dovekie (*Alle alle*)<br>Black guillemot (*Cepphus grylie*) | <br>--<br>--<br>--<br>--<br>--<br>-- | Migrant, winter resident | Winter | Nearshore, offshore | <br>Uncommon<br>Uncommon<br>Uncommon<br>Rare<br>Common<br>Uncommon |
| Land birds* | | Migrant | Spring, fall | Migrating | Uncommon |

Sources: Paton et al., 2010; Tetra Tech and DeTect, 2012; Winiarski et al., 2012; and Sussman and USGS, 2014.

* Observed land bird species: various swallow species

**SFEC – OCS and SFEC - NYS**

The following summary focuses on avian groups documented or expected to occur in portions of the SFEC − OCS. The SFEC − OCS is primarily a pelagic environment, and bird species composition, distribution, seasonality, and resource base are likely to be similar to that described for the SFWF. Where the proposed cable route travels south of Montauk Point, the bird community is expected to include more coastal species. In the area where the proposed cable route comes within 10 mi (16 km) of Montauk Point, pelagic species become more uncommon and the composition of birds begins to include species that occur both nearshore and offshore.

Table 4.3-46 summarizes species present or potentially present within the SFEC. Avian groups likely to use deeper offshore waters at least seasonally include loons, shearwaters, fulmars, storm-petrels, gannets, seaducks, jaegers, gulls, kittiwakes, terns, alcids, and to a lesser extent, migrating shorebirds and land birds. Appendix Q provides additional detail about the occurrence on bird species and their status with respect to the SFEC, including additional information on listed species.

The SFEC − NYS will be more than 3 miles (5 km) from the productive shallow waters nearshore, including Montauk Shoals and Endeavor Shoals. Data from local surveys, such as Christmas Bird Counts, indicate a variety of land birds and waterbirds occur onshore in the area. Horseshoe crabs breed on the beaches in large numbers during the spring providing forage for migrant shorebirds, including the rufa red knot. Species known to occur in the New York Bight, the location of the SFEC route, include terns, gulls, cormorants (*Phalacrocoracidae spp.*), and shorebirds during summer and seaducks, bay ducks (*Aythyinae spp.*), fish ducks (*Anatidae spp.*), dabblers (*Anas spp.*), loons, grebes (*Podicipedidae spp.*), and alcids during winter. In the fall, the highest densities of seabirds are observed south and east of Montauk Point and along the south shore of Long Island. Other more pelagic species that could occur around the SFEC − NYS include Cory's shearwater (*Calonectris borealis*), northern gannet (*Morus bassanus*), and black-legged kittiwake (*Rissa tridactyla*). Table 4.3-47 summarizes species present or potentially present within New York State waters. Appendix Q provides additional detail about the occurrence on bird species and their status with respect to the SFEC − NYS nearshore and onshore.

Shorebirds will use intertidal zones of beaches for foraging for invertebrates, small crustaceans, bivalve mollusks, small polychaete worms, insects, and talitrid amphipods (Macwhirter et al., 2002). Terns and related species will forage over shallow waters and sandspits near shore in pursuit of small prey fish (Nisbet et al., 2017). Breeding shorebirds on Long Island include piping plover, American oystercatcher (*Haematopus palliates*), and killdeer (*Charadrius vociferous*). Several species will overwinter on Long Island (sanderling [*Calidris alba*], dunlin [*C. alpine*], purple sandpiper [*C. maritima*]), but most shorebirds occur as migrants. Other species likely to occur on Long Island during migration include black-bellied plover (*Pluvialis squatarola*), semipalmated plover (*Charadrius semipalmatus*), ruddy turnstone (*Arenaria interpres*), semipalmated sandpiper (*Calidris pusilla*), and short-billed dowitcher (*Limnodromus griseus*). Shorebirds will forage in the intertidal zone of beaches. During migration, rufa red knots occur on large waterbodies with suitable shoreline habitat. Concentrations of this species can occur on the south shore of Long Island in spring and fall. Preliminary results from BOEM's nanotag study detected birds flying around Long Island's south shore (Loring et al., 2017).

**Table 4.3-46. Timing, Distribution, and Status of Avian Species Groups That Have Potential to Occur in the SFEC − OCS**

| Avian Group | Seasonal Use | Peak Seasons | Peak/Primary Location | Status Offshore |
|---|---|---|---|---|
| Loons | Migrant, winter resident | Fall, winter | Offshore, nearshore | Common (more common nearshore) |
| Shearwaters | Summer resident | Summer | Offshore | Common |
| Storm-petrels | Summer resident | Summer | Offshore | Common |
| Gannets | Migrant, winter resident | Winter, spring, fall | Offshore | Common |
| Seaducks[a] | Migrant, winter resident | Winter, spring, fall | Offshore, nearshore | Uncommon |
| Jaegers | Migrant | Spring, summer, fall | Offshore | Rare |
| Gulls[b] | Breeder, migrant, winter resident | Year-round | Offshore, nearshore | Abundant (more abundant nearshore) |
| Kittiwakes | Migrant, winter resident | Winter | Offshore | Abundant |
| Terns | Migrant, post-breeding | Summer | Offshore, nearshore | Rare offshore |
| Alcids | Migrant, winter resident | Winter | Offshore, nearshore | Common (more common nearshore; exc. dovekie, more common offshore) |
| Land birds[c] | Migrant | Spring, fall | Migrating | Uncommon |

Sources: Paton et al., 2010; Tetra Tech and DeTect, 2012; Winiarski et al., 2012; and Sussman and USGS, 2014.

[a] Observed waterfowl species: common eider, surf scoter, black scoter, long-tailed duck, white-winged scoter, red-breasted merganser.
[b] Observed gull species: herring gull, great black-backed gull, laughing gull, ring-billed gull, Bonaparte's gull.
[c] Observed land bird species: various swallow species.

**SFEC – Onshore**

A variety of land birds have potential to occur in upland and coastal habitats associated with the onshore portions of the SFEC. A wide variety of passerines and other land birds use Long Island as a potential stopover location along the Atlantic Coast during migration and could fly over the cable route when coming to land. These migrants include species that breed in the surrounding dune, coastal wetland, shrub, forested, and urban habitats near the SFEC − Onshore, as well as species with breeding ranges further to the north and east that only pass through Long Island in spring and fall.

Avian species that may breed in the area primarily include locally nesting marsh and wading birds using nearby coastal wetlands and common swallows, thrushes, corvids, warblers, sparrows, and blackbirds using residential, backyard, and small field habitats proximal to the SFEC − Onshore.

The state threatened northern harrier is known to breed at locations across Long Island, with breeding records near the SFEC − Onshore, including Napeague State Park, Hither Hills State Park, Napeague Harbor (NYSDEC, 2017). Their breeding period extends from April through September, with nesting habitat in marshes, meadows, and grasslands with low, thick vegetation (Smith et al., 2011). Species occurring only in winter are even fewer and may include species such as snow buntings (*Plectrophenax nivalis*), horned larks (*Eremophila alpestris*), and snowy owls (*Bubo scandiacus*) as well as some of the year-round resident land bird species, including corvids, chickadees, and titmice.

**Table 4.3-47. Timing, Distribution, and Status of Avian Species Groups Likely to Occur in the Onshore Cable Route and Landing Sites of the SFEC − NYS**

| Avian Group | Seasonal Use | Peak/Primary Seasons | Peak/Primary Location | Status in Coastal Waters |
|---|---|---|---|---|
| Loons | Migrant, winter resident | Fall, Winter | Offshore, nearshore | Common |
| Grebes | Migrant, winter resident | Winter | Nearshore | Occasional |
| Gannets | Migrant, winter resident | Spring, fall | Offshore | Uncommon |
| Cormorants | Summer breeder; winter resident | Summer, fall | Nearshore | Common (exc. great cormorant, occasional) |
| Seaducks[a] | Winter resident | Winter | Offshore, nearshore | Common |
| Geese, bay ducks, fish ducks, and dabblers[b] | Migrant, winter resident | Fall, winter | Offshore, nearshore | Common |
| Shorebirds[c] | Breeding, migrant, winter resident | Spring, fall | Nearshore, onshore | Common |
| Gulls[d] | Breeding, migrant, winter resident | Spring, summer | Offshore, nearshore, onshore | Abundant |
| Kittiwakes | Winter resident | Winter | Offshore | Occasional |
| Terns[e] | Breeding, migrant | Summer, fall | Nearshore, onshore | Common |
| Land birds[f] | Breeding, migrant, winter resident | Spring, summer | Onshore | Common |

Sources: Paton et al., 2010; O'Connell et al., 2011; Tetra Tech and DeTect, 2012; Veit et al., 2016; Sussman and USGS, 2014; and land-based surveys and nearshore boat surveys.

[a] Observed seaduck species: black scoter, white-winged scoter.
[b] Observed geese and duck species: Canada goose, brant, common goldeneye, bufflehead, greater scaup, hooded merganser, red-breasted merganser, American black duck, mallard, American widgeon, harlequin duck.
[c] Observed overwintering shorebird species: purple sandpiper, sanderling, dunlin, piping plover.
[d] Observed gull species: herring gull, great black-backed gull, laughing gull, ring-billed gull, Bonaparte's gull.
[e] Observed tern species and allies: common tern, Forster's tern, roseate tern, least tern, black skimmer.
[f] Observed land birds include raptors, herons, doves, and passerines.

#### 4.3.6.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the SFWF and SFEC have the potential to affect avian species through both direct and indirect impacts, including habitat loss/modification, disturbance, and collision risk, and displacement, attraction, barrier effects, and mortality or injury associated with discharges/releases or trash/debris.

The IPFs and anticipated levels of impact to birds associated with the construction, O&M, and decommissioning phases for the SFWF and SFEC are outlined in Tables 4.3-48 and 4.3-49 and Figure 4.3-11, including potential impacts to the federally listed roseate tern, piping plover, and red knot, and state-listed least tern and common tern. Impacts resulting from the SFWF and SFEC are anticipated to range from no impact to negligible to minor. The SFWF and SFEC's risk assessment in Appendix Q includes additional details of these impacts which are summarized below.

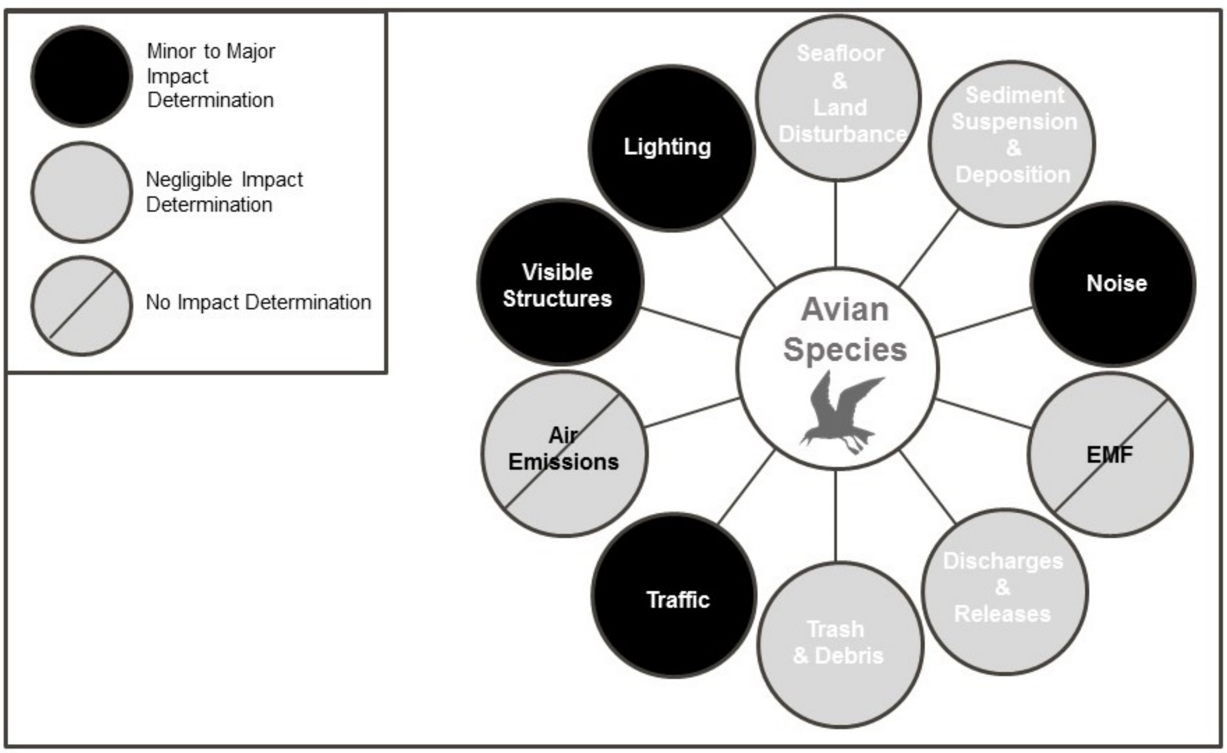


**Figure 4.3-11. IPFs on Avian Species**

### South Fork Wind Farm

This section summarizes the assessment of potential impacts on avian species presented in Appendix Q. The primary IPFs associated with the SFWF that could impact avian species include seafloor or land disturbance, sediment suspension/deposition, noise, traffic, visible structures and lighting, discharges/releases, and trash/debris. The potential impacts associated with each phase of the SFWF are addressed separately in the following sections.

### *Construction*

Table 4.3-48 summarizes the level of impacts expected to occur to avian species during the construction and decommissioning phase of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-48. IPFs and Potential Levels of Impact on Avian Species for the SFWF during Construction and Decommissioning**

| Impact Producing Factor | Project Activity | Potential Impact |
|---|---|---|
| Seafloor/Land Disturbance | Habitat loss/modification from WTG foundation and inter-array cable installation | Negligible direct |
| Sediment Suspension and Deposition | Habitat loss/modification from WTG foundation and inter-array cable installation | Negligible direct |
| Noise | Disturbance from pile-driving and inter-array cable installation | Negligible or Minor direct |
| Traffic | Disturbance from vessel activity | Negligible or Minor direct |
| Visible Structures / Lighting | Collision risk with construction vessels/platforms | Negligible to Minor direct |
| Discharges/Releases | Mortality/decreased breeding success during construction activities associated with WTG foundation and inter-array cable installation | Negligible indirect |
| Trash/Debris | Mortality/injury from accidental disposals associated with WTG foundation and inter-array cable installation | Negligible indirect |

#### Seafloor Disturbance

Because of the short-term nature of construction and decommissioning activities, only ***negligible*** to ***minor impacts*** associated with the direct effect of habitat loss or modification due to seafloor/land disturbance are anticipated.

#### Noise and Traffic

Only ***negligible*** to ***minor impacts*** to birds because of disturbances associated with noise and vessel traffic are expected during construction activities. These impacts will be short-term and similar to those observed with normal non-project-related vessel traffic.

#### Visible Structures and Lighting

***Negligible*** to ***minor impacts*** associated with collision risk with visible structures for birds during construction may occur, depending on the species and number of individuals involved in potential collision events. Birds are susceptible to collision with both moving and stationary man-made structures extending above the surface of the water, particularly at night and/or during other periods of low visibility (e.g., rain or fog). Brightly illuminated structures offshore such as research platforms pose a risk to birds migrating at night particularly during rain or fog when birds can become disoriented by sources of artificial light. While nocturnal migrant passerines are known to be most prone to collision with man-made structures, among those species that may be at risk of collision include federally or state-listed species: roseate tern, rufa red knot, piping plover, least tern, and common tern. While collision risk for these species of concern is considered low, the loss of one or a few individuals to these populations already at risk could represent a ***minor impact***. Other bird groups with relatively stable populations may generally be at risk of ***negligible*** to ***minor impacts*** resulting from collision, depending on the time of year and number of individuals involved. Lighting during construction activities will be limited to the minimum required for safety during construction activities to minimize impacts.

**Discharges and Releases**
Potential indirect effects such as mortality or injury from contaminant discharges or releases during construction and decommissioning would be expected to result in ***negligible*** to ***minor impacts*** because of the preemptive implementation of BMPs to prevent such incidents.

**Trash and Debris**
Potential indirect effects such as mortality or injury from accidental disposal of trash or debris during construction and decommissioning is expected to result in ***negligible impacts*** because of the preemptive implementation of BMPs to prevent such incidents.

***Operations and Maintenance***

Table 4.3-49 summarizes the level of impacts expected to occur to avian species during the O&M phase of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-49. IPFs and Potential Levels of Impact on Avian Species for the SFWF during Operations and Maintenance**

| IPF | Potential Effect from Project Activity | Potential Impact |
|---|---|---|
| Noise | Disturbance from WTG operation and maintenance vessel activity | Negligible to Minor direct |
| Traffic | Disturbance from maintenance vessel activity | Negligible to Minor direct |
| Visible Structures / Lighting | Collision risk with WTGs or OSS | Negligible to Minor direct |
| | Displacement, attraction, or barrier effect, based on presence of WTGs or OSS | Negligible to Minor direct |
| Discharges/Releases | Maintenance vessel activity at WTGs or OSS | Negligible indirect |
| Trash/Debris | Maintenance vessel activity at WTGs or OSS | Negligible indirect |

**Traffic and Noise**
Direct impacts during O&M could include short-term disturbances associated with traffic or noise during maintenance activities. These disturbances would be ***short-term*** and ***negligible*** to ***minor*** and similar to those observed with normal vessel traffic.

**Visible Structures and Lighting**
The primary direct impact for birds during O&M is collision risk with WTGs at the SFWF because of visible structures and lighting. Species most at risk of collision are those that more frequently occur in the rotor-swept zone (RSZ) and those that may travel through the SFWF at night or periods of inclement weather. Impacts associated with risk of collision are anticipated to be ***negligible to minor*** and would be dependent on species and the number of individuals involved. Federally and state-listed species are among birds that may be susceptible to minor impacts associated with collision risk, including roseate tern, rufa red knot, piping plover, least tern, and common tern. While these species are not expected to frequent the SFWF, individuals in general may cross the area at most twice per year during migration. The loss of one or a few individuals, over the life of the SFWF, for a population already at risk would represent an adverse impact; however, it would not represent an impact that that these populations could not recover from. Other avian groups with relatively stable populations may generally be at risk of ***negligible to minor impacts*** resulting from collision, depending on the time of year and number of individuals involved.

Indirect operational impacts related to visible structures and lighting may pose ***negligible to minor impacts***, depending on type of impact (displacement, attraction, or barrier effect, or discharge/release). Displacement, attraction, and barrier effects are expected to generally result in ***negligible to minor impacts*** to most species that seasonally occur in the SFWF.

**Discharges and Releases**
The level of impact of a contaminant spill or release would be dependent on the type, size, and location of the spill. Federally and state-listed birds are among species that may be impacted after a spill or release. However, any potential spill-related impacts are expected to be mitigated by a series of avoidance and minimization measures and preemptive implementation of BMPs during operations; therefore, discharges and releases during O&M are expected to result in ***negligible impacts***.

