South Fork Wind Farm and South Fork Export Cable

Essential Fish Habitat Assessment with NOAA Trust Resources

April 2021

For the National Marine Fisheries Service

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Office of Renewable Energy Programs

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Abbreviations

AC	alternating current
ADEON	Atlantic Deepwater Ecosystem Observatory Network
ASMFC	Atlantic States Marine Fisheries Commission
BIWF	Block Island Wind Farm
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CTV	crew transfer vessels
DML	dorsal mantle length
DTSS	Distributed Temperature Sensing System
DWSF	Deepwater Wind South Fork, LLC
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ELMR	Estuarine Living Marine Resources
EMF	electromagnetic field
EPMs	environmental protection measures
ESA	Endangered Species Act
EZs	exclusion zones
FGDC	Federal Geographic Data Committee
FHWG	Fisheries Hydroacoustic Working Group
FL	fork length
FMPs	fishery management plans
HAPCs	habitat areas of particular concern
HDD	horizontal directional drill
HRG	high-resolution geophysical
HVAC	high voltage alternating current
MAFMC	Mid-Atlantic Fishery Management Council
MARCO	Mid-Atlantic Regional Council on the Ocean
MARMAP	Marine Resources Monitoring, Assessment, and Prediction

MD	Maryland
MLLW	mean lower low water
MWA	maximum work area
NCCA	National Coastal Condition Assessment
NCCR	National Coastal Condition Report
NEFMC	New England Fishery Management Council
NJ	New Jersey
NMFS	National Marine Fisheries Service
NMS	noise mitigation system
NOAA	National Oceanic and Atmospheric Administration
NPV	Nelson, Pope & Voorhis, LLC
NYSDEC	New York State Department of Environmental Conservation
NY	New York
NYS	New York State
OCS	outer continental shelf
O&M	Operations and Maintenance
OSS	offshore substation
PAM	passive acoustic monitoring
RICRMC	Rhode Island Coastal Resources Management Council
RI/MA WEA	Rhode Island/Massachusetts Wind Energy Area
SAV	submerged aquatic vegetation
SFEC	South Fork Export Cable
SFWF	South Fork Wind Farm
SPLs	sound pressure levels
TL	total length
TSS	total suspended sediment
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
VA	Virginia
WTG	wind turbine generator
YOY	young-of-the-year

Unit Abbreviations

°C	degrees Celsius
µm/s^2	micrometers per second squared
µPa	micro Pascal
µPa^2/Hz/m	micro Pascal squared per hertz per meter
µPa^{2}s	micro Pascal squared second
µPa/sec^2	micro Pascal per second squared
µT	micro Tesla
µV/m	microvolts per meter
dB	decibels
dB$_{peak}$	Peak decibels
dB$_{RMS}$	root mean square decibels
dB $_{SEL}$	Sound exposure level
Hz	hertz
Hz/m	hertz per meter
kJ	kilojoules
km	kilometers
kV	kilovolts
$L_{E,\ 24hr}$	Cumulative sound exposure level, 24 hour equivalent
L_{pk}	Peak sound exposure level
m^2	square meters
m^3	cubic meters
m/f	male/female
mG	milligauss
mg/L	milligrams per liter
mm	millimeters

m/s	meters per second
mV/m	millivolts per meter
MW	megawatts
nm	nautical miles
ppt	parts per thousand

1 Introduction

This assessment evaluates the impacts of the Project to determine whether it may adversely affect designated Essential Fish Habitat (EFH) for federally managed fisheries from the proposed construction, operation, and decommissioning of a commercial wind energy facility on the outer continental shelf (OCS) offshore of New York, Rhode Island, and Massachusetts.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 2007 (16 United States Code 1801-1884), requires federal agencies to consult with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) on activities that may adversely affect EFH. EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (National Marine Fisheries Service [NMFS] 1999; NOAA 2018a). NOAA Fisheries further clarified the terms associated with EFH (50 Code of Federal Regulations [CFR] 600.05-600.930 and 600.910) by the following definitions:

- Waters – Aquatic areas and their associated physical, chemical, and biological properties that are used by fish and, where appropriate, may include aquatic areas historically used by fish;
- Substrate – Sediments, hard bottoms, structures underlying the waters, and associated biological communities;
- Necessary – The habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem;
- Spawning, breeding, feeding, or growth to maturity – Stages representing a species’ full life cycle; and
- Adverse effects – may include direct or indirect physical, chemical, or biological alterations of the waters or substrate as well as the loss of and/or injury to benthic organisms, prey species, their habitat, and other ecosystem components. Adverse effects may be site-specific or habitat-wide impacts including individual, cumulative, or synergistic consequences of actions.

Deepwater Wind South Fork, LLC (DWSF) has submitted the draft Construction and Operations Plan (COP) for the South Fork Wind Farm (SFWF) and South Fork Export Cable (SFEC) to Bureau of Ocean Energy Management (BOEM) for review and approval. Consistent with the requirements of 30 CFR 585.620 to 585.638, COP submittal occurs after BOEM grants a lease for the Project and DWSF completes all studies and surveys defined in their site assessment plan. BOEM’s renewable energy development process is described in the following section. DWSF is working with BOEM to address additional information needs to finalize the COP. This EFH assessment relies on the most current information available for the Project.

The SFWF includes up to 15 wind turbine generators (WTGs or turbines) with a nameplate capacity of 6 to 12 megawatts (MW) per turbine, an offshore substation (OSS), and a submarine transmission cable network connecting the WTGs (inter-array cables) to the OSS, all of which will be located in BOEM Renewable Energy Lease Area OCS-A 0517 (Lease Area), part of the Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA). The Lease Area is in federal waters of the OCS approximately 19 linear miles (30.6 kilometers [km], 16.5 nautical miles [nm]) southeast of Block Island, Rhode Island, and 35 linear miles (56.3 km, 30.4 nm) east of Montauk Point, New York. The SFWF also includes an Operations and Maintenance (O&M) facility that will be located onshore at a commercial port facility at Lake Montauk in East Hampton, New York.

The SFEC is an alternating current (AC) electric cable that will connect the SFWF to the mainland electric grid on Long Island. The connection point would be located in either East Hampton or Hither Hills, New York. The SFEC includes both offshore and onshore segments. The SFEC includes an offshore component located in federal waters (SFEC – OCS) and a component located in New York State territorial waters (SFEC – NYS). The cable will be buried to a target depth of 4 to 6 feet (1.2 to 1.8 meters) below the seabed over its entire length, except where limited by local substrate conditions.

The onshore underground segment of the export cable (SFEC – Onshore) will be located in East Hampton, New York. The SFEC – NYS will be connected to the SFEC – Onshore via a sea-to-shore transition where the offshore and onshore cables will be spliced together. The SFEC includes a new Interconnection Facility to link the SFEC to the Long Island Power Authority electric transmission and distribution system. The Interconnection Facility will be located in the town of East Hampton, New York. The onshore segments of the SFEC would have no effect on designated EFH and are not considered further in this assessment.

1.1 Project Area

The project area comprises the project footprint for the SFEC, SFWF, and O&M facility and all areas affected by the construction and operation of these facilities, which includes coastal nearshore habitats on eastern Long Island and adjacent New York State waters, the protected coastal bay of Lake Montauk, and ocean habitats in the RI/MA WEA on the OCS offshore of New York, Rhode Island, and Massachusetts. The SFWF and SFEC project areas are shown in Figure 1.1.

The project area is encompassed entirely by 15 10-minute by 10-minute quadrangles as presented in Figure 1.2. These quadrangles are used by the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC) to delineate specific areas for the purpose of EFH designation. The selected quadrangles usefully bound the reasonably foreseeable effects on EFH resulting from the construction and operation of the SFWF, SFEC, and O&M facility. This includes short-term impacts on habitat suitability from impact mechanisms like construction noise and suspended sediments, long-term impacts from the presence of the structures, operational noise, and electromagnetic field effects, and potentially permanent impacts. These impacts are detailed in Section 4.

For ease of reference, the quadrangles in Figure 1.2 are assigned reference numbers from 1 to 15 and are used to identify designated those species and life stages having designated EFH in the project area (see Section 5.1). Boundary coordinates for these EFH quadrangles are described in Table 1.1.