**Trash and Debris**
Potential indirect effects such as mortality or injury from accidental disposal of trash or debris during O&M is expected to result in ***negligible impacts*** because of the preemptive implementation of BMPs to prevent such incidents.

#### *Decommissioning*

Decommissioning of the SFWF will have similar impacts as construction.

### South Fork Export Cable

This section summarizes the assessment of potential impacts on avian species presented in Appendix Q. The primary IPFs associated with the SFEC that could affect avian species include Seafloor/Land Disturbance, Sediment Suspension and Deposition, Noise, Traffic, Visible Structures and Lighting, Discharges/Releases, and Trash/Debris. The potential impacts associated with each phase of the SFWF are addressed separately in the following sections.

## SFEC – OCS and SFEC – NYS

### *Construction*

Table 4.3-50 summarizes the level of impacts expected to occur to avian species during the construction and decommissioning phases of the SFEC. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-50. IPFs and Potential Levels of Impact on Avian Species for the SFEC during Construction and Decommissioning**

| IPF | Project Activity | Potential Impact |
|---|---|---|
| Seafloor/Land Disturbance | Habitat loss/modification from cable and interconnection facility installation | Negligible direct |
| Sediment Suspension and Deposition | Habitat loss/modification from cable installation | Negligible direct |
| Noise | Disturbance from cable installation, HDD, and interconnection facility installation | Negligible to Minor direct |
| Traffic | Disturbance from vessel and vehicle activity during cable and interconnection facility installation | Negligible to Minor direct |
| Discharges/Releases | Mortality/decreased breeding success during construction activities associated with cable and interconnection facility installation | Negligible indirect |
| Trash/Debris | Mortality/injury from accidental disposals associated construction activities associated with cable and interconnection facility installation | Negligible indirect |

**Seafloor Disturbance**

Because of the short-term nature of construction and decommissioning activities, only ***negligible*** associated with the direct effect of habitat loss or modification from seafloor disturbance are anticipated.

At the sea-to-shore transition, HDD will mitigate potential construction impacts on the inter-tidal community within the vicinity of the landing site. No long-term changes in inter-tidal habitat structure or prey availability is expected because of cable installation activities. Any increase in turbidity and potential relocation of sandy sediments would be ***short-term, localized, and negligible***, resulting in no lasting physical changes to coastal areas or beaches.

There will be ***no impacts*** to nesting areas at beaches as installation for the SFEC will occur under the beach. The need for time of year restrictions for beach work at onshore components will be determined in consultation with the agencies.

**Noise and Traffic**
Only ***negligible or minor*** impacts to birds from disturbances associated with noise and vessel traffic are expected during construction of the submarine cable. These impacts will be short-term and similar to those observed with normal non-project-related vessel traffic.

Noise from installation of the cofferdam and from HDD in the sea-to-shore transition and activities at beach work areas could result in ***short-term disturbance impacts*** that will be relatively ***short-term and localized***; therefore, only ***negligible to minor impacts*** to shorebirds are expected from construction. Because the construction period is expected to occur largely outside of the breeding period of listed species that breed in the area and use of the shoreline at the proposed landing sites is expected to be minimal for other listed species that may occur in the region, disturbance impacts for listed species are expected to be ***negligible to minor*.**

**Visible Structures and Lighting**
***Negligible to minor impacts*** associated with collision risk with visible structures (e.g., construction vessels or platforms) for birds during construction may occur, as described for the SFWF.

**Discharges and Releases**
Potential indirect effects such as contaminant discharges or releases during construction and decommissioning would be expected to result in ***negligible to minor impacts*** because of the preemptive implementation of BMPs to prevent such incidents.

**Trash and Debris**
Potential indirect effects such as mortality or injury from accidental disposal of trash or debris during construction and decommissioning is expected to result in ***negligible impacts*** because of the preemptive implementation of BMPs to prevent such incidents.

***Operations and Maintenance***

No impacts to avian species are anticipated during routine O&M of the SFEC – OCS and SFEC – NYS.

***Decommissioning***

Decommissioning of the SFEC – OCS and SFEC – NYS will have similar impacts as construction.

**SFEC – Onshore**

***Construction***

**Land Disturbance**
There will be ***no impacts*** to nesting areas at beaches as installation for the sea-to-shore transition will occur under the beach.

Construction activities along the SFEC – Onshore route have the potential to affect shorebirds and some seabirds (e.g., terns), including potential impacts to listed species including piping plover (federally- and NYS-threatened), red knot (federally threatened) and least tern (NYS-threatened). These species breed, forage, and/or rest in the vicinity of the sea-to-shore transition and SFEC – Onshore. These potential impacts were considered during the siting process and the HDD work area was setback at least 650 feet (198 m) from the MHWL to minimize the potential for impacts. Additional construction activities are scheduled to occur outside of the tern and plover breeding period; red knots may be present during migration only briefly, if at all. DWSF will develop a plan to manage listed species in consultation with regulatory agencies to address residual risk to these species; therefore, ***no impacts*** to listed species are expected.

A variety of land birds including passerines and raptors use terrestrial habitats on Long Island in the East Hampton area. Except for construction of the new SFEC – Interconnection Facility to be located adjacent to the existing East Hampton substation, all components of the SFEC – Onshore will be set within a new underground duct bank in developed areas along existing ROWs, thus avoiding disturbances to land birds. Woodland habitat will be cleared for construction of the new SFEC – Interconnection Facility, and there may be a small amount of additional clearing along railroad ROWs for the SFEC − Onshore. During the breeding season, clearing of trees or vegetation that may contain nests of land birds could result in destruction of nests, causing impacts to some individuals; however, significant impacts to local breeding populations are not anticipated. No listed land bird species are expected to occur at the new SFEC – Interconnection Facility location; therefore**, *no impacts*** are expected.

**Noise and Traffic**

HDD activities will generate noise and vibration that could temporarily flush birds, if present, during migration or winter. Certain activities may require limited equipment and vehicle activity on the beach (e.g., rollout of the conduit pipe to support HDD). DWSF will develop a plan to manage listed species in consultation with regulatory agencies to address risk to these species.

There will be noise and traffic associated with construction of the SFEC - Onshore and the SFEC – Interconnection Facility. These activities could affect shorebirds, some seabirds, and land birds that use the beach and terrestrial habitats of eastern Long Island in the immediate vicinity of installation activities. Noise- and traffic-related impacts are expected to have ***short-term to minor impacts*** on these birds because construction will occur in already developed areas, and impacts associated with construction will be similar to existing sources of noise and traffic in the local area.

***Operations***

No impacts to avian species are anticipated during routine operations of the SFEC – Onshore.

***Decommissioning***

Decommissioning of the SFEC – Onshore will have similar impacts as construction.

#### 4.3.6.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to avian species.

- The SFWF WTGs will be spaced at least 0.8 miles (1.3 km, 0.7 nm) apart; this wide spacing will allow avian species to avoid individual WTGs and minimize risk of potential collision.
- The location of the SFWF, more than 18 miles (30 km, 16 nm) offshore, avoids the coastal areas, which are known to attract birds, particularly shorebirds and seaducks.
- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction or disorientation.
- DWSF will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.

- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).
- The SFEC sea-to-shore transition will be installed via HDD to avoid impacts to the dunes, beach, and near-shore zone.
- An avian management plan for listed species will be prepared for the SFEC - Onshore.
- The SFEC - Onshore cable will be buried; therefore, avoiding the risk to birds associated with overhead lines.

## 4.3.7 Bat Species

The description of the affected environment and assessment of potential impacts to bat species and their habitats were evaluated by reviewing a compilation of published and unpublished environmental and technological literature, anecdotal records, records incidental to other scientific research, and studies that targeted bats offshore, including acoustic bat monitoring at the BIWF and vessel-based acoustic monitoring at the SFWF. Bat species that may occur within the SFWF and SFEC are described in this section, followed by an evaluation of potential project-related impacts. For more information regarding the bat species that may occur at the SFWF, see Vessel-based Acoustic Bat Monitoring, Draft Avian and Bat Risk Assessment, and Draft Avian and Bat Resources Technical Report in Appendix Q.

### 4.3.7.1 Affected Environment

For bats, relating occurrence to certain physical and biological features in the offshore environment is more difficult to estimate than for birds. While known to be present, the circumstances of when and where bats occur offshore is only beginning to be understood.

For the purposes of this summary, "offshore" is defined as waters beyond a 3-nautical-mile (5.6 km) distance from land, and "nearshore" is within the 3-nautical-mile (5.6 km) distance from land.

**Regional Overview**

The extent of scientific knowledge regarding the presence and behavior of bats in the offshore environment is limited. Historical observations and a few scientific studies indicate that bats migrate and possibly forage offshore. They will use islands, vessels, and other offshore structures as opportunistic or deliberate stopover sites (Pelletier et al., 2013). Bats may forage offshore during migration, perhaps to avoid competition or to exploit certain food sources (Ahlén et al., 2009). Detections of bats anecdotally in the offshore environment have been reported most often during the migratory periods, particularly in the fall (Nichols, 1920; Thomas, 1921; Norton, 1930; Griffin, 1940; Carter, 1950; Mackiewicz and Backus, 1956; Pelletier et al., 2013).

Historical observations of bats offshore have been predominately of the migratory tree-roosting species, which include eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*) (Pelletier et al., 2013). However, focused surveys documented offshore detections of species considered to be nonmigratory (Ahlén, 2006; Ahlén et al., 2007, 2009; Stantec, 2016; Pelletier et al., 2013), some of which are subject to population declines because of white-nose syndrome. The northern long-eared bat (*Myotis septentrionalis*) is the only bat species with potential to occur in the SFWF and SFEC that is afforded protection under the federal ESA and New York's Fish and Wildlife Law. See Appendix Q for additional information on listed species.

Bats were detected from 10 to 43 miles (16 to 70 km) offshore during either boat-based or high-definition video aerial surveys in the mid-Atlantic (Hatch et al., 2013). During acoustic studies conducted in the northeast, mid-Atlantic, and Great Lakes regions, Stantec Consulting Services Inc. (Stantec) (2016) found relative bat activity (mean number of bat passes per night) on coastal and offshore sites to be comparable to onshore sites. Prior statistical analyses also failed to detect significant differences in bat activity levels at island versus mainland sites (Pelletier et al., 2013). Bats are regularly detected at remote islands and offshore structures, but primarily on a seasonal basis, with declining activity as the distance from shore increases.

Bat acoustic detector surveys were conducted at BIWF during preconstruction, construction, and postconstruction phases. During postconstruction surveys, bat detection rates at BIWF were highest in the months of August and September. No bat passes were recorded from November through January, as described in Draft Avian and Bat Risk Assessment and Draft Avian and Bat Resources Technical Report in Appendix Q.

Available regional data suggest bats could occur anywhere in the SFWF or SFEC, particularly during the fall migratory period, but also potentially during spring migration and early summer. Table 4.3-51 provides a summary of probable occurrence of bat species in the SFWF or SFEC.

**Table 4.3-51. Timing, Distribution, and Relative Frequency of Occurrence of Bat Species and Species Groups in the SFWF and SFEC**

| Species/Species Group | Scientific Name | Occurrence | Peak Occurrence | Relative Frequency of Occurrence | | |
|---|---|---|---|---|---|---|
| | | | | Onshore | Nearshore | Offshore |
| eastern red bat | *Lasiurus borealis* | May to October | August | Seasonally common | Uncommon | Uncommon |
| hoary bat | *Lasiurus cinereus* | July to October | August | Seasonally common | Uncommon | Uncommon |
| silver-haired bat | *Lasionycteris noctivagans* | May, July, August | August | Seasonally common | Uncommon | Uncommon |
| little brown bat | *Myotis lucifugus* | May to October | August | Seasonally common to abundant | Uncommon | Uncommon |
| northern long-eared bat | *Myotis septentrionalis* | May to October | August | Seasonally common to abundant | Uncommon | Uncommon |
| eastern small-footed bat | *Myotis leibii* | May to October | August | Seasonally common to abundant | Uncommon | Uncommon |
| big brown bat | *Eptesicus fuscus* | May to October | August | Seasonally common to abundant | Uncommon | Uncommon |
| tri-colored bat | *Perimyotis subflavus* | May to October | August | Seasonally common to abundant | Uncommon | Uncommon |

### SFWF, SFEC − OCS, and SFEC − NYS

Bat acoustic detector surveys were conducted during G&G surveys from mid-July to mid-November 2017. Vessel-mounted detectors recorded bat passes from July through November, with most calls recorded in the August – September period. Species identified within the SFWF included silver-haired bat, hoary bat, eastern red bat, tri-colored bat (*Perimyotis subflavus*), and little brown bat (*Myotis lucifugus*). A northern long-eared bat call was detected at the southeastern edge of the SFWF, and multiple northern long-eared bat calls were detected along the SFEC route (as described in Vessel-based Acoustic Bat Monitoring, Appendix Q). For the entire study area, northern long-eared bat calls represented 4 percent of all recorded calls (however, there are limitations to positive identification of northern long-eared bat calls due to overlaps with species that have similar call signatures). Most northern long-eared bat activity was detected in the month of August; however, it should be noted that the survey was conducted for only a portion of the year (mid-July through mid-November).

Available data suggest bats are more likely to occur at nearshore locations compared to offshore. Field surveys on Block Island documented resident populations of bats and indicated the island may act as a migration stopover point for migratory tree roosting species (Tetra Tech and DeTect, 2012; Stantec, 2016). The surveys demonstrated that Block Island, and to a lesser extent, nearshore waters immediately surrounding the island, provide habitat for at least five species of bat, including big brown bat (*Eptesicus fuscus*), little brown bat, eastern red bat, silver-haired bat, and hoary bat. Passive and active acoustic monitoring data showed detections were predominately limited to the island and nearshore waters, with a low rate of detection offshore.

**SFEC − Onshore**

Anecdotal and survey-focused evidence includes bat detections on the coast of Long Island in fall (Merriam, 1887). Mist-netting surveys and acoustic monitoring documented all eight species likely to occur on Long Island, based on these species' known ranges (Cane, 2011; Fishman, 2013). NYSDEC 2017 acoustic surveys did not identify northern long-eared bat within 1.5 miles (2.4 km) of the Beach Lane landing site; there have, however, been positive identifications for this species within 1.5 miles (2.4 km) of the Hither Hills landing site (Jennings and Gaidasz, 2018, pers. comm.).

#### 4.3.7.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the SFWF and SFEC have the potential for both direct and indirect impacts to bat species, including habitat loss or modification, disturbance, collision risk, displacement, attraction, and barrier impacts.

The IPFs and anticipated levels of impact to bats associated with the construction, O&M, and decommissioning phases for the SFWF and SFEC are outlined on Figure 4.3-12 and in Tables 4.3-52 and 4.3-53, including potential impacts to the federally listed northern long-eared bat. Impacts resulting from the SFWF and SFEC are anticipated to range from no impact to negligible to minor. The SFWF and SFEC's risk assessment in Appendix Q includes additional details of these impacts, which are summarized in the rest of this section.

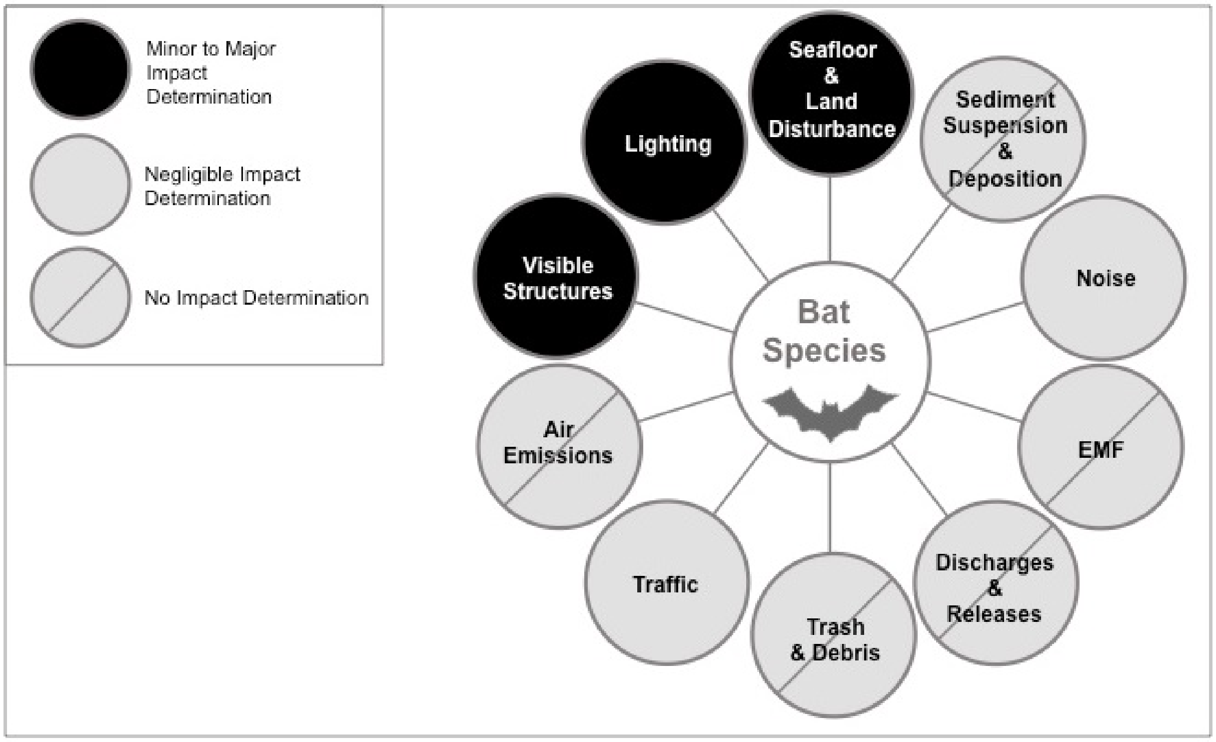


**Figure 4.3-12. IPFs on Bat Species**

**South Fork Wind Farm**

This section summarizes the assessment of potential impacts on bat species presented in Appendix Q. The primary IPFs associated with the SFWF that could impact bat species include Visible Structures and Lighting. The potential impacts associated with each phase of the SFWF are addressed separately in the following sections.

***Construction***

No impacts are expected during construction of the SFWF. Bats are expected to seasonally occur in the SFWF while migrating, commuting, or foraging but will be unimpacted by seafloor disturbances during construction of the SFWF due to a lack of roosting habitat in these areas. There are ***no collision-related impacts*** to bats anticipated during construction because bats are expected to detect stationary structures. As bats are only anticipated to occur occasionally in the airspace of the SFWF during migration, impacts associated with traffic and noise during construction are anticipated to have ***no impact*** to bats. Bats are typically expected to forage for insects in flight (but may rarely take prey from the surface of the water); therefore, **no impacts** to bats from discharges or releases at the SFWF are expected.