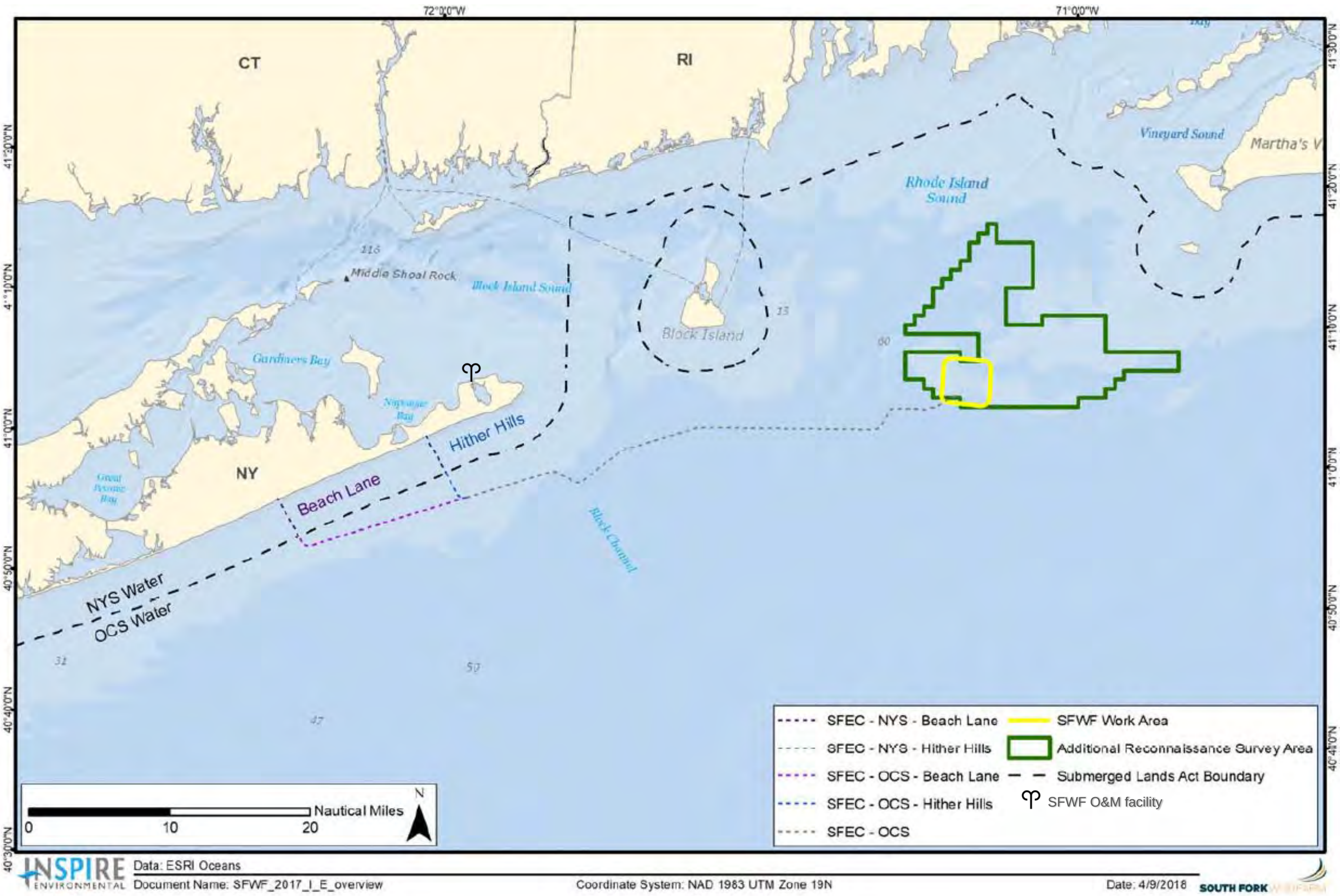

Figure 1.1. SFWF and SFEC project components

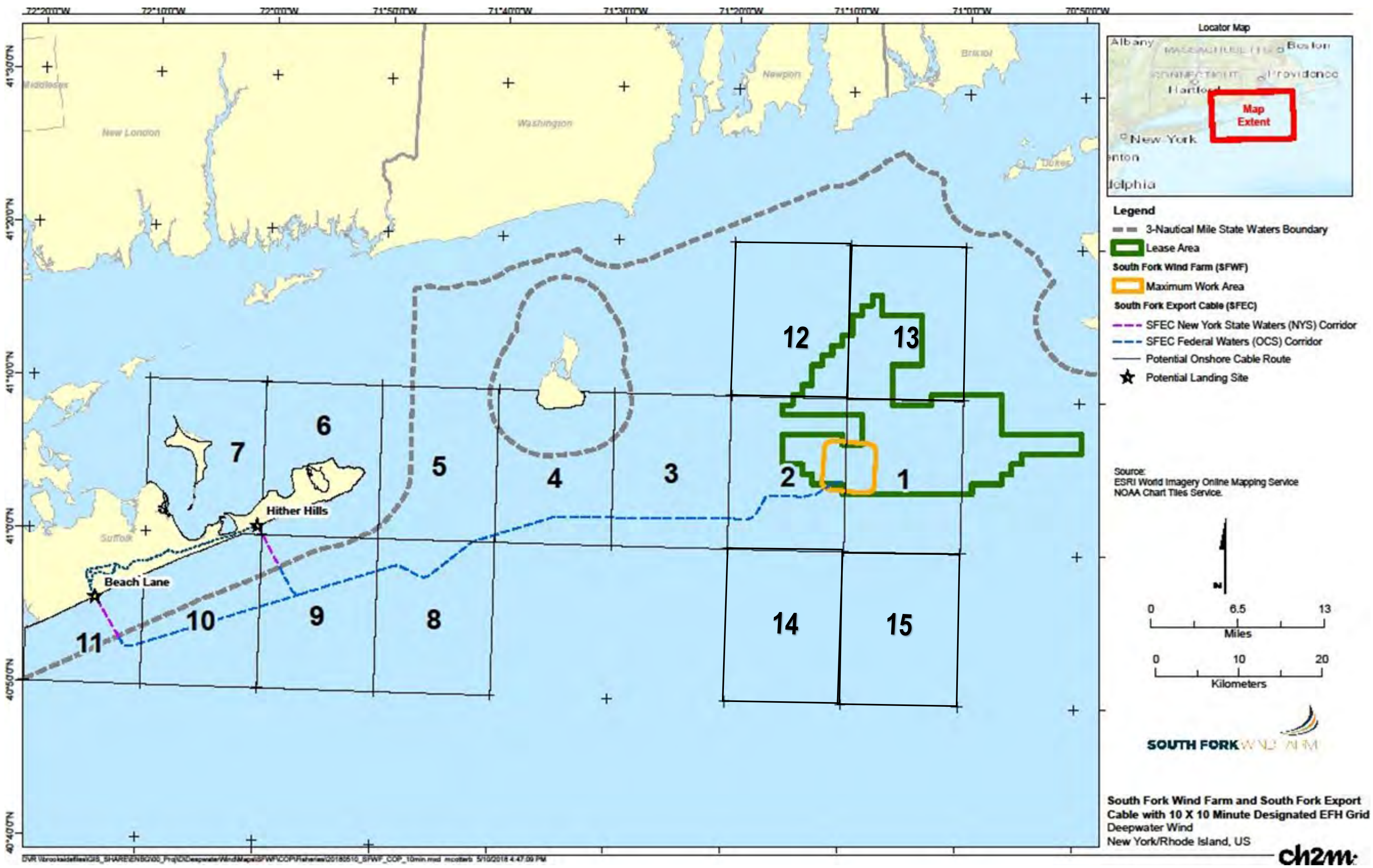

Figure 1.2. EFH quadrangles overlapping the project footprint for the SFWF, SFEC and O&M facility.

Table 1.1. EFH quadrangle reference numbers, associated project components, and boundaries.

Quadrangle Reference Number	Project Component and Associated Construction and Operational Effects	Latitude and Longitude of Quadrangle Boundaries			
		North	East	South	West
1	SFWF	41° 10.0	71° 00.0	41° 00.0	71° 10.0
2	SFWF and SFEC	41° 10.0	71° 10.0	41° 00.0	71° 20.0
3	SFEC Route	41° 10.0	71° 20.0	41° 00.0	71° 30.0
4	SFEC Route	41° 10.0	71° 30.0	41° 00.0	71° 40.0
5	SFEC Route	41° 10.0	71° 40.0	41° 00.0	71° 50.0
6	O&M Facility, SFEC Hither Hills Route	41° 10.0	71° 50.0	41° 00.0	72° 00.0
7	SFEC Hither Hills Route	41° 10.0	72° 00.0	41° 00.0	72° 10.0
8	SFEC Route	41° 00.0	71° 40.0	40° 50.0	71° 50.0
9	SFEC Beach Lane and Hither Hills Routes	41° 00.0	71° 50.0	40° 50.0	72° 00.0
10	SFEC Beach Lane Route	41° 00.0	72° 00.0	40° 50.0	72° 10.0
11	SFEC Beach Lane Route	41° 00.0	72° 10.0	40° 50.0	72° 20.0
12	SFWF (construction noise)	41° 20.0	71° 10.0	41° 10.0	71° 20.0
13	SFWF (construction noise)	41° 20.0	71° 00.0	41° 10.0	71° 10.0
14	SFWF (construction noise)	41° 00.0	71° 10.0	40° 50.0	71° 20.0
15	SFWF (construction noise)	41° 00.0	71° 00.0	40° 50.0	71° 10.0

1.2 Analysis Structure

The remainder of this EFH consultation is organized as follows:

- Section 2 – Description of the project
- Section 3 – Description of the environmental baseline in the project area
- Section 4 – Quantification of the short-term and long-term impacts of project construction and operation
- Section 5 – Description of EFH and designated species and life stages occurring in the project area
- Section 6 – Analysis of the effect of these impacts on EFH and effect determinations by EFH species and life stage
- Section 7 – Analysis of the effect of short-term and long-term project impacts on NOAA trust species

2 Proposed Action

The proposed action is the construction, operation, and conceptual decommissioning of an offshore wind energy facility on the Atlantic OCS in the RI/MA WEA. The action includes two major components, the SFWF and the SFEC as described in Section 1.0. These components are differentiated in the project description and effects analysis where appropriate to clarify the potential impacts of the action on EFH. The final design of these components is currently in development. DWSF is considering the following alternatives for the SFWF:

- 15 6-MW turbines and 1 OSS, mounted on 26.2-foot (8-meter) monopile foundations
- 15 12-MW turbines and 1 OSS, mounted on 36-foot (11-meter) monopile foundations

Two alternatives are being considered for the SFEC (Figure 1.2):

- Hither Hills route: 50 linear miles (80.4 km, 43.4 nm) from the SFWF OSS to a sea-to-shore transition 1,755.2 feet (535 meters) offshore of Montauk, New York
- Beach Lane route: 61.8 linear miles (99.5 km, 53.7 nm) from the SFWF OSS to a sea-to-shore transition 1,755.2 feet (535 meters) offshore of East Hampton, New York

Project construction and operational components are summarized in Table 2.1 and described in the following sections.

Table 2.1. Summary of SFWF and SFEC Construction and O&M Effect Mechanisms by Design Alternative

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Alternative	Effect
SFWF construction	Turbine selection/spacing	Installation disturbance area	WTG size	6 MW or 12 MW	--
			Number of turbines	6 MW or 12 MW	15
			Rotor height above mean sea level	6 MW	577.2 feet (176 meters) at peak 85.3 feet (26 meters) minimum
				12 MW	839.9 feet (256 meters) at peak 105 feet (32 meters) minimum
			Spacing	6 MW or 12 MW	1.1 linear miles (1.8 km, 1 nautical mile [nm])
			Array area	6 MW or 12 MW	5,750 acres (2,331 hectares)
	Monopile foundation installation	Habitat alteration, physical disturbance	Number of monopiles		16
			Footprint area total (with scour protection)	26.2-foot (8-meter monopile)	7.17 acres (2.90 hectares)
				36-foot (11-meter) monopile	14.36 acres (5.81 hectares)
			Installation method	26.2-foot (8-meter) monopile	4,000 kilojoules (kJ) impact hammer 4,500 strikes/day 60 days total
				36-foot (11-meter monopile)	4,000 kJ impact hammer 15 normal: 4,500 strikes/day 1 difficult: 8,000 strikes/day 60 days total
			Underwater noise (approximate)	All	250 dB_{peak} re: 1 µPa2/Hz/m @ 10 meters, 30-60 Hz frequency band
	Inter-array cable construction	Physical disturbance, turbidity, entrainment	TL	All	21.4 linear miles (34.4 km, 18.6 nm)
			Installation method	All	Cable trenching/burial 4- to 6-feet (1.2- to 1.8-meter) depth
			Short-term disturbance	All	363 acres (146.9 hectares)
			Long-term habitat conversion (exposed cable protection)	All	13.8 acres (5.6 hectares)
			Total suspended sediments (TSSs)	All	82-100 mg/L
			Area exposed to sediment deposition > 3mm	All	2,268 acres (~918 hectares)
	O&M facility construction	Dredging disturbance, water quality effects,	Dredging within existing maintenance dredging footprint in developed harbor	All	0.034 acre (0.014 hectare)
			Dredging water quality effects	All	TSS levels up to 282 to 485 milligrams per liter (mg/L) during active dredging