***Operations and Maintenance***

Table 4.3-52 summarizes the level of impacts expected to occur to bat species during the O&M phases of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-52. IPFs and Potential Levels of Impact on Bats for the SFWF during Operations and Maintenance**

| IPF | Project Activity | Potential Impact |
|---|---|---|
| Visible Structures / Lighting | Collision risk with WTGs or OSS | Negligible to Minor direct |
| | Displacement, attraction, or barrier effect, based on presence of WTGs or OSS | Negligible to Minor direct |

**Visible Structures and Lighting**

While bats are presumably less abundant in offshore environments than onshore, the possible attraction of bats to tall structures on an otherwise flat landscape may influence bat activity and risk of collision at offshore WTGs. The actual number of bats that may collide with offshore turbines is presently unknown, and methods for monitoring are limited. Further, the level of mortality observed at onshore turbines is not necessarily transferable to offshore turbines due to the different use of habitats and behaviors offshore. A lack of bat carcasses reported during large-scale, bird-related fatality events at illuminated lighthouses, lightships, and oil or research platforms indicates bats do not appear to be susceptible to the same large-scale collision events that birds are vulnerable to with lit structures (Appendix Q).

However, light sources on the SFWF, WTG decks, and OSS may serve as an attractant to bats as they navigate, or bats may potentially be indirectly attracted if insect prey are drawn to the lighting. Specific WTGs may also be lit with aviation lighting; however, aviation lighting has not been found to influence bat collision risk at onshore facilities in North America (Arnett et al., 2008).

Bat collision-related impacts may result in ***minor impacts*** at the SFWF, with long-distance migratory bats considered to be most at risk. Additionally, several North American nonmigratory bat species populations are in decline (notably the federally threatened northern long-eared bat). Given bats have low reproductive rates and require a high adult survivorship, those populations in decline are potentially vulnerable to impacts (Arnett et al., 2013). Despite an anticipated low collision risk, the level of impact to the listed northern long-eared bat is also considered ***minor*** (because they are a population already at risk).

Based on available information, bats may more likely be attracted to the wind farm rather than displaced due to the presence of the WTGs, as they may investigate WTGs for potential roosting opportunities or use the structures for navigational purposes while migrating. While these behaviors may increase their risk of collision, there are ***no impacts or negligible impacts*** associated with displacement or barrier impact anticipated during SFWF operations.

**Noise and Traffic**

Boat activity and noise already occur to some extent within and adjacent to the SFWF area due to existing levels of vessel traffic. Short-term increase of activity and associated disturbances during maintenance activities is expected to have ***no impact*** on bats in SFWF.

**Discharges and Releases**

There are also ***no impacts*** to bats anticipated with discharges and releases during operation at the SFWF, since these components will be buried beneath the seabed, and there will be no routine maintenance at these components.

***Decommissioning***

Decommissioning of the SFWF will have similar impacts as construction.

### South Fork Export Cable

This section summarizes the assessment of potential impacts on bat species presented in Appendix Q. The primary IPFs associated with the SFEC that could impact bat species include seafloor and land disturbance, noise, traffic, visible structures, lighting, and discharges and releases. The potential impacts associated with each phase of the SFEC are addressed separately in the following sections.

***Construction***

Similar to SFWF, no impacts to bat species are anticipated during construction of the SFEC – OCS and SFEC – NYS.

***Operations and Maintenance***

No impacts to bat species are anticipated during routine operations of the SFEC – OCS and SFEC – NYS.

***Decommissioning***

Decommissioning of the SFEC – OCS and SFEC – NYS will have similar impacts as construction.

### SFEC – Onshore

***Construction***

Table 4.3-53 summarizes the level of impacts expected to occur to bat species during the construction and decommissioning phases of the SFWF. Additional details on potential impacts from the various IPFs are described in the following sections.

**Table 4.3-53. IPFs and Potential Levels of Impact on Bats for the SFEC - Onshore during Construction and Decommissioning**

| IPF | Project Activity | Potential Impact |
|---|---|---|
| Seafloor/Land Disturbance | Habitat loss/modification from cable installation and interconnection facility installation | Negligible or Minor direct |
| Noise | Disturbance from cable installation, HDD, and interconnection facility installation | Negligible direct |
| Traffic | Disturbance from vessel and vehicle activity during cable and interconnection facility installation | Negligible direct |

**Land Disturbance**
Installation of the SFEC – Onshore and construction of the SFEC – Interconnection Facility will result in short-term and minor land disturbances. Since the SFEC – Onshore is within existing ROWs (primarily existing roads), ***no impacts*** to bats are expected from installation of the SFEC – Onshore, and ***minor impacts*** are expected from construction of the SFEC – Interconnection Facility. Only ***minor impacts*** to bats are expected, given these activities will occur in already developed areas; and only a relatively small area will be cleared for the substation, with minimal additional vegetation clearing along railroad ROWs for the SFEC – Onshore.

**Noise and Traffic**
There will be noise and traffic associated with construction of the SFEC – Onshore and SFEC – Interconnection Facility. Since these activities will occur in already developed areas, there are ***negligible impacts*** to bats expected.

***Operations***

***No impacts to bat species are anticipated during routine operations of the SFEC – Onshore.***

***Decommissioning***

Decommissioning of the SFEC – Onshore will have similar impacts as construction.

#### 4.3.7.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to bat species.

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey) and possibly collision of bats at night.
- SFEC - Onshore will be located underground in previously disturbed areas, such as roadways and railroad ROW, therefore, minimizing potential impacts from clearing.

DWSF will also consult with the agencies regarding the need for time-of-year restrictions for tree-clearing at onshore project components to mitigate potential impacts to tree-roosting bats.

## 4.4 Cultural Resources

Cultural resources include archaeological sites, above-ground buildings and structures, objects, districts, and other properties that illustrate important aspects of prehistory or history or that have important and long-standing cultural associations with established communities or social groups. Around the proposed Project (both the SFWF and the SFEC), there is potential to find cultural resources both in submerged marine contexts and in upland terrestrial contexts. Sites that relate to earliest periods of known human occupation in the area may be in what are currently submerged marine environments, as well as onshore terrestrial environments.

Several laws and regulations protect cultural resources. Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. 306108), requires that federal agencies consider the impacts of their actions on properties listed in or eligible for listing in the National Register of Historic Places (NRHP). The Archaeological Resources Protection Act (16 U.S.C. 470aa-mm) and Abandoned Shipwreck Act (43 U.S.C. 2101 et seq.) also outline protections for terrestrial and submerged cultural resources. The BOEM, as Lead Federal Agency, will lead the Section 106 process and engage the SHPOs and Native American tribes that may have an interest in the Project area. In many cases, Tribal Historic Preservation Officers (THPOs) participate in consultations as designated representatives of their tribes. As part of the consultation process for the SFWF and SFEC, BOEM will consult with the Rhode Island, Massachusetts, New York, and Connecticut SHPOs, as well as the Mashpee Wampanoag, Narragansett Indian, Mohegan, Mashantucket Pequot Tribal Nation, Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah) THPOs and the National Park Service (NPS). DWSF has also facilitated consultation with the SHPOs and THPOs to support survey protocol development and design of the Project in a way that avoids and minimizes impacts on cultural resources to the extent practicable.

The identification of cultural resources in the SFWF and SFEC and the evaluation of potential impacts have involved several meetings with agency and tribal representatives, oral interviews, and the completion of desktop and field studies. The cultural resources studies that have been completed for the Project include the following surveys and assessments:

- Historic Resources Visual Effects Analysis (HRVEA) and Visual Impact Assessment (VIA), which assessed visual impacts to historic properties in New York, Rhode Island, and Massachusetts (EDR, 2018a, 2018b);
  - A revised HRVEA and VIA addressing changes to the proposed locations of WTGs on the OCS will be completed and submitted to BOEM in late Spring 2019.
- Marine Archaeological Resources Assessment report, which includes documentation of settings with the potential to contain archaeological sites on the OCS and in New York State waters surveyed in 2017 (Gray & Pape, 2018);
  - Supplemental marine archaeological assessment for an expanded work area on the OCS are underway and the results of these efforts will be incorporated in the final Marine Archaeological Resources Assessment report in late Spring 2019;
- Phase I Archaeological Survey report, which documented efforts to identify terrestrial archaeological sites onshore in New York (EDR, 2018c); and
- Historic Resources Assessment and Visual Resource Assessment (VRA) for the SFEC – Interconnection Facility, which assessed visual impacts to historic properties in the vicinity of the proposed substation (EDR, 2018d).

The full text of the HRVEA is included as Appendix W, while the full text of the VIA is included as Appendix V. The complete marine archaeology assessment is included as Appendix R, and the full text of the terrestrial archaeological resources assessment is included as Appendix S. The full text of the Historic Resources Assessment for the SFEC – Interconnection Facility is included as Appendix T while the full text of the Visual Resources Assessment is included as Appendix U. Summaries of the findings of each study are presented below.

## 4.4.1 Above-Ground Historic Properties

### 4.4.1.1 Affected Environment

**Regional Overview**

Historic properties are defined as districts, buildings, structures, objects, or sites that are listed in or determined eligible for listing in the NRHP. DWSF commissioned an analysis of visual impacts to historic resources within the visual Area of Potential Effects (APE) of both the SFWF and the SFEC - Onshore to identify impacts to previously recorded and designated above-ground historic properties near the Project area, as well as additional properties that may be eligible for NRHP listing or state-level historic designation (Appendix W). The APE will be formally determined by BOEM as part of the agency's Section 106 process; "APE" as used here refers to the areas DWSF believes will be subject to direct or indirect impacts from Project activities. The process for identifying and evaluating visual impacts to historic properties from the SFWF and SFEC will involve consultation with BOEM, SHPOs, THPOs, and other consulting parties with a demonstrated interest in the historic properties (e.g., a local historical society).

**South Fork Wind Farm**

A Study Area for Potential Visual Effects (SAPVE) was defined to include those areas where proposed WTGs will be visible and where there is a potential for a significant visual impact to historic properties. The SAPVE was not based solely on potential Project visibility, but also on the distance within which visibility of the Project could result in a significant impact on the visual setting of a given historic property, as detailed in the HRVEA (Appendix W).

Based on the results of these studies, and to provide a conservative analysis of potential Project visibility from historic properties, the visual study area for the SFWF was defined as the area within a 40-mile (64.4-km) radius of each of the proposed turbines. This study area includes approximately 4,820 square miles (12,483.7 $km^2$) of open ocean, 735 square miles (1,903.6 $km^2$) of land (including inland water bodies), and over 1,000 linear miles (1,609.3 km) of shoreline in New York, Rhode Island, Massachusetts, and Connecticut. However, within this study area, only a relatively small portion of onshore areas will have open views of the SFWF. For example, topography, current land cover, and intervening land masses (Fishers Island and Block Island) screen views of the planned offshore facilities from Connecticut.

Based on viewshed mapping within a preliminary 40-mile (64.4-km) APE for the SFWF, the SAPVE for assessing impacts to above-ground historic properties field survey was defined as all locations on Block Island and the New York, Rhode Island, and Massachusetts mainland with potential views of one or more WTGs. As a result of geographic information system (GIS) and light detection and ranging (lidar) viewshed analyses, approximately 1.8 percent of lands within the 40-mile (64.4 km) study area have potential views of some portion of the SFWF, based on the availability of an unobstructed line of sight.

The above-ground historic properties evaluation (Appendix W) was coordinated with the VIA for the Project (Appendix V). The VIA is dependent on, and contributes to, the anticipated review of the SFWF and SFEC's impact on historic resources, which is required as part of BOEM's review under Section 106 of the NHPA.

The viewshed analysis informed the selection of the historic properties recommended for impacts evaluation, and the identified historic properties were subsequently included as a category of visually sensitive receptors in the VIA. The VIA considered 590 historic sites either designated as NRHP- or state-listed, or NRHP- or state-eligible individual resources or districts, Traditional Cultural Properties (TCPs), or state-inventoried resources in New York, Rhode Island, and Massachusetts. Of these resources, only 54 were determined to be located within the SAPVE (i.e., within areas where there is a potential for visibility of the SFWF and SFEC, as determined by GIS-based viewshed analysis).

**South Fork Export Cable**

Additionally, consideration was given to areas where the SFEC – Interconnection Facility maintained a potential for a significant visual impact to historic properties surrounding its location on Long Island, as detailed in the VRA (Appendix U). For the SFEC - Onshore, a visual study area encompassed an area within a 3-mile (4.8-km) radius of the SFEC – Interconnection Facility, which covers approximately 28.3 square miles (73.3 km$^2$) within the towns of East Hampton and Southampton, encompassing the village of East Hampton in its entirety, as well as a portion of the village of Sagaponack.

### 4.4.1.2 Potential Impacts

Direct impacts with potential to affect above-ground historic properties include construction that alters the character of a property through physical modifications or change of use of the property. Indirect impacts may result from the introduction of a new or altered visual element (setting), noise, vibration, traffic, and air quality factors.

IPFs that could result in impacts to above-ground historic properties during the construction, O&M, and decommissioning phases of the SFWF and SFEC are described in Section 4.1. A summary of the IPFs that could result in impacts to above-ground historic properties are shown in Figure 4.4-1. Only those IPFs with anticipated impacts negligible or greater are included in the following discussion.

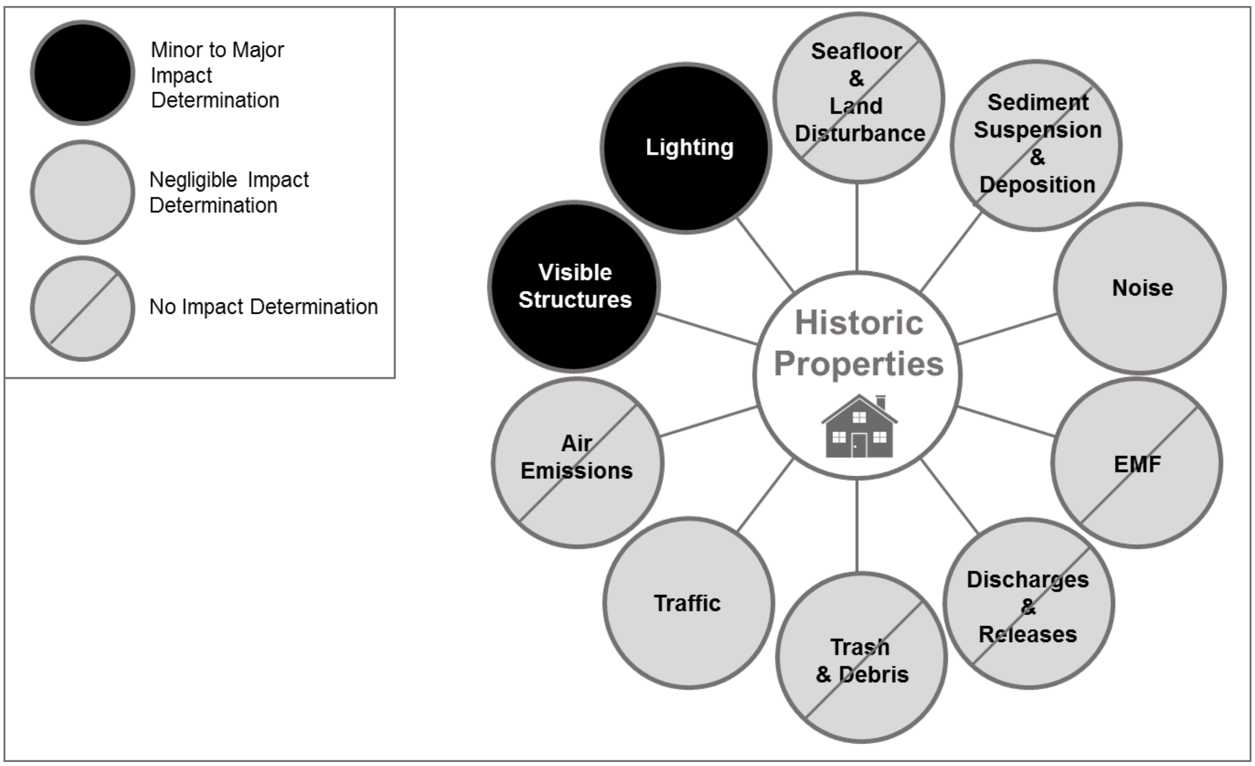


**Figure 4.4-1. IPFs on Above-Ground Historic Properties**

**South Fork Wind Farm**

Of the three phases of the SFWF, the construction and O&M phases are expected to pose the highest threat of adverse impacts to historic properties because of the potential visibility of various Project components. After decommissioning, all potential visual impact would be removed expect for a brief period when vessels and equipment are removing the WTGs and other components.

### *Construction. Operations, Decommissioning*

**Visible Structures**

The Project will be visible and will result in a change to the visual setting of historic properties located along the shoreline. However, the relatively small number of WTGs, their distance from shore, and the relatively small area of the horizon they occupy all help to minimize the visual impact. This, along with the presence of the Block Island Wind Farm nearer to shore, minimizes the SFWF's overall impact on the visual setting associated with historic properties, resulting in relatively ***minor impacts*** or alterations to the existing views during the period of SFWF O&M. Changes to the existing viewsheds for shoreline areas at the east end of Long Island are further reduced by the existing Block Island Wind Farm WTGs, which are located between Montauk Point and the proposed SFWF WTGs. The closest point to shore from the proposed WTGs is between 18.9 miles (30.4 km), on Block island, and 23 miles (37 km), on mainland Rhode Island. Even at the closest distance, the SFWF will occupy a relatively small portion of an expansive seaward view, and thus will not dominate the horizon.

DWSF recognizes that TCPs associated with Native American communities may be present within the study area, and such properties would potentially be sensitive to visual impacts from Project construction, O&M, or decommissioning. DWSF coordinated with THPOs to identify sensitive viewpoints within the SAPVE where visual impacts to TCPs might occur. Based on analyses and coordination with the tribes, DWSF does not anticipate adverse impacts to TCPs, but recognizes that government-to-government consultation among BOEM and tribes under Section 106 may be beneficial to the consideration of such potential impacts. Based on consultation, field studies, and photosimulations, the Project is not anticipated to result in adverse impacts to historic properties.

**Lighting**

The VIA (Appendix V) and the HRVEA (Appendix W) indicate that visibility of the SFWF is limited from most of New York, Rhode Island, and Massachusetts, resulting in ***negligible*** to historic properties in those areas. The historic properties with the highest potential for SFWF visibility were those that were situated to take advantage of panoramic ocean views, such as the Southeast Lighthouse on Block Island, Aquinnah Lighthouse on Martha's Vineyard, Beavertail Lighthouse in Jamestown, the Newport Cliff Walk on Aquidneck Island, and Watch Hill Lighthouse in Westerly, Rhode Island. These represent examples of NRHP properties that receive high public use/visitation in the region that will have at least some visibility of the SFWF, although nighttime safety lighting associated with WTGs will have only a ***minor impact*** to a limited number of areas along the coast. A comprehensive list of areas from which potential SFWF facilities will be visible within the SAPVE are listed in Appendix A and depicted in Figure 8 of the HRVEA (Appendix W). The VIA report in Appendix V provides further discussion of the visibility of the WTGs within the 40-mile (64.4-km) study area and the methods used to assess potential visual impacts from the SFWF, including viewshed mapping, field reviews, and visual simulations.

There are no NRHP-listed or -eligible above-ground historic properties within the APE that will be directly affected by construction, O&M, or decommissioning of the SFWF. Therefore, construction and O&M of the SFWF would be expected to result in ***no direct impacts*** on above-ground historic properties.

The visual impacts assessment studies completed as part of the SFWF will be provided to SHPOs and THPOs as part of the Project's ongoing consultation. The formal impacts determination for the Project will be completed through the Section 106 consultation process between BOEM, SHPOs, THPOs, and other interested parties, as applicable.

**SFEC - Onshore**

Of the three phases of the SFEC, the construction and O&M phases are expected to pose a risk of adverse impacts to historic properties. When and if removal of the SFEC occurs as a result of decommissioning, then it is expected that short-term effects would occur during removal of the SFEC and its components.

***Construction. Operations, Decommissioning***

As described in Appendix U, there are no NRHP-listed or potentially eligible above-ground historic properties within the APE that would be directly affected by construction of the SFEC and the SFEC – Interconnection Facility. Therefore, construction and O&M of the SFEC - Onshore would be expected to result in ***no direct impacts*** to above-ground historic properties.

Visibility of the potential SFEC - Onshore cable routes on Long Island will have ***no impact***, since the cable will be buried beneath existing roads or within other public ROWs.

**Visible Structures**

Construction of the SFEC – Interconnection Facility will occur adjacent to the existing East Hampton substation, in a lot surrounded by mature trees. A digital surface model (DSM) of the study area was created from lidar data, which includes the elevations of buildings, trees, and other objects. This analysis indicates that the SFEC – Interconnection Facility could potentially be visible from only 1.8 percent of the 3-mile (4.8-km) visual study area. Field review indicated that actual visibility of the SFEC – Interconnection Facility is likely to be even more limited than suggested by the computer-based viewshed analysis. Throughout most of the study area, the SFEC – Interconnection Facility will likely not be visible due to the density of modern buildings and structures in the villages, and dense, mature evergreen and deciduous forest in the SFEC – Interconnection Facilities surroundings. Potential visibility of the substation will be generally limited to a few areas within approximately 0.25 mile (0.4 km) of the SFEC – Interconnection Facility. These areas generally correspond to the areas of predicted visibility as indicated by the lidar-based viewshed analysis. In these areas, the existing East Hampton substation, as well as the SFEC – Interconnection Facility, is visually screened from most nearby areas by dense, mature vegetation that ranges in height between approximately 50 and 70 feet (15.2 to 21.3 m).

During field review, photos were taken from the various historic districts within the study area to support preparation of photosimulations reflecting the nature and extent of visibility from historic properties within the study area (viewpoint references for examples detailed in Appendix V follow). These include Buell's Lane Historic District (see Viewpoints 6 and 28), Jericho Historic District (see Viewpoint 19), and East Hampton Historic District (see Viewpoints 26, 27, 31–33, 36-39, 50, and 75). At each of these locations, the Project would be screened due to the combination of large, mature street trees, forest vegetation, and intervening buildings and structures. No visibility of the Project is anticipated from these areas. As a result of this analysis, the SFEC – Interconnection Facility will result in ***minor*** to ***negligible impacts*** to historic properties.

The locations of NRHP-listed and state- and NRHP-eligible historic properties on Long Island in relation to the viewshed of the SFEC – Interconnection Facility are shown in Figure 7 of Appendix T. Section 4.6 and Appendix U provide further discussion of the visibility of the SFEC construction and O&M activities within the study area and the methods used to assess the potential visual impacts of the Project, including viewshed mapping, field reviews, and visual simulations. The visual impacts assessment studies appended to this report will be provided to the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) and BOEM for review, as part of the Project's ongoing consultation.

**Noise**

As discussed above, the Project would not directly affect NRHP-listed or state- or NRHP-eligible above-ground historic properties. The SFEC onshore components will be collocated with existing electric generation and transmission facilities, located on compatible industrial properties, or buried within existing roadway or other public ROWs to avoid negative visual impacts. Also, of the SFEC-Interconnection Facility at least partially obstructed from each of the historic properties by topography, vegetation, and intervening buildings and structures. As such, ***negligible impacts*** are anticipated from noise.

**Traffic**

During construction of the SFEC – Interconnection Facility, vehicular traffic will increase. As a result, short-term noise and vibration may occur as a result of the passage of equipment to and from the construction site. However, traffic will use the same means of ingress and egress as used for the existing East Hampton substation. Therefore, only ***short-term, negligible impacts*** to above-ground historic properties could result from traffic associated with the SFEC.

### 4.4.1.3 Proposed Environmental Protection Measures

For the SFWF, options for mitigating visual impacts of wind energy facilities of this type are limited, given the nature of offshore wind energy projects and their siting criteria. Because of these limitations, mitigation for impacts to historic properties typically consists of measures that directly benefit historic properties and/or the public's appreciation of them. Mitigation measures that have been proposed for other wind energy projects in states within the visual study area have included activities such as cultural resources studies, monetary contributions to historic property restoration causes, development of heritage tourism promotional materials, development of educational materials and lesson plans, and development of public history materials, such as roadside markers.

For the SFEC – Interconnection Facility, due to the relatively small size and modest height, views from visually sensitive resources have largely been avoided.

Several environmental protection measures will reduce potential impacts to historic resources.

- The location of SFWF WTGs, approximately 18.9 miles (30.4 km, 16.4 nm) from Block Island, 22 miles (35.4 km, 19.1 nm) from Martha's Vineyard, and 34.9 miles (56.2 km, 30.3 nm) from Montauk, restricts available views from visually sensitive above-ground historic properties.
- SFWF WTGs will have uniform design, speed, height, and rotor diameter.

- The color of the the SFWF WTGs (less than 5 percent grey tone) generally blends well with the sky at the horizon and eliminates the need for daytime lights or red paint marking of the blade tips.
- The SFEC - Onshore cable will be buried; therefore, minimizing potential visual impacts to above ground historic properties.
- The SFEC - Interconnection Facility will be located adjacent to an existing substation on parcel zoned for commercial and industrial/utility use.
- The SFEC - Interconnection Facility land parcel is currently screened by mature trees. After construction, DWSF will consider additional screening to further reduce potential visibility and visual impact.

The complete range of potential mitigation measures evaluated by DWSF as part of Project development for the SFWF are detailed in the VIA and HRVEA report, in Appendix V and W.

The complete range of potential mitigation measures evaluated by DWSF as part of Project development for the SFEC – Interconnected Facility are detailed in the Historic Resources Assessment and VRA report, in Appendices U and T, respectively.

## 4.4.2 Marine Archaeological Resources

### 4.4.2.1 Affected Environment

**Regional Overview**

As part of cultural resources investigations for the Project, DWSF commissioned a marine archaeological resources assessment for the SFWF and SFEC. The SFWF is located on the OCS in Rhode Island Sound, and the SFEC will run from the SFWF to the southern shore of Long Island, New York. The goal of the assessment was to identify NRHP-listed and -eligible submerged archaeological resources that may be affected by the SFWF or SFEC. Potential archaeological resources on the OCS fall into two broad categories: (1) post-contact period shipwrecks, or other lost warcraft, aircraft losses, or historic marine infrastructure, and (2) pre-contact period Native American sites. Pre-contact resources may include sites used by indigenous peoples prior to marine transgression or sites associates with post-transgression indigenous maritime activities, such as fishing and water transport. The SFWF and SFEC assessment was designed to identify geological features with pre-contact period archaeological sensitivity and remote sensing anomalies or targets potentially associated with post-contact period submerged cultural resources. The study encompassed areas subject to bottom-disturbing activities during the construction, O&M, and decommissioning of the SFWF and SFEC based on the project design in 2018.

Based on the marine archaeological assessment completed to date, several paleochannels were identified within the SFEC-OCS and SFWF with the potential to contain pre-contact Native American archaeological resources. Shallow geotechnical investigations indicate the majority of sediments within these channels have a low potential to contain intact terrestrial soils or cultural sites; however, a single vibracore sample from one paleochannel within the SFEC-OCS contained an archaeologically sensitive paleosol. Supplemental analyses of geophysical data collected in 2017 are being completed to identify specific settings within these paleochannels that may retain intact pre-transgression soils and archaeological resources. Subsequent to completion of the 2017 surveys and in response to stakeholder input, DWSF identified an expanded work area extending to the east of 2017 study area that would accommodate a revised layout with wider spacing between WTGs. Supplemental G&G surveys and marine archaeological resources assessments of the expanded work area and deep geotechnical investigations of potential WTG and OSS foundations are currently underway, the results of which will be incorporated in revised marine archaeological resources assessment report. All supplemental marine archaeological assessments will be conducted in accordance with BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* and relevant lease stipulations.

The anticipated APE for the 2017 marine archaeological resources assessment included areas on the OCS, which is administered by BOEM, and areas of the SFEC extending west from the SFWF to the southern portion of eastern Long Island, where it turns north and enters New York State waters. BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585*, dated March 2017, was used in the preparation of the marine archaeological assessment report (Appendix R). Since Project activities will also occur in New York State waters, the report also complies with regulations outlined in the New York Historic Preservation Act of 1980.

In conjunction with detailed literature and site files research, G&G field investigations were conducted within the 2017 SFWF survey area, and along the approximately 61.5-mile (99-km) long SFEC corridor on the OCS and in New York State waters. Shallow geotechnical investications were conducted at depths of 20 feet (6 m) below the seafloor for the SFWF assessment, and 10 feet (3 m) for the SFEC corridor. Seabed disturbance associated with installation of the SFWF inter-array cables and SFEC and is anticipated to be confined within these depths. The 20-foot (6m) depth of shallow geotechnical investigations within the SFWF encompasses sediments potentially affected by derrick barge anchorage, described below. The underwater survey employed a variety of remote sensing technologies deployed from survey vessels to examine the seabed and to locate anomalies and acoustic targets on or buried in submerged sediments that might be affected by Project activities. Vibracores were collected from suspected paleo landforms (relict terrestrial landforms that survived transgression). The vibracores were used to corroborate interpretations of geophysical data and evaluate the potential for archaeological deposits to be present within areas subject to sea bed disturbance. A detailed description of the methodology and results of this study is contained in Appendix R.

Disturbance of sediments at depths greater than 20 feet (6m) below the seafloor during project construction or decommissioning of the SFWF is expected to be confined to construction of foundation systems for the WTG and OSS. Post-driven skirt piles, if required, may extend to depths of 200 feet (61m) below the seafloor. Deep geotechnical investigations of potential foundation locations are currently underway; the results of which will be incorporated in a revised Marine Archaeology Assessment report.

**South Fork Wind Farm**

Archival investigations of the SFWF Project area were conducted to identify previously documented pre- and post-contact period archaeological deposits or Native American underwater archaeological sites that have been recorded to date within the SFWF study area. Few archaeological studies have been conducted within Rhode Island or Block Island sounds, and data coverage is sparse relative to terrestrial contexts in the surrounding sections of Rhode

Island, Massachusetts, and New York. Site file and shipwreck data were reviewed at the RIHPHC (Rhode Island SHPO) and the NYSOPRHP (New York SHPO). Additionally, archaeological reports and studies were used in conjunction with site files data to create a context for pre-contact cultural materials. NOAA, BOEM, and other shipwreck databases were accessed to identify potential post-contact period resources in the anticipated APE. Additional regional and maritime secondary histories, maps, and other resources were used to refine the historic contexts for pre- and post-contact use of the study area. The historic contexts provided a basis for assessing the types and ages of archaeological resources that might be present within the SFWF and SFEC, and where such resources would most likely be preserved.

No shipwrecks or pre-contact sites within are recorded within the SFWF area at RIHPHC or NYSOPRHP. Four shipwrecks were reported in the NYSOPRHP records, at the eastern end of Long Island (nearer to the SFEC), from East Hampton to Montauk Point. Data from NOAA’s Automated Wreck and Obstruction Information System (AWOIS) and Electronic Navigational Charts (ENC) databases, as well as the proprietary BOEM shipwreck database, indicated one shipwreck reported within the SFWF, and several others within 1 mile (1.6 km) of the SFWF and SFEC. Additionally, the OSAMP, which includes the vast majority of the SFWF area, indicates many potential shipwreck site locations, but none specifically identified within the APE. The OSAMP lists 26 military craft losses and 36 known shipwrecks and several hundred additional reported shipwreck losses in the waters off Rhode Island. Known or suspected wrecks are concentrated closer to shore, rather than in the open waters of Rhode Island Sound, where the SFWF would be constructed.

Although no pre-contact sites were documented in RIHPHC or NYSOPRHP site files, a number of recent studies were reviewed to assess the potential for submerged pre-contact sites within the APE, as well as appropriate methods to identify them. Importantly, the relevant geologic and archaeological contexts of the southern New England region were studied to assess where potential pre-contact sites may once have been located on the now-submerged landscapes of the OCS. DWW consulted with six federally-recognized tribes to address potential resource locations and site types that may not be reflected in the existing archaeological literature. For the marine archaeological assessment, an archaeological context was developed based on known geological conditions and previous archaeological research of terrestrial settings near the study area. Settlement patterns for the periods of potential pre-contact Native American use of the OCS were reviewed to identify landforms and environmental settings with an elevated potential to support habitations. A model of sea level rise within and around the SFWF was created to estimate the time range of potential Native American sites, and geophysical data were examined to identify potential relict geological features such as paleochannels, estuaries, deltas, coastal or riverine terraces, beach barrier complexes, paleolakes and lagoons, or other indications of habitable landforms that may be preserved within the APE. Using known pre-contact cultural chronology and settlement patterns, sea level data, geomorphic contexts, and geophysical data, an assessment of the potential for pre-contact sites or other resources to be present within the APE was completed.

G&G surveys were conducted to characterize shallow hazards, geological conditions, geotechnical characteristics, and to provide data for marine archaeological resource assessments. The 2017 survey area extended approximately 3,281 feet (1,000 m) beyond the potential WTG positions,identified at the time of the surveys to provide coverage of the area where vessels may come into contact with and/or disturb the seafloor during construction, O&M, and decommissioning of the SFWF. A high-resolution geophysical (HRG) survey was conducted using a 98-foot (30-m) line spacing. Perpendicular tie lines were spaced at 1,640 feet (500 m). Survey transects ran in an east-west orientation, while tie lines were perpendicular, with a general north-south orientation.

The HRG survey included a magnetometer, side-scan sonar, sub-bottom profiler (both Chirp and Sparker), and a multibeam sounding system. Sparker data were collected using two instrument configurations. Data were collected at a 300 joules using a single hydrophone on 30m spacing to corroborate Chirp data. Sparker data were also collected at 500 joules using a multi-hydrophone array on 150m-spaced tracklines. The variety of remote sensing methodologies were used to enhance the potential of identifying potential archaeological sites and locations warranting direct sampling for further evaluation. In addition to review of previous archaeological and geological research, DWSF coordinated with tribal representatives to better understand the range of potential cultural resources that may be present within the study area. The marine archaeologist, on behalf of DWSF, invited representatives of the Narragansett Indian Tribe, Mohegan Tribe, Mashantucket Pequot Tribal Nation, Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head (Aquinnah), and the Shinnecock Tribal Nation to participate in a series of review sessions to identify potentially sensitive contexts represented in the geophysical data that warranted further investigation. Based on these meetings and analyses by the marine archaeologist, sampling locations were selected for geotechnical investigations with vibracores.

**South Fork Export Cable**

Consistent with the methods used for the SFWF, archival investigations of the SFEC were conducted to identify previously documented pre- and post-contact period archaeological sites or underwater archaeological resources within the SFEC study area. Site file data and published histories and maps were used to assess the potential for archaeological resources and to develop a context for interpretation of potential materials within the SFEC.

NYSOPRHP data indicate four shipwrecks at the eastern end of Long Island, from East Hampton to Montauk Point. Data from NOAA's AWOIS and ENC databases, as well as the proprietary BOEM shipwreck database, indicated several others within 1 mile (1.6 km) of the SFEC. Additionally, the various sources consulted during research for both the SFWF and SFEC indicate that a number of potential shipwrecks could be located within the vicinity of the SFEC, although accurate mapping of these locations is not available. As with the SFWF, a number of recent marine archaeological studies were reviewed to establish relevant geological and archaeological contexts for the SFEC and to develop formulations for testing and/or modeling for potential archaeological sites within the SFEC route.

As with the SFWF, G&G surveys were conducted to characterize conditions and to provide data for marine archaeological resource assessments. The SFEC survey corridor included a centerline and three offset lines on either side spaced 98 feet (30 m) apart, encompassing a 590.5-foot (180-m) wide corridor. Centerline Sparker data were collected at 500 joules with a multi-hydrophone array. The corridor, which was surveyed using the same methods and instrumentation as used for the SFWF area, was widened in three areas. These include:

- The section within approximately 6.8 miles (11 km) of the SFWF was widened, while maintaining a 98-foot (30-m) line spacing, to a variable width of approximately 2,296.5 to 3,281 feet (700 to 1,000 m), to allow room to route the cable through a boulder area.

- The shore approaches for the potential landing sites were widened to approximately 0.6 and 0.9 mile (1 and 1.5 km), respectively, from approximately 0.62 mile (1 km) offshore to the inshore survey limit. Survey tie lines along the SFEC corridor were spaced approximately 1,640 feet (500 m) apart.

Survey transects within the SFEC survey area ran in an east-west orientation (parallel to the SFEC corridor), while tie lines were perpendicular, in a north-south orientation. The only modifications to this methodology occurred around seabed obstructions and directly offshore Long Island. Vibracoring was conducted to evaluate potentially sensitive paleo landforms identified during the geophysical survey of the SFEC and in coordination with the above-listed tribes.

A complete description of the survey methodologies and results for both the SFWF and SFEC is provided in the full text of the marine archaeological assessment in Appendix R.

#### 4.4.2.2 Potential Impacts

IPFs that could result in impacts to marine archaeological resources are indicated in Figure 4.4-2. Only those IPFs with anticipated impacts negligible or greater are included in the following discussion.

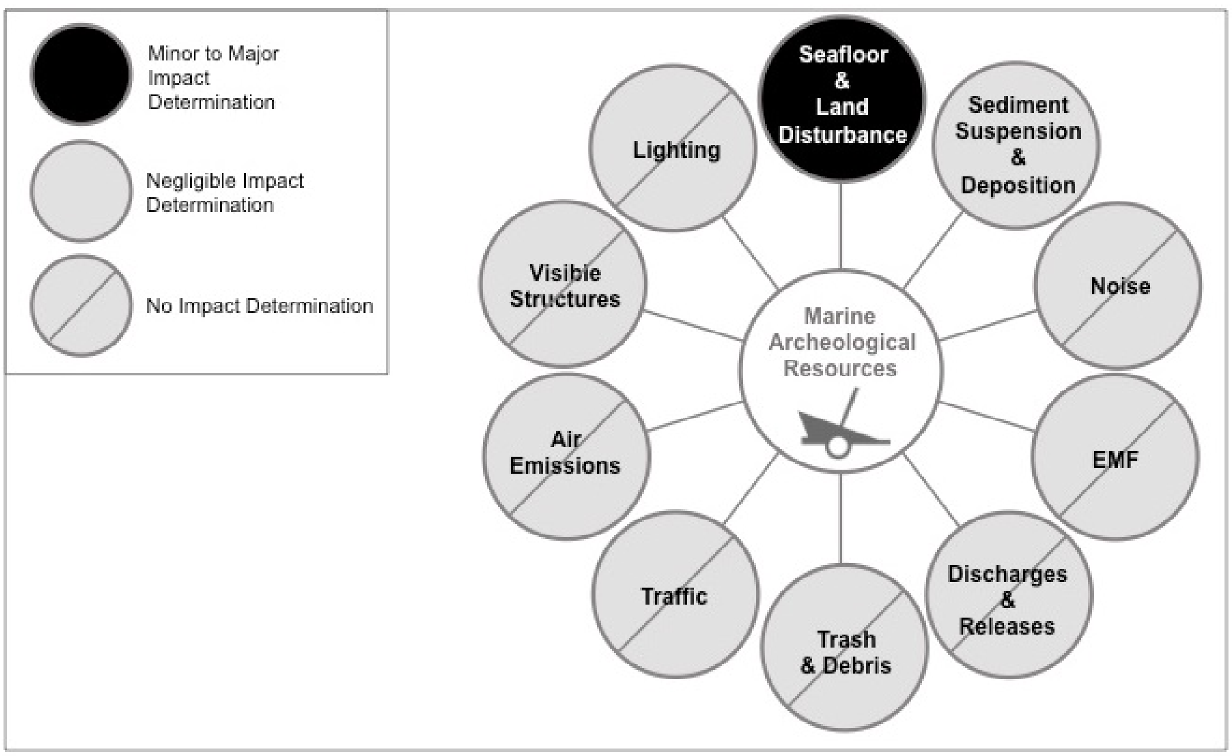


**Figure 4.4-2. IPFs on Marine Archaeological Resources**

**South Fork Wind Farm**

Of the three phases of the SFWF, the construction phase is expected to pose the highest threat of adverse impacts to marine archeological resources. The O&M of the SFWF does not cause IPFs that would impact these resources. When and if removal of the SFWF occurs as a result of decommissioning, then it is expected that marine archeological resources encountered during construction have already been managed according to Tribal, federal, and state expectations and regulations.

***Construction***

**Seafloor and Land Disturbance**

DWSF proposes to site WTGs to avoid or minimize impacts to submerged cultural resources. Disturbance to submerged cultural resources may occur because of anchor drop and anchor sweep from the derrick barge associated with the installation of the WTGs or displacement of sediment for construction of WTG foundations or inter-array cabling. The approximately 3,281-foot (1,000-m) survey corridor around the WTGs was defined based on the anticipated maximum radius for the derrick barge anchors.

Side-scan sonar imagery indicated numerous natural and few cultural features on the seabed. Most cultural features appeared to be related to fishing, lobster traps, or isolated debris. Two shipwrecks were identified during the geophysical survey of the SFWF study area. Both wrecks are likely of modern age based on analysis of side-scan sonar images and associated magnetic anomalies. A third likely shipwreck site of undetermined age was identified east of the study area. DWSF will maintain a protective buffer extending 164 feet (50 m) from the maximum discernable extent of each wreck during Project construction, O&M, and decommissioning. Other magnetic anomalies and side-scan sonar targets identified during the HRG survey represent fishing equipment, modern debris, submarine cables, or features associated with fishing activities.

Sea-level modeling indicates that the SFWF would have been exposed, terrestrial lands (subaerial) for thousands of years following the last glaciation. Rising seas caused by the melting of ice sheets approximately 22,000 years ago inundated the area during the Paleoindian Period, which is the earliest period of Native American settlement defined by archaeologists. The SFWF was progressively submerged, with the highest elevations being inundated between 11,000 and 10,000 years ago. The archaeological assessment for pre-contact resources within the SFWF included a reconstruction of the now-inundated landscapes that would have been available to ancient Native Americans and an analysis of how those ancient landscapes have been altered by natural processes operating over the course of millennia. Marine transgression caused extensive erosion of former terrestrial surfaces. Previous research and the marine archaeological assessment completed for the SFWF and SFEC indicate that contexts with the potential to preserve archaeological sites are generally confined to areas that were deeply buried before transgression or topographic/bathymetric basins where marine sediments were deposited in low-energy settings during transgression.

Several prominent paleochannels identified in sub-bottom data cross-cut the SFWF. Analyses of G&G data indicate these large channels are tunnel valleys formed below the ice sheet during the last glaciation. The tunnel valleys are filled with varied outwash sediments likely deposited in the period immediately following local ice recession around 22,000 years ago. Smaller channels, largely conforming to the tunnel valley alignments and incising the earlier outwash deposits, were also identified in the sub-bottom data. These second-generation channels likely reflect subaerial drainage networks formed after ice recession, while the SFWF was a terrestrial landscape. The smaller channels or incised valleys would have contained rivers or streams during the potential period of pre-contact occupations of the SFWF, following deglaciation and ending with marine transgression over Cox Ledge about 11,000 years ago. The configuration of second-generation channels suggests they are associated with high-order stream or river channels on the subaerial landscape. Low-order channels associated with tributary streams that may have once extended to the morainal terrain are lacking, likely due to more extensive erosion of interfluves during marine transgression.

Although the deep geotechnical investigations have not been completed, subbottom conditions characterized by Chirp and Sparker data indicate potentially sensitive contexts at depths greater than 20 feet (6m) of the seafloor will be confined depositional surfaces within second generation channels, if extant. First generation channel fills, glacial tills, and glacio-tectonic morainal deposits have a low potential to contain intact paleosols or archaeological resources.

Analyses of vibracores suggest that the majority of the terrestrial sediments preserved beneath the erosional unconformity created by transgression (ravinement) are unweathered glacial deposits with a low potential to contain intact archaeological resources. One core placed within the SFWF was located adjacent to a former freshwater wetland, which likely transitioned to an estuary prior to marine transgression. The topographic setting is consistent with a low-energy depositional environment that may have allowed for sedimentation during the early stages of marine transgression. That vibracore contained a peaty paleosol radiocarbon-dated to approximately 12,000 calendar years before present and has the potential to preserve archaeological deposits. The paleosol is within the depth of anticipated seabed disturbance.

Avoidance of seabed disturbance within 164 feet (50 m) of the vibracore location containing the paleosol is recommended. Analyses of the second-generation (post-glacial) channel features suggests the potential for preservation of additional paleosols where ancient terraces or other surfaces were buried by alluvium prior to marine transgression. Supplemental analyses of geophysical data collected in 2017 is currently underway to identify and avoid archaeologically sensitive settings within the second generation channels.

Additional archaeological resources may also be identified in the on-going G&G surveys of the expanded work area. Wherever feasible, DWSF will establish a 164 foot (50m) protective buffer from the maximum discernable extent of such resources. If avoidance is not feasible, DWSF will consult with BOEM and other interested parties to determine whether additional investigations to evaluate the significance of such resources and/or mitigation of potential impacts is warranted.

DWSF recognizes that TCPs associated with Native American communities may be present within the study area, and such properties would potentially be sensitive to seabed disturbance from Project construction. DWSF coordinated with THPOs during the G&G surveys to identify areas of concern and evaluate potential paleo landforms that may retain cultural sites significant to Native American tribes. Based on analyses and coordination with the tribes, DWSF does not anticipate adverse impacts to TCPs from offshore construction, but recognizes that government-to-government consultation among BOEM and tribes under Section 106 may be beneficial to the consideration of such potential impacts.

Although DWSF will make every effort to site WTGs and inter-array cabling away from marine archaeological resources and potential TCPs, unanticipated discoveries below the seafloor during construction remain a possibility. Therefore, construction of the SFWF maintains the potential to result in ***minor*** to ***moderate impacts*** to marine archaeological resources.

**Sediment Suspension and Deposition**
Potential sediment suspension and deposition during construction is unlikely to impact submerged archaeological resources. Deposition of suspended sediment is anticipated to be localized to areas of sea bed disturbance. Low energy deposition of sediments over archaeological resources buried beneath the sea bed is not expected to disturb or otherwise affect the integrity of those resources. The protective buffers recommended for shipwreck sites and archaeologically sensitive areas will minimize the potential impacts from construction-related suspension and deposition to cultural resources.

Sediment suspension and deposition will result in ***negligible impacts*** to marine archaeological resources, as no direct disturbances to these resources would occur.

### South Fork Export Cable

Of the three phases of the SFEC – OCS and SFEC - NYS, the construction phase is expected to pose the highest threat of adverse impacts to marine archeological resources. The O&M of the SFEC does not cause IPFs that would impact these resources. When and if removal of the SFEC occurs as a result of decommissioning, then it is expected that marine archeological resources encountered during construction have already been managed according to Tribal, federal, and state expectations and regulations.

#### *Construction*

**Seafloor and Land Disturbance**
Sub-bottom profiler data indicated two general sub-seabed environments, a sheet of Holocene sands south of Long Island, and a more dynamic area beginning with the Block Island Channel and eastward toward the SFWF, on Cox Ledge. The sub-seabed contained no discernable gas pockets, salt domes, pipelines, or other buried materials. The majority of the SFEC study area was substantially altered by erosion during marine transgression. G&G evidence for paleo landforms with the potential to contain archaeological resources in SFEC are limited to paleochannel margins or terraces that were buried by relatively thick sediments prior to inundation.

The orientation of SFEC runs approximately parallel to the ancient shoreline prior to marine transgression. Analyses of seismic data suggests the SFEC will intersect multiple post-glacial stream or river valleys that once drained the area south of present-day Long Island. One vibracore placed along the upper margins of a paleochannel feature south of Montauk Point contained an intact terrestrial paleosol radiocarbon dated to approximately 17,000 years before present. Although the dated context pre-dates archaeologically confirmed Native American occupations of the Northeast, it falls within the potential age of indigenous settlement based on oral histories and traditional knowledge, as conveyed to DWSF by the coordinating Native American tribes. Sea level reconstruction suggests the vibracore location was submerged by rising seas approximately 10,500 years ago and may represent a stable land surface that endured for several millennia. The archaeologically-sensitive paleosol is within the 10-foot (3-m) depth of potential disturbance from construction. A 164-foot (50-m) protective buffer will be observed during construction. DWSF is undertaking supplemental analyses of shallow post-glacial valley settings to identify comparable archaeologically sensitive deposits that may be subject to seabed disturbance during Project construction. Such settings are expected to include former stream terrace surfaces near shallow valley margins/flanks.

DWSF proposes to site the SFEC away from known submerged cultural resources. Disturbance to potential submerged cultural resources may occur because of anchor drop and anchor sweep from the derrick barge, or displacement of sediment for the burial of the export cabling during installation of the SFEC. The extended survey corridor for the SFEC was defined based on the anticipated maximum radius for the derrick barge anchors. The potential for archaeologically sensitive submerged resources was assessed within this area. A possible shipwreck with a low confidence in location was reported near the potential Beach Lane landing site (AWOIS 7248). No evidence of a wreck was detected during the geophysical survey of the area, and no further investigations of this location are recommended. No other shipwrecks or aircraft losses were identified in the area of anticipated sea bed disturbance for the SFEC.

DWSF has committed to measures that would avoid impacts to cultural resources during construction. The preservation of paleosols and potential archaeological resources is expected to be rare in the study area, even within the post-glacial channel and estuary margin settings identified during the assessment.

Although DWSF will make every effort to site the SFEC away from marine archaeological resources and potential TCPs, unanticipated discoveries in the paleochannel margins or terraces during construction remain a possibility. Therefore, construction of the SFEC maintains the potential to result in ***minor*** to ***moderate impacts*** to marine archaeological resources.

**Sediment Suspension and Deposition**

As discussed in Section 4.2.3.2, deposition of suspended sediment during SFEC construction is expected to be localized to the cable corridor. Hydrodynamic and sediment dispersal modeling indicates up to 0.4 inch (1.1 cm) of sedimentation may occur in areas adjacent to the cable installation with the thickest deposits occurring within approximately 29 feet (9 m) of the burial route. Low energy deposition of sediments over archaeological resources buried beneath the sea bed are not expected to disturb or otherwise affect the integrity of those resources. The protective buffers recommended for archaeologically sensitive areas and potentially significant shipwrecks will minimize the potential impacts from construction-related suspension and deposition to cultural resources.

Thus, the SFEC will result in ***negligible impacts*** on marine cultural resources.

The full text detailing the potential impacts identified as a result of the marine archaeological assessment for both the SFWF and the SFEC is contained in Appendix R.

#### 4.4.2.3 Proposed Environmental Protection Measures

DWSF will continue to consult with BOEM, the NYSOPRHP, Native American tribes, and other interested consulting parties regarding the recommendations and proposed avoidance measures made as a result of the marine archaeological assessment. If any submerged cultural resources are identified during the course of project development and those resources cannot be avoided, DWSF would again consult with BOEM, the NYSOPRHP, Native American tribes, and other interested parties, to determine an appropriate approach and to provide BOEM with sufficient information to determine whether such resources are eligible for listing in the NRHP. Any mitigation of adverse impacts to significant archaeological sites would require additional consultation. Mitigation would be formalized in a Memorandum of Agreement that would be signed by BOEM, the NYSOPRHP, DWSF, and other interested parties.

Several environmental protection measures will reduce potential impacts to marine archaeological resources.

- The SFWF and SFEC - Offshore will avoid or minimize impacts to potential submerged cultural sites, to the extent practicable.
- Native American tribes were involved, and will continue to be involved, in marine survey protocol design, execution of the surveys, and interpretation of the results.
- A plan for vessels will be developed prior to construction to identify no-anchor areas inside the MWA to protect sensitive areas or other areas to be avoided. An Unanticipated Discovery Plan will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during installation.
- As appropriate, DWSF will conduct additional archaeological analysis and/or investigation to further assess potential sensitive areas.

## 4.4.3 Terrestrial Archaeological Resources

### 4.4.3.1 Affected Environment

**South Fork Export Cable - Onshore**

Archaeological investigations of the onshore portion of the proposed Project have been conducted according to Article VII of the New York State Public Service Law, under the guidance of the NYSDPS. The information and recommendations in the terrestrial archaeological resources report (Appendix S) are intended to assist BOEM, the NYSDPS, the NYSOPRHP, and other interested stakeholders and consulting parties, in their review of the Project's potential impact on archaeological resources.

The APE for direct impacts is defined as the area containing all proposed soil disturbance or other alteration associated with the onshore components of the Project. The formal determination of the APE per 36 CFR 800.4(a)(1) will occur once BOEM accepts a COP for the onshore SFEC, consistent with 30 CFR 585 et seq.

At the time that the terrestrial archaeological survey was conducted, DWSF was considering five potential landing sites for the onshore SFEC (Figure 2.2-2 in Section 2), as well as associated alternative potential routes from each landing site to the SFEC – Interconnection Facility (see Figure 2.2-3 in Section 2 above). As depicted in Figure 1-2 of the terrestrial archaeological resources report (Appendix S), the Phase 1 archaeological survey for the terrestrial portions of the SFEC included the investigation of five alternative landing sites, the cable routes proposed within public roadways, a proposed route within the LIRR, and the SFEC – Interconnection Facility.

A literature review and background research for the proposed Project area was conducted using information available on NYSOPRHP's Cultural Resources Information System (CRIS). The GIS-based CRIS program includes NRHP-eligible and -listed properties and sites, previously conducted surveys, historic districts, previously recorded archaeological sites and districts, museum sites and areas, cemeteries, and archaeologically sensitive areas. For the onshore SFEC, a 1-mile (1.6-km) study radius, which included areas adjacent to the APE, was investigated. In addition to a review of the CRIS database, cultural resources reports for the area were also examined. Background research identified a total of 16 archaeological sites and seven previous cultural resources studies within 1 mile (1.6 km) of the Project. These are detailed in Appendix S.

Based on archival research, potential archaeological resources within the APE were expected to include pre-contact Native American sites with lithic debris (stone flakes) and or stone tools, ceramics, and possible shell or bone food refuse. Archaic and Woodland Period resources are most commonly reported in eastern Long Island, with far less evidence for sites pre-dating 5,000 before present day (BP). Several pre-contact shell middens have been identified within 1 mile (1.6 km) of the APE and present-day shorelines may retain additional examples of this site type. Two possible post-contact or contact period Native American forts are reported in the general vicinity, reflecting the turmoil and strife among tribes and between tribes and European colonists during the seventeenth century. Additional military sites may be located in the area, though the potential for encountering them within the APE is low relative to the commonly documented Native American site types. Post-contact Native American or Euro-American domestic sites reflecting small households dating from the eighteenth century and nineteenth centuries, and post-contact industrial sites primarily associated with fish meal/fish oil processing are located along the Napeague Bay shoreline.

The Phase 1 archaeological fieldwork was conducted under the supervision of a registered professional archaeologist in a manner consistent with the New York Archaeological Council's (NYAC's) 1994 *Standards for Cultural Resources Investigations and the Curation of Archaeological Collections in New York State* (the *NYAC Standards*; NYAC, 1994). The portions of the Phase 1 archaeological survey located within New York State Parks were conducted in accordance with approved Section 233 Permits from the New York State Education Department. Phase 1B archaeological survey fieldwork was conducted within the limits of proposed disturbance for the Project and consisted of pedestrian surface survey of the beach front between the low and high tide lines where ground surface visibility was 100 percent as well as excavation of shovel tests in areas where ground surface visibility was less than 70 percent. The detailed methodology of archaeological survey is detailed in Appendix S. Importantly, no testing was conducted in paved areas. The results of shovel tests excavated immediately adjacent to these areas were interpreted to be indicative of the potential for archaeological resources to be located within paved areas. Also, no shovel testing was undertaken in portions of the APE situated within the LIRR ROW. The depth of disturbance for the proposed SFEC is 4 feet (1.2 m) below the existing ground surface, and a typical section of track would have been constructed on fill at least 3 to 4 feet (0.9 to 1.2 m) deep.

The archaeological survey did not identify any cultural materials or archaeological sites within the APE of: SFEC – Interconnection Facility; Beach Lane Landing Site; Hither Hills State Park Landing Site; Napeague Lane Landing Site (dismissed); Fresh Pond Landing Site (dismissed, located on the north shore); the LIRR ROW; and public highway ROW. As a result of these survey results, no further archaeological work is recommended in these areas. However, the survey resulted in the identification/documentation of three archaeological sites/historic properties located within or adjacent to the APE:

- Napeague State Park Pre-Contact Site 1 is located within the now-dismissed Napeague Bay State Park alternative landing site. It is unlikely that the Project will use this potential landing site. If this landing site had been selected, the route of the SFEC would have been sited to avoid any potential impacts to this site. Therefore, the site will not be affected by the proposed Project.

- The Promised Land/Smith Meal Fish Factory Site (Unique Site Number [USN] 10303.000007) is located within the now-dismissed Napeague Bay State Park alternative landing site. It is unlikely that the Project will use this potential landing site. If this landing site had been selected, the route of the SFEC would have been sited to avoid any potential impacts to this site. Therefore, the site will not be affected by the proposed Project.
- The NRHP-eligible Amagansett Railroad Station Freight Depot (USN 10303.000339) is located adjacent to the APE within the LIRR ROW. The depot is located on the north side of the LIRR tracks, north of Montauk Highway and west of Abrahams Landing Road in the Village of Amagansett. The proposed SFEC cable is being sited to avoid any direct impacts to this historic property.

Finally, a scatter of historic-period debris identified within the APE of the Fresh Pond Landing Site (dismissed, located on north shore) was situated within a disturbed context; therefore, this material was noted but not collected for analysis, as it is not associated with a potentially significant, intact archaeological resource.

With the exception of the LIRR, primary routing of the terrestrial export cable will be within existing roadways. During DWSF coordination with the Shinnecock Indian Nation, Mashantucket Pequot Tribal Nation, Mohegan Tribe, Mashpee Wampanoag Tribe, and Wampanoag Tribe of Gay Head (Aquinnah), several tribal representatives expressed a concern that archaeological resources could be preserved beneath paved roadways, particularly in coastal settings where limited grading was conducted during previous road construction. DWSF commissioned an assessment of the potential cable routes, which included historical research of local road construction, analyses of historical aerial and other photographic records of road alterations, elevation modeling, and pedestrian survey of road margins. Sections of roadways likely built at or near the original surface grade were identified and will be subject to further evaluation. Phase 1 archaeological testing is planned for 2018. The survey will test potentially sensitive areas along road margins to identify archaeological resources adjacent to areas of potential roadway trenching.

#### 4.4.3.2 Potential Impacts

IPFs that could result in impacts to terrestrial archaeological resources are indicated in Figure 4.4-3. Only those IPFs with anticipated impacts negligible or greater are included in the following discussion.

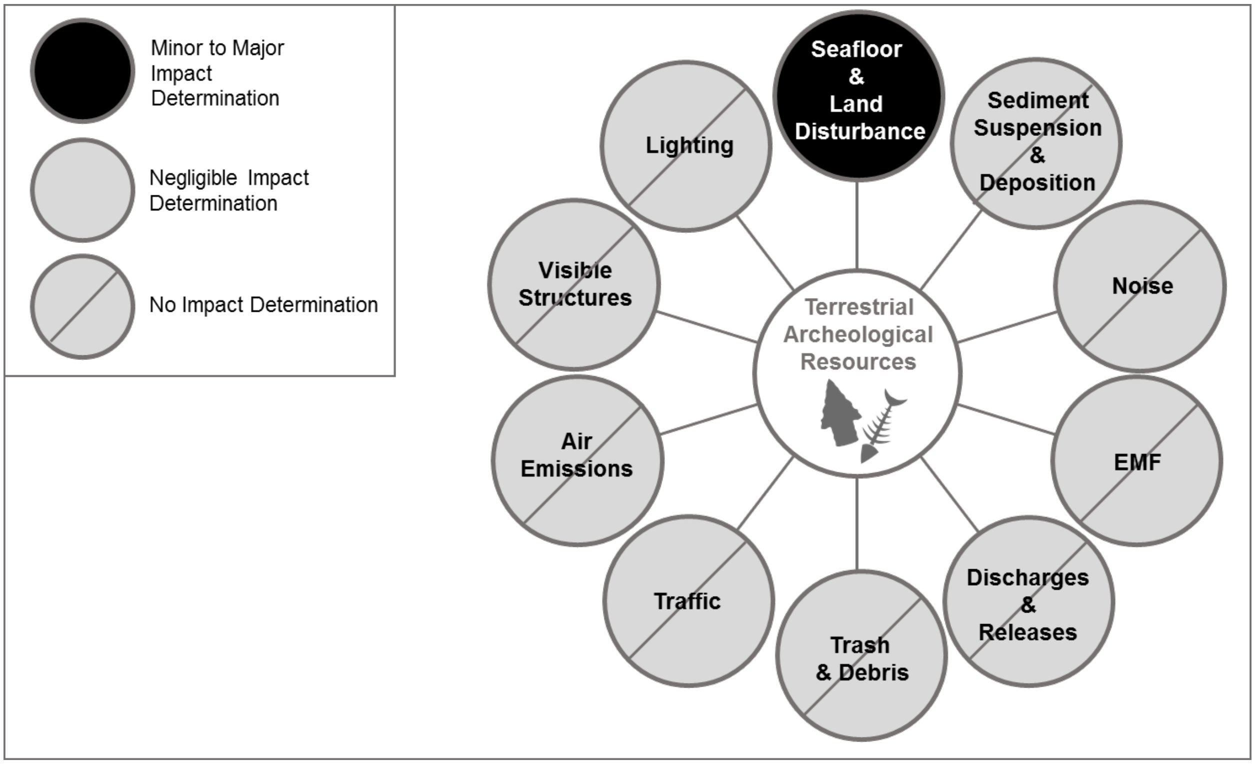


**Figure 4.4-3. IPFs on Terrestrial Archaeological Resources**

### South Fork Export Cable – Onshore

Of the three phases of the SFEC – Onshore, the construction phase is expected to pose the highest threat of adverse impacts to terrestrial archeological resources. The O&M of the SFEC – Onshore does not cause IPFs that would impact these resources. When and if removal of the SFEC – Onshore occurs as a result of decommissioning, then it is expected that subsurface terrestrial archeological resources encountered during construction have already been managed according to Tribal, federal, and state expectations and regulations.

***Construction***

**Land Disturbance**

The Phase 1 archaeological survey identified no prehistoric sites that are potentially eligible for NRHP listing. The survey did identify the Promised Land/Smith Meal Fish Factory Site (USN 10303.000007) within the APE. This site is within a landing site that is no longer under consideration; therefore, the site will not be affected by the Project. The survey identified the NRHP-eligible Amagansett Railroad Station Freight Depot (USN 10303.000339), which is located adjacent to a portion of the APE, within the LIRR ROW. The proposed cable is being sited to avoid direct impacts to this historic property.

As noted above and as detailed in the terrestrial archaeology report in Appendix S, DWSF will site the SFEC - Onshore within previously disturbed areas to the extent practicable and will avoid archaeological sites and/or historic properties. Additionally, DWSF has considered the results of the terrestrial archaeological studies, as well as agency and tribal input, during development of the proposed Project. As a result, the Project design avoids direct impacts. Although DWSF will make every effort to site the SFEC - Onshore away from known archaeological resources, unanticipated discoveries during construction remain a possibility. Therefore, construction of the SFEC - Onshore maintains the potential to result in ***minor*** to ***moderate impacts*** to terrestrial archaeological resources.

### 4.4.3.3 Proposed Environmental Protection Measures

DWSF will continue to consult with BOEM and the NYSOPRHP regarding the NRHP eligibility recommendations made as a result of the terrestrial archaeological resources survey, as well as proposed avoidance measures. If any sites would be affected by the Project, DWSF would again consult with BOEM and the NYSOPRHP, as well as Native American tribes and other interested parties, to determine an appropriate mitigation of adverse impacts to significant archaeological sites. Mitigation would be formalized in a Memorandum of Agreement that would be signed by BOEM, the NYSOPRHP, DWSF, and other interested parties.

Several environmental protection measures will reduce potential impacts to terrestrial archaeological resources.

- The route for the SFEC - Onshore will minimize impacts to, or avoid, potential terrestrial archeological resources, to the extent practicable.
- Native American tribes were involved, and will continue to be involved, in terrestrial survey protocol design, execution of the surveys, and interpretation of the results.
- Analysis shows that the majority of the SFEC - Onshore route has been previously disturbed; therefore, the risk of potentially encountering undisturbed archaeological deposits is minimized.
- An Unanticipated Discovery Plan will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during installation.
- DWSF will conduct additional archaeological investigation to further assess potential sensitive areas.

## 4.5 Visual Resources

This section addresses the visibility and potential visual impact associated with the construction and operation of the SFWF and the above ground components of the SFEC. A VIA is a technical analysis used to determine whether an action diminishes the scenic quality or enjoyment of a landscape and the resources that exist within. The process broadly includes a description of the existing environment, the public resources that define the character of the visual environment and the users of the landscape. This information is then quantitively evaluated in order to define the scenic quality of the landscape. Next, several analyses are employed to assess the visibility and visual character of the project, allowing for a direct quantitative comparison of the landscape with and without the project in place. If a project is found to have visual impact, potential mitigation measures are also suggested.

To determine the extent of potential Project visibility and visual impact, DWSF engaged Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) to prepare a comprehensive VIA for the SFWF and a VRA for the above-ground portions of the SFEC. The purpose of these studies was to analyze potential

Project visibility and determine its potential effect on scenic quality and the use/enjoyment of the landscape by viewers.

Based on DWSF's experience on the BIWF Project, and guidance provided by BOEM and other involved agencies and tribes, the VIA utilized standard visibility assessment techniques, including viewshed analysis, cross section analysis, and field verification. The SFWF's visual impact was evaluated through the preparation of representative visual simulations and use of the USACE Visual Resource Assessment Procedure (VRAP). The VRAP defines discrete landscape similarity zones (LSZs) within the visual study area, characterizes the baseline scenic quality/sensitivity of each LSZ, and then determines if the proposed Project exceeds the threshold of acceptable visual change through a quantitative rating process conducted by a panel of visual professionals. The methodology and results for all visual analyses conducted for the SFWF are described in detail in the full text of the VIA report, in Appendix W.

The VRA used the same visibility assessment methods as employed by the VIA (viewshed analysis, cross sections, field review, and visual simulations). However, visual impact contrast ratings were not completed for the SFEC substation. Rather, each view was qualitatively reviewed by a visual assessment expert. The methodology and results are described in detail in the full text of the SFEC VRA report, in Appendix V.

### 4.5.1 Affected Environment

To define and describe the affected environment, visual study areas for both the SFWF and SFEC were defined.

**South Fork Wind Farm**

Based on the height of the proposed WTGs, previous analyses conducted for the BIWF, guidance from BOEM, and the desire to address potential Project visibility from sensitive resources in New York, Rhode Island, Massachusetts, and Connecticut, a 40-mile (64.4-km) radius around the proposed WTG array was defined as the SFWF visual study area. This study area also approximates the theoretical limits of Project visibility based on the maximum height of the WTGs, the screening effect of curvature of the earth, and atmospheric affects associated with distance.

The 40-mile (64.4-km) radius surrounding the SFWF includes approximately 4,820 square miles (12,484 km$^2$) of open ocean (i.e., 87 percent of the study area), 736 square miles (1,906.2 km$^2$) of land (including inland water bodies), and over 1,000 linear miles (1,609.3 km) of shoreline in New York, Rhode Island, Massachusetts, and Connecticut. The proposed visual study area includes all or portions of 2 towns in New York, 21 towns in Rhode Island, 16 towns in Massachusetts, 21 towns in Rhode Island, and 3 towns in Connecticut. The location and extent of the visual study area is illustrated in Figure 4.5-1 and in Figure 4 of the VIA, in Appendix V. However, within this study area, only a relatively small portion of the onshore locations would have open views toward the proposed Project. To further refine and accurately define an inclusive and reasonable zone of visual influence (ZVI), the potential geographic areas of Project visibility were identified by running a preliminary lidar viewshed analysis within the 40-mile (64.4-km) study area.

The viewshed model considered vegetation, buildings/structures, and the curvature of the earth in order to delineate those areas that may have potential views of the highest portions of the proposed WTGs (i.e., blade tips in the upright position). The viewshed analysis results indicated that 14.7 square miles (38.1 $km^2$) (2.0 percent) of the land area within the 40-mile (64.4-km) study area could have potential views of the Project from ground-level vantage points (Figure 4.5-1). For the purpose of the VIA, the ZVI was used to define those areas where further analyses of Project visibility and visual impact was warranted.

Within the ZVI for the SFWF, 17 different LSZs were defined in accordance with the VRAP methodology (see Table 4.5-1). The sensitivity of each LSZ was classified by the rating panel as a means of defining their sensitivity to visual change. The process used to assign these classifications is detailed in the VIA (Appendix V).

**Table 4.5-1. LSZs within the SFWF Study Area.**

| Management Classification System Zone | Classification |
|---|---|
| Shoreline Bluffs | Retention Class |
| Salt Pond Tidal Marsh | Retention Class |
| Maintained Recreation Area | Retention Class |
| Shoreline Beach | Retention Class |
| Inland Lakes and Ponds | Partial Retention Class |
| Coastal Dunes | Partial Retention Class |
| Open Water | Partial Retention Class |
| Rural Residential | Partial Retention Class |
| Shoreline Residential | Partial Retention Class |
| Developed Waterfront | Partial Retention Class |
| Coastal Scrub | Modification Class |
| Agricultural Open Field | Modification Class |
| Village or Town Center | Modification Class |
| Forest | Modification Class |
| Transportation | Modification Class |
| Suburban Residential | Rehabilitation Class |

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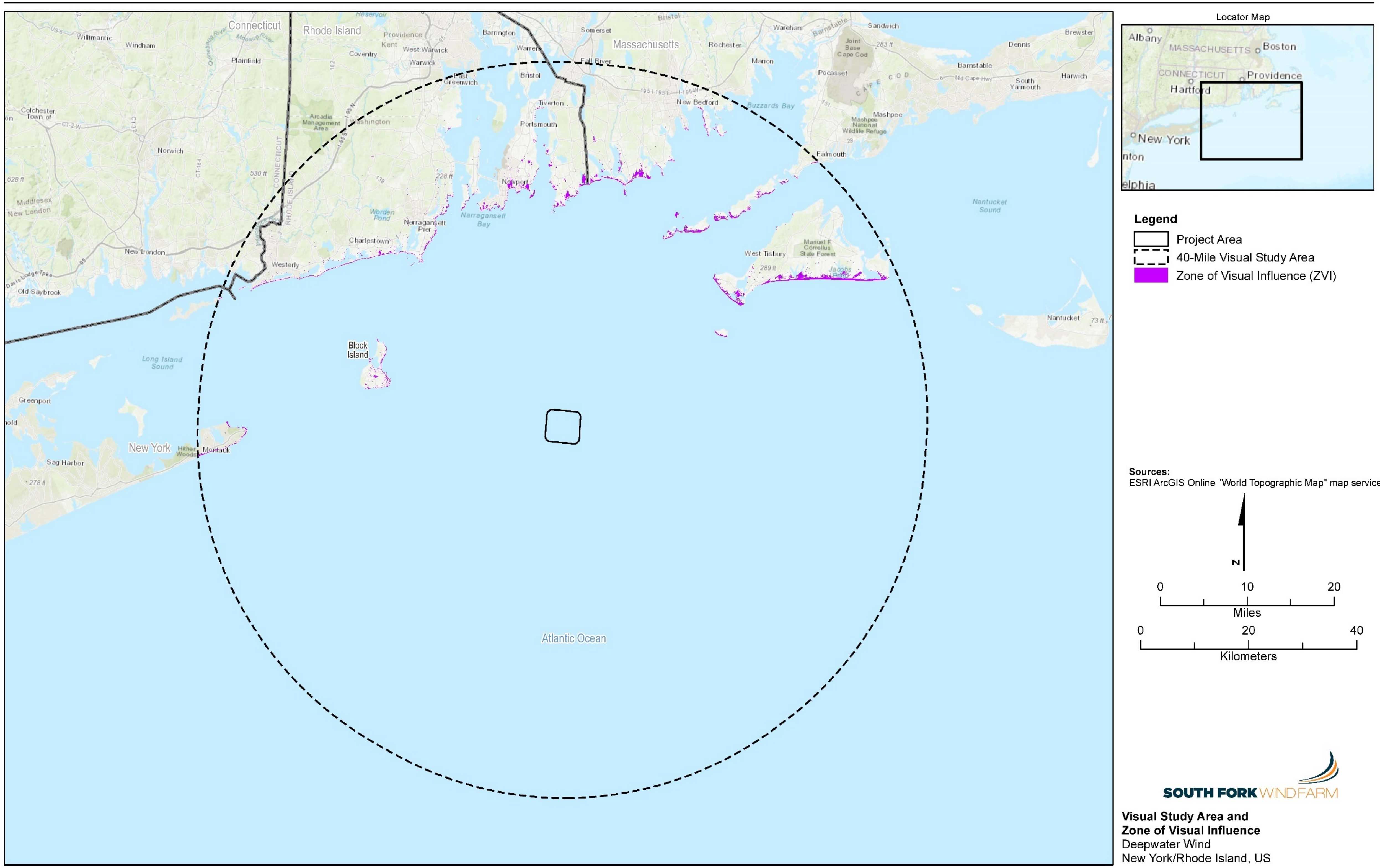


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**Figure 4.5-1. Visual Study Area and Zone of Visual Influence**

Viewers within the SFWF study area/ZVI include residents, through travelers, tourists/ vacationers, and the fishing community. The sensitivity of these viewers to visual change is variable, but many are assumed to be sensitive to changes in views they value and/or are familiar with. In addition, the ZVI includes over 1,000 visually-sensitive sites/resources that have been identified by national, state, or local governments, organizations, and/or Native American tribes as important sites which are afforded some level of recognition or protection. A comprehensive inventory of the visually sensitive resources identified during the study is included in the VIA (Appendix V). A summary of the types of sensitive resources included in the SFWF ZVI is presented in Table 4.5-2, and the locations of these resources within the study area are illustrated in Figure 4.5-2, sheets 1 through 3.

**Table 4.5-2. Visually Sensitive Resources within the Zone of Visual Influence.**

| Type of Resource | Occurrences of Resource Within ZVI | | | |
|---|---|---|---|---|
| | NY | RI | MA | Total |
| Properties Listed in the National or State Registers of Historic Places | 3 | 30 | 10 | **43** |
| Properties Eligible for Listing in the National or State Registers of Historic Places | 1 | 0 | 0 | **1** |
| Traditional Cultural Properties | 0 | 2 | 1 | 3 |
| Rhode Island Historic Districts | 0 | 67 | 0 | **67** |
| Massachusetts Historical Commission Resources | 0 | 0 | 476 | **476** |
| National Natural Landmarks | 1 | 0 | 0 | **1** |
| State Scenic Areas | 3 | 81 | 3 | **87** |
| Scenic Area of Local Significance | 1 | 0 | 0 | **1** |
| State Scenic Overlooks | 4 | 0 | 0 | **4** |
| National Wildlife Refuges | 0 | 5 | 1 | **6** |
| State Wildlife Management Areas | 0 | 13 | 5 | **18** |
| State Parks | 5 | 8 | 5 | **18** |
| State Nature and Historic Preserve Areas | 0 | 1 | 0 | **1** |
| State Forests | 0 | 0 | 1 | **1** |
| State Beaches | 0 | 7 | 1 | **8** |
| Nationwide Rivers Inventory | 0 | 1 | 0 | **1** |

| Type of Resource | Occurrences of Resource Within ZVI | | | |
|---|---|---|---|---|
| | NY | RI | MA | Total |
| Highways Designated or Eligible as Scenic | 0 | 5 | 0 | **5** |
| National Historic Trails | 0 | 1 | 0 | **1** |
| National Recreation Trails | 0 | 1 | 0 | **1** |
| State Trails | 1 | 1 | 0 | **2** |
| State Bike Routes | 1 | 1 | 0 | **2** |
| State Fishing and Boating Access | 0 | 18 | 1 | **19** |
| State Conservation Areas | 1 | 99 | 0 | **100** |
| Lighthouses (not NRHP-Listed or State Historic-Listed) | 0 | 1 | 8 | **9** |
| Public Beaches | 4 | 25 | 76 | **105** |
| Ferry Routes (Occur across multiple states) | 2 | 7 | 9 | **18** |
| Seaports (Commercial Maritime Facilities) | 1 | 3 | | **4** |
| **Total** | **28** | **377** | **597** | **1002** |

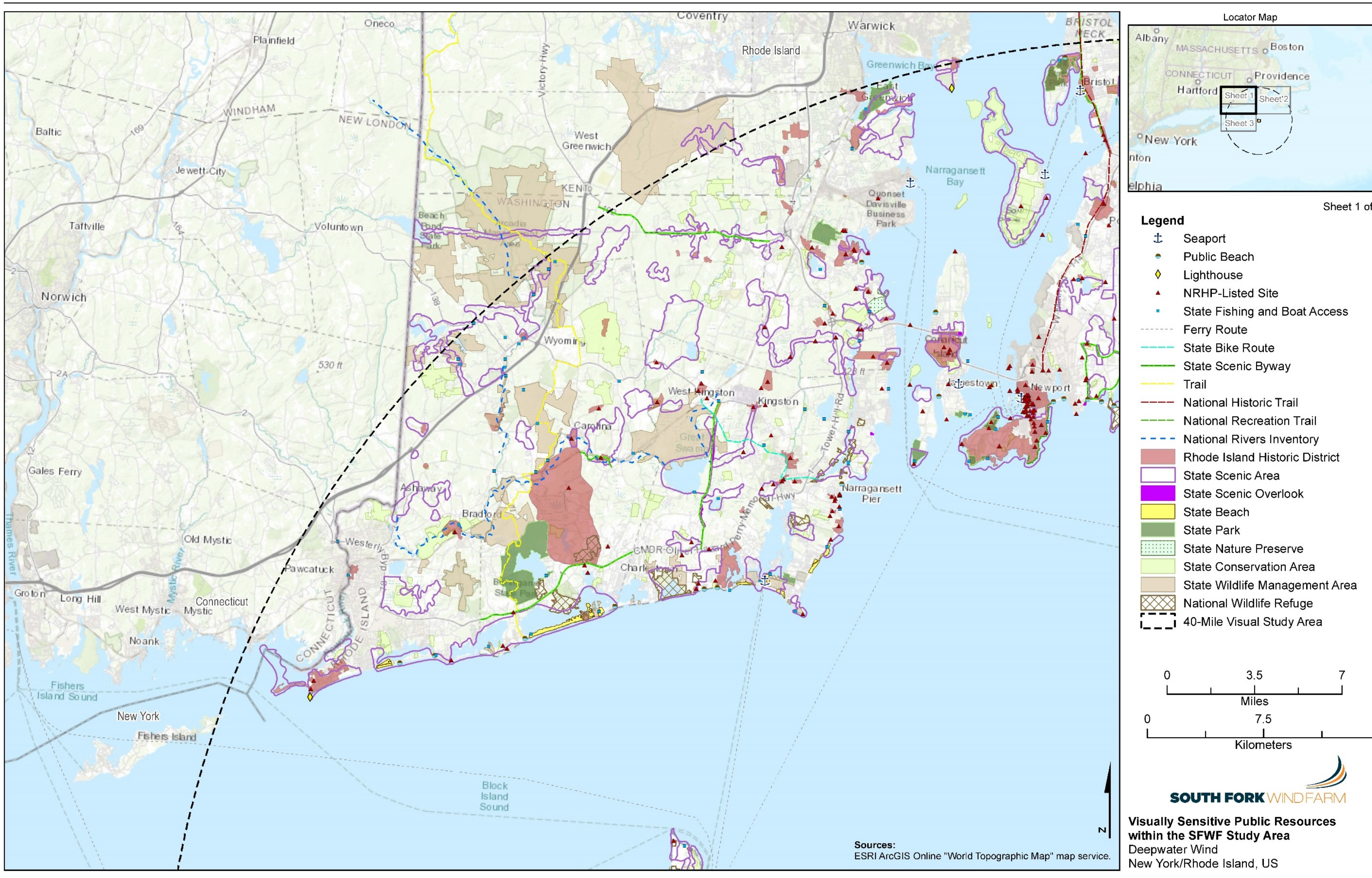


**Figure 4.5-2 (Sheet 1 of 3). Visually Sensitive Public Resources within the SFWF Study Area**

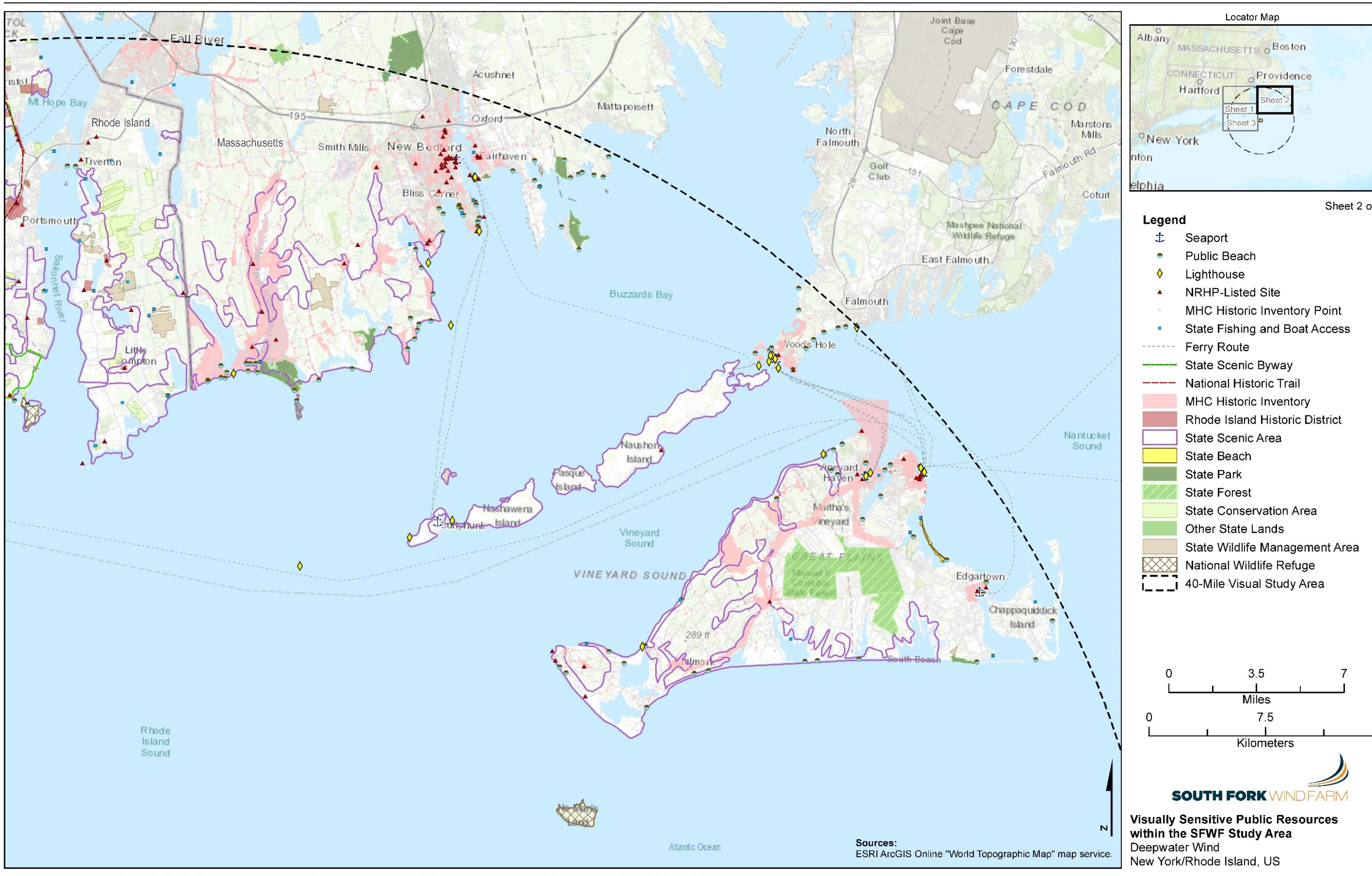


**Figure 4.5-2 (Sheet 2 of 3). Visually Sensitive Public Resources within the SFWF Study Area**

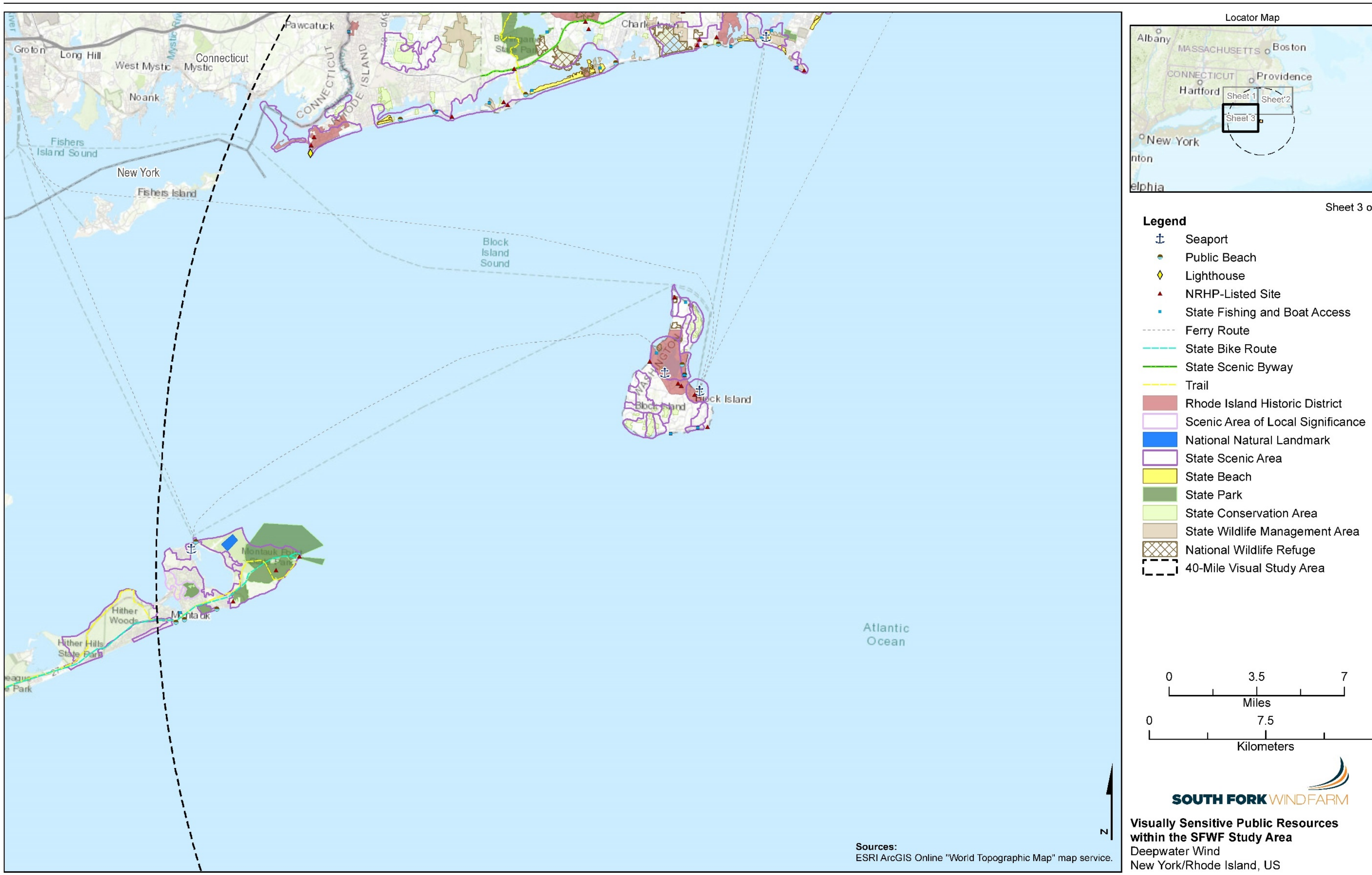


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**Figure 4.5-2 (Sheet 3 of 3). Visually Sensitive Public Resources within the SFWF Study Area**

**South Fork Export Cable - Onshore**

The onshore SFEC visual study area was defined as a 3-mile (4.8-km) radius around the SFEC – Interconnection Facility as depicted in Figure 4.5-3, and in Figure 5 of the VRA (Appendix U). This area contains several scenic resources of statewide significance, including 15 resources listed on the NRHP, 59 resources eligible or potentially eligible for listing on the NRHP, and the East Hampton Scenic Area of Statewide Significance (SASS). A complete list of inventoried visually sensitive resources by type, including their locations, is presented in the full VRA report in Appendix U.

Additionally, several resources of local significance were identified within the SFEC onshore visual study area based on their local designation as scenic resources (see Figure 4.5-4, and Figure 7 of the VRA in Appendix U). These include the East Hampton Village Scenic Area of Local Significance, which is largely made up of the portion of the Village of East Hampton that falls outside of the SASS, including Three Mile Harbor, East Hampton Marina, and Three Mile Harbor Marina, all located in the northeastern portion of the SFEC visual study area.

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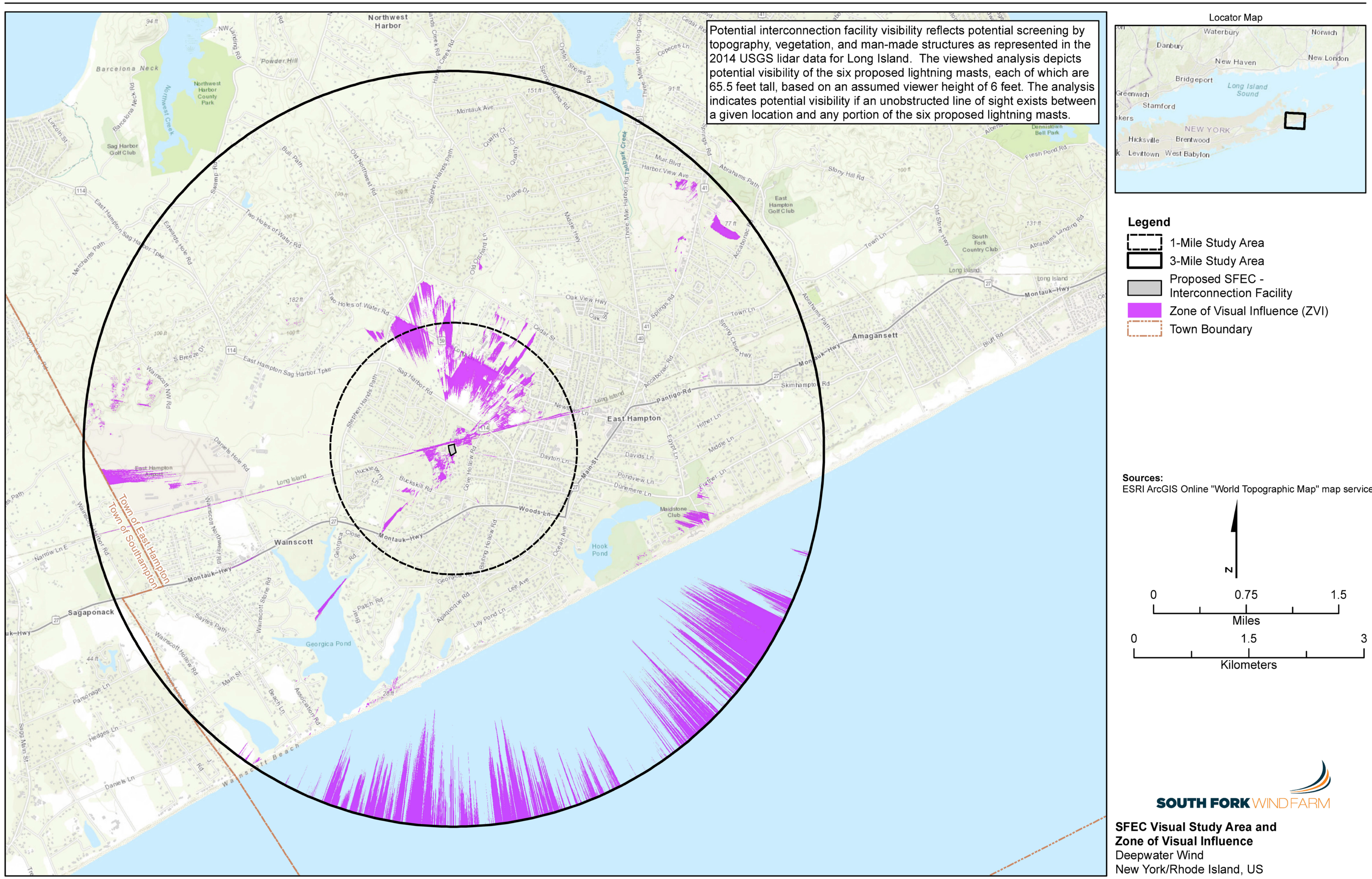


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**Figure 4.5-3. SFEC Visual Study Area and Zone of Visual Influence**

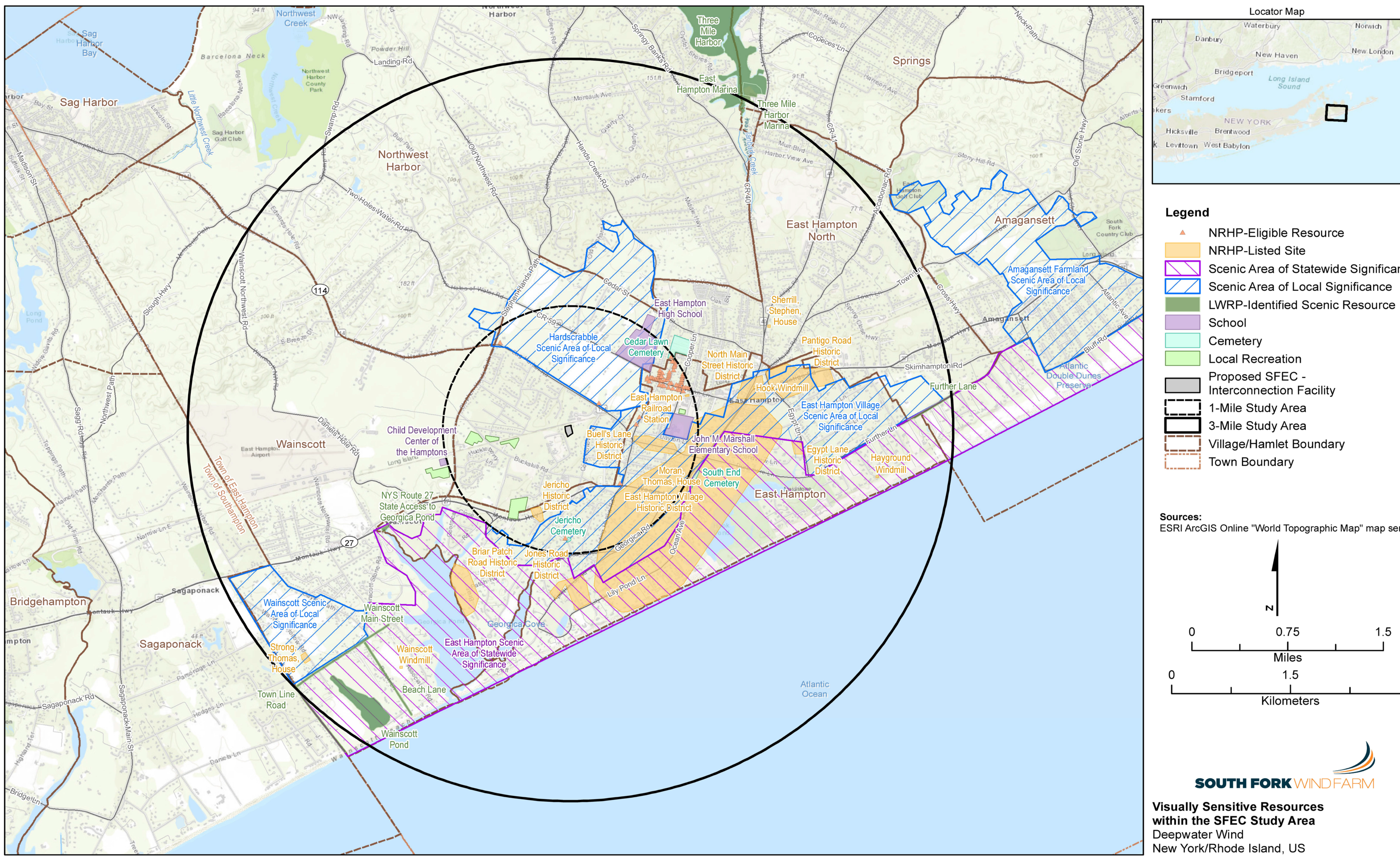


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**Figure 4.5-4. SFEC Visually Sensitive Resources within the SFEC Study Area**

## 4.5.2 Potential Impacts

IPFs that could result in impacts to visual resources are depicted in Figure 4.5-5. IPFs which will not impact visual resources are shown with slashes through the circle. For the IPFs that could impact visual resources, but were found to be negligible in the analyses in Section 4.1, the circle is gray without a slash. IPFs that could impact visual resources based on the analyses included in the VIA and VRA, the circle is black.

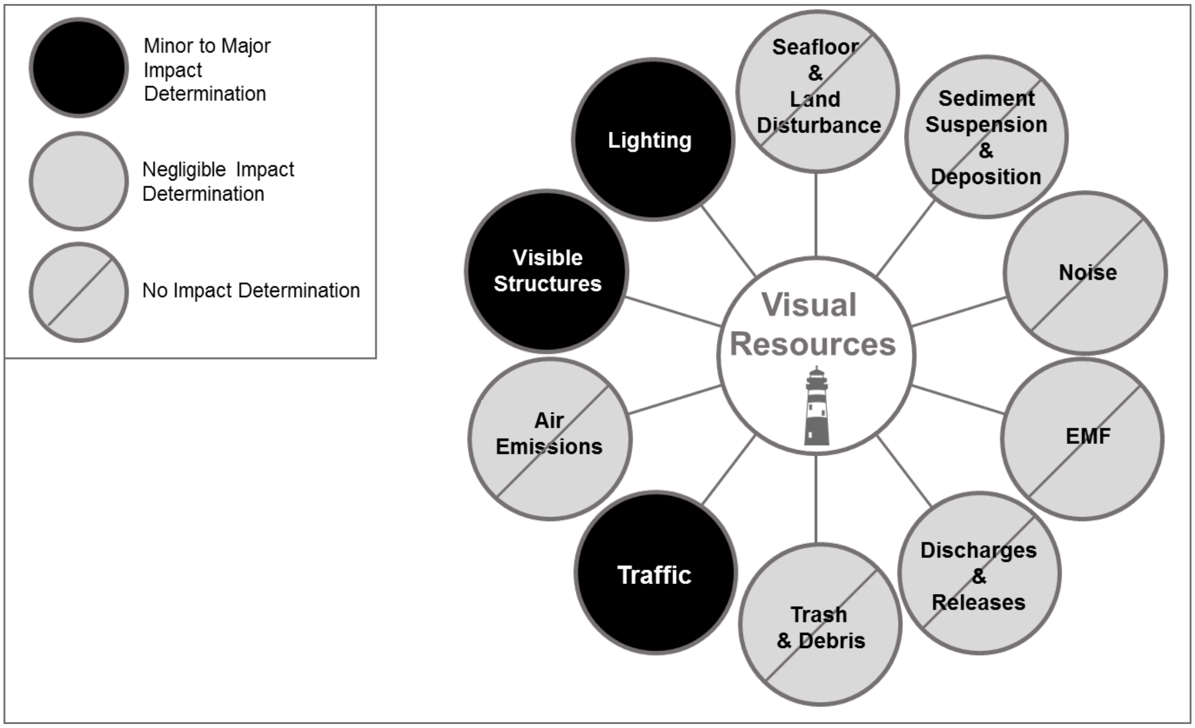


**Figure 4.5-5. Impact-producing Factors on Visual Infrastructure IPF Potential**

As indicated in Figure 4.5-5, visual impacts associated with the Project could result from construction and operational vessel traffic, new visible structures, and new sources of lighting. Each of the IPFs for both the SFWF and SFEC is discussed below.

### South Fork Wind Farm

#### *Construction*

**Traffic**

During construction of the SFWF, marine vessel traffic could potentially increase in Narragansett Bay, Buzzards Bay, Rhode Island Sound, and the open ocean. However, as discussed in Section 4.1.7, the construction vessels will not represent a significant increase over the existing vessel traffic in the area and accordingly will result in only ***short-term*** and ***minor*** visual impacts. Project operation is not anticipated to result in a noticeable increase in vessel traffic.

#### *Operations*

**Visible Structures**

To evaluate potential visual impacts during operation of the SFWF, the VIA included a viewshed analysis of the potential visibility of the proposed WTGs, which represent the tallest proposed structures. Utilizing USGS lidar data, a highly detailed DSM of the SFWF visual study area was created. The DSM included the elevations of buildings, trees, and other objects large enough to be resolved by lidar technology. Additionally, a digital terrain model (DTM) was created, representing bare earth conditions. The analysis of potential SFWF visibility was based on 15 points representing the proposed WTGs, each with an assumed maximum blade tip height of 840 feet (256 m); one point representing the OSS, with a maximum height of 200 feet (61 m); and an assumed viewer height of 5.5 feet (1.7 m). The viewshed analysis was conducted using ESRI ArcGIS® software with the Spatial Analyst extension and considered curvature of the earth in the analysis.

Viewshed analysis results are summarized in Table 4.5-3 below. Viewshed mapping demonstrated that the SFWF WTGs have the potential to be visible from a relatively small portion of the 40-mile (64.4-km) radius visual study area (see Figure 4.5-1 and Appendix V, Figure 4). The lidar-based viewshed analysis indicates that approximately 2.0 percent of the land within the study area (the ZVI) could have potential views of some portion of the SFWF, based on the availability of an unobstructed line of sight. Open Water/Ocean is the dominant LSZ within the study area and, in most areas, offers an unobstructed line of sight toward the proposed Project. Other LSZs identified by the viewshed analysis as offering potential views of the Project include Shoreline Beaches and Bluffs, Coastal Dunes, Coastal Scrub/Shrub Forest, Salt Ponds/Tidal Marsh, Shoreline Residential, and Maintained Recreational Areas. Visibility will be eliminated in large portions of the visual study area, where buildings/structures and vegetation screen views toward the SFWF. Forest land, which covers approximately 53 percent of the land within the study area, will significantly reduce potential visibility of the SFWF throughout the inland portions of the study area. Additionally, buildings/structures will also significantly screen outward views in more developed portions of the study area. Considering the screening provided by buildings/structures, vegetation, and topography, potential SFWF visibility is largely restricted to the ocean shoreline and water bodies immediately inland of the shoreline.

Viewshed results suggest some minor areas of potential SFWF visibility in inland portions of the visual study area. These areas typically extend inland from undeveloped and unvegetated shorelines, especially along barrier beaches backed by salt marshes and ponds. Additionally, some areas of inland visibility occur at topographic highpoints that are devoid of dense vegetation and buildings/structures (see Figure 4.5-1 and Appendix V, Figure 4).

**Table 4.5-3. Blade Tip Viewshed Results Summary.**

| Distance from Project Site | 40-Mile Radius Study Area | | |
|---|---|---|---|
| | Total Land Area (square miles) (square kilometers) | Land Area with Potential Visibility/ZVI3 (square miles) (square kilometers) | Percent |
| 0 to 10 Miles[a] | 0 | 0 | 0.0% |
| 10 to 20 Miles[s] | 3.8 (9.8) | 0.4 (1.0) | 11.3% |
| 20 to 30 Miles | 174.9 (452.9) | 9.3 (24.1) | 5.3% |
| 30 to 40 Miles | 557.0 (1,442.6) | 4.9 (12.7) | 0.9% |
| **Total 40 Mile Landward Study Area[c]** | 735.6 (1,905.2) | 14.7 (38.1) | 2.0% |

[a] There is no significant land area within 10 miles of the Project Site.

[b] Block Island, Rhode Island and Nomans Land Island are the only significant land masses within 20 miles of the Project site.
[c] Land area and percent totals may not add up to 100 percent or equal study area acreage reported elsewhere in this report due to rounding and/or raster-to-vector conversion.

Field review conducted during June 2017 and January 2018 confirmed the results of the lidar viewshed analysis. Much of the inland portions of the visual study area were found to be screened from view of the SFWF by vegetation and buildings/structures. Open views toward the Project, as indicated by visibility of the ocean, were concentrated within 1 mile (1.6 km) of the shoreline, and were largely restricted to beaches, bluffs, dunes, open fields, salt ponds, road corridors, and cleared residential yards, where lack of foreground trees allowed for unscreened views of the ocean.

- From Block Island, views of the SFWF were largely restricted to beaches and bluffs along the south shore of the island. No views were documented from beaches and bluffs along the western and northern shorelines or the village/town center area of New Shoreham. Similarly, views toward the Project were not available from most interior roads. However, potential views were documented from beach areas along the eastern shoreline, the northwest side of Great Salt Pond, and the Block Island Ferry in transit. Although private roads, yards, and homes could generally not be accessed, many of these locations on the southern portion of the island and on areas of higher ground are also likely to have at least partial views of the Project.
- Views from Long Island were available from within Montauk State Park and Camp Hero State Park on the eastern edge of the South Shore, mainly from bluff overlooks along hiking trails or at designated bluff overlook parking areas. Views toward the Project further inland were completely obscured by topography and/or vegetation.
- From Conanicut and Aquidneck Islands, views towards the SFWF are restricted to the south-facing shorelines, including Beavertail State Park, Brenton Point State Park, the Newport Cliff Walk, Sachuest Beach, and Sachuest Point National Wildlife Refuge (NWR). As the viewer moves inland, views toward the Project are blocked by buildings/structures and vegetation, with the exception of topographic highpoints, such as Hanging Rock at Normans Bird Sanctuary and the inland portions of Brenton Point State Park.
- In the Elizabeth Islands chain, Cuttyhunk Island will have open views toward the SFWF along the southern and western shores, as well as from the topographic high point in the central portion of the island. This high point offers the potential for views of the full height of the WTGs, whereas shoreline views from the island toward the Project would be partially screened by curvature of the earth.
- Views from Martha’s Vineyard were also generally restricted to the shoreline and bluffs on the western and southern sides of the island. The southern beaches of Martha’s Vineyard, such as Lucy Vincent Beach and Squibnocket Beach, had partially or fully screened views, respectively. Screening at these locations was provided by the western headlands of Martha’s Vineyard and intervening vegetation. Visibility was noted as far east as South Beach State Park but was fully obscured by curvature of the earth at Wasque Point in Edgartown. Inland views on Martha’s Vineyard were located at the Peaked Hill Reservation, which is located atop a topographic high point. Other open views from inland locations will generally be partially screened, tightly enclosed, and/or of short duration due to the abundant screening provided by topography, vegetation, and buildings/structures.

- Open views from the mainland were available along the shoreline from Westerly, Rhode Island to Falmouth, Massachusetts. These views were generally restricted to the immediate shoreline and, based on the calculated effects of curvature of the earth, will typically only include the upper one-third to one-half of the WTGs. Throughout the extent of the visual study area, views toward the Project site were screened by vegetation, dunes, and buildings/structures.

Visually sensitive public resources with open views toward the SFWF included several historic sites, lighthouses, state parks/beaches, wildlife refuges, designated scenic areas, and a National Recreation Trail. The historic resources with the highest potential for Project visibility were those that were situated to take advantage of panoramic ocean views. No open views toward the site were documented from any mainland parks, historic sites, designated scenic areas, conservation lands, or village/town center areas that were over a mile inland from the ocean.

Moreover, open views toward the Project do not necessarily equate to actual Project visibility. A variety of other factors will limit visibility, including weather conditions, waves on the ocean surface, humidity, and air pollution. National Climatic Data Center (NCDC) weather data collected from the Newport and Block Island Stations over the six-year period from January 1, 2010 to December 31, 2016 indicate that clear skies (0-30 percent cloud cover) occur during daylight hours on average 42 percent of the time. While partly cloudy and cloudy skies do not preclude Project visibility, these data suggest that weather conditions could substantially reduce long distance visibility (i.e., from land-based viewpoints) during much of the year. Because, NCDC weather data only reports visibility to 10 miles (16.1 km), BOEM utilized a methodology to evaluate visibility at 20 and 30 nm using the observed visibility out to 10 miles (16.1 km) and a relational algorithm based on relative humidity (Wood et al, 2014). For data collected from the Newport Station, visibility to 20 nm occurred approximately 61 percent of the year during daytime hours, while visibility to 30 nm occurred approximately 35 percent of the year during daytime hours. These calculations indicate that weather will have a significant influence on visibility from most land-based viewpoints within the Project's ZVI.

To evaluate the visual impact of the SFWF, a total of 44 visual simulations were prepared from 29 selected key observation points (KOPs) throughout the ZVI (29 unique daytime views, 9 sunset views, 5 nighttime views, and 1 simulation depicting construction). These KOPs were identified based on studies prepared by BOEM (2012a and 2012b) that identified visually and culturally sensitive sites with views toward offshore lease areas along the entire Atlantic coast, including all of the coastline that falls within the visual study area for the SFWF. In addition, DWSF and its technical team had multiple discussions with various agencies and stakeholders, including the Wampanoag Tribe of Gay Head (Aquinnah), the Shinnecock Indian Nation, the Mohegan Tribe of Indians in Connecticut, the Mashantucket Pequot Tribal Nation, the Mashpee Wampanoag Tribe, the Massachusetts Historical Commission (MHC, Massachusetts SHPO), the NYSOPRHP, RIHPHC, and the MassDEP, regarding the selection of KOPs of visual and cultural importance. Final KOPs were selected based upon the following criteria:

1. They were identified as KOPs by federal, state, local, or tribal officials/agencies as important visual resources, either in prior studies or through direct consultation.
2. They provide clear, unobstructed views toward the SFWF (as determined through field verification).
3. They illustrate the most open views available from historic sites, designated scenic areas, and other visually sensitive resources within the visual study area.

4. They are representative of a larger group of candidate KOPs of the same type or in the same geographic area.
5. They illustrate typical views from LSZs where views of the SFWF are most likely to be available.
6. They illustrate typical views of the SFWF that will be available to representative viewer/user groups within the visual study area.
7. They illustrate typical views from a variety of geographic locations and under different lighting conditions to illustrate the range of visual change that could occur with the SFWF in place.

Information regarding each selected viewpoint is detailed in the full text of the VIA in Appendix V. Additionally, graphic depictions showing locations of the selected KOPs are illustrated in Figure 4.5-6 and Appendix V, Figure 10.

Visual simulations of views of the proposed Project from the selected KOPs were prepared, as illustrated in Figure 4.5-7 and Appendix B of the VIA (see Appendix V). These simulations illustrate the full range of distances, lighting conditions, and landscape settings from which the SFWF will be viewed. However, all photos used for the development of simulations illustrate high visibility conditions where the proposed WTGs would not be significantly obscured by atmospheric haze or fog. All of the selected KOPs offered the most open, unobstructed views available toward the SFWF from each KOP. Consequently, the simulations from these viewpoints can be considered "worst case" representations of potential WTG visibility within the study area.

Evaluation of these simulations by a panel of visual professionals was conducted using the USACE VRAP. The elevation process, which is described in detail in the VIA, indicated that the Project's overall contrast with the visual/aesthetic character of the area will be variable, with the most substantial visual impact documented at KOPs that are relatively close to the Project (such as on a ferry or passenger cruise ship in the Atlantic Ocean), offer largely unobscured views of the proposed WTGs, and include few other man-made/developed features. Impact evaluation results indicated relatively minor impact on mainland/more distant KOPs, where the WTGs are barely perceptible on the horizon. In the higher impact KOPs, the WTGs' contrast with water resources (open ocean) and sky conditions, user activity (residential and tourist-related), land use (undeveloped land and ocean), and/or a strong level of cultural importance at the land/sea interface generally were the greatest contributors to Project impact. However, from the majority of KOPs, the WTGs are barely perceptible under clear, daytime conditions, as supported by rating panel scores that indicated little or no visual change.

Even for those viewpoints where more appreciable visual impact was noted, there was generally a high degree of variability among the scores of individual rating panel members. In some cases, certain panel members indicated no impact for the same viewpoints where other panel members noted an adverse effect. This reflects the individual variability in the way people perceive landscapes and react to WTGs, and is consistent with published studies of public reaction to wind projects. Several studies have documented variable, but generally positive, public reaction to views of operating wind projects (Ladenburg, 2008; Ladenburg, 2010; West, 2011; Firestone et al, 2017).

Using the USACE VRAP procedure, it was determined that with the proposed Project in place, the threshold of acceptable visual impact was not exceeded for any of the LSZs identified within the visual study area. The most appreciable impact was assigned to KOPs in the Shoreline

Bluffs, Maintained Recreation Areas, and Open Water/Ocean Zones, but the cumulative scores received by all the KOPs within these LSZs were well below the threshold of acceptable visual impact. Therefore, visible structures will result in a ***minor impact***.