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Alternative	Effect
		mooring improvements	Beach nourishment (dredge material disposal)	All	2,500 cubic yards (1,911 cubic meters)
			Removal of existing 95'x8' dock	All	0.022 acre (0.009 hectare)
			Installation of 6 24-inch steel piles, 16'x100' pontoon floating dock, 4'x28' aluminum gangway	All	Net increase in overwater structure area = 0.017 acre (0.007 hectare)
			Pile installation method	All	Vibratory pile driving
			Underwater noise	All	185 dB_{SEL} @ 1 meter 2 to 4 days total
	Construction vessels	Physical disturbance, noise	Number of vessels	All	12
			Anchoring disturbance	All	820 acres (332 hectares)
			Vessel noise	All	171 root mean square decibels (dB_{RMS}) @1 meter, duration of construction
SFWF operation		Operational electromagnetic field (EMF) (Inter-array cable)	Transmission voltage	6 MW	34.5 kilovolts (kV)
				12 MW	66 kV
			Magnetic field	All	Buried cable at seabed, 21 milligauss (mG) Exposed cable at seabed, 65 mG
			Induced electrical field	All	Buried cable at seabed, 1.4 millivolts per meter (mV/m) Exposed cable at seabed, 4.3 mV/m
	O&M facility	Maintenance dredging disturbance, entrainment, water quality effects	Dredged area	All	0.034 acre (0.014 hectare)
			Dredging frequency/duration	All	Annually/up to 1 month
			Water quality effects	All	TSS levels up to 282 to 485 mg/L during active dredging
			Beach nourishment (dredge material disposal)	All	1,500 cubic yards (1,146 cubic meters)
		Vessel traffic	Number of vessels	All	1, up to 7 trips per month
			Vessel noise	All	160 dB_{RMS} @1 meter

Project Component	Design Element	Effect Mechanism	Measurement Parameter	Alternative	Effect
SFEC	Export cable construction	Installation disturbance area	TL	Hither Hills route	50 linear miles (80.4 km, 43.4 nm)
				Beach Lane route	61.8 linear miles (99.5 km, 53.7 nm)
			Installation method	All	Cable trenching/burial, 4- to 6-foot (1.2- to 1.8-meter) target depth
			Short-term disturbance area	Hither Hills route	462 acres (187 hectares)
				Beach Lane route	573 acres (232 hectares)
			TSS	All	Maximum concentration 1,347 mg/L within 8.2 feet (2.5 meters) of bed
			Area exposed to sedimentation > 3mm	Hither Hills route	804.6 acres (~325.6 hectares)
				Beach Lane route	1,032.2 acres (417.7 hectares)
			Activity duration		up to 74 days
			Long-term habitat alteration	Hither Hills route	147.5–169.5 acres (59.7–68.6 hectares)
				Beach Lane route	155.9–187 acres (63.1–75.7 hectares)
		Vessel traffic	Number of vessels	All	11
			Anchoring disturbance	All	None
			Vessel noise	All	171 dB_{RMS} @1 meter
	Sea-to-shore transition construction	Cofferdam installation/removal	Cofferdam footprint	All	0.042 acre (0.017 hectare)
			Excavation/backfill	All	26,500 cubic yards (20,260 cubic meters)
			Sheetpile size	All	Z-Type typical
			Number of sheetpiles	All	133
			Underwater noise	All	185 peak dB $_{SEL}$ re: 1 µPa2/Hz/m @ 1 meter
			Piles per day	All	100
			Total pile driving days	All	2
			Construction duration	All	12 weeks
	Operation and maintenance	Operational EMF	Transmission voltage	6 MW	138 kV
				12 MW	230 kV
			EMF generation	All	Buried cable at seabed, 30 mG Exposed cable at seabed, 76.62 mG
			Induced electrical field - ocean	All	Buried cable at seabed, 2.1 mV/m Exposed cable at seabed, 5.4 mV/m

2.1 Project Construction

The construction of the SFWF and SFEC would result in short-term and long-term impacts on aquatic habitats in the nearshore and offshore waters of the mid-Atlantic OCS, and the nearshore estuarine waters of Lake Montauk where the proposed SFWF O&M facility is sited. Project construction methods and estimated quantities for each design alternative are described in the following section. The short-term and long-term impacts of project construction on the environment are quantified in Sections 4.1 and 4.2, respectively.

Construction of the SFWF would occur in 2023 and construction of the SFEC would occur between 2022 and 2023. During this period, activities would occur 24 hours a day to minimize the overall duration of activities and the associated period of potential impact on marine species. mitigation measures proposed by DWSF include restrictions on pile driving between January 1 and April 30 and enhanced mitigation measures during the month of May to minimize potential impacts to the North Atlantic right whale (*Eubalaena glacialis*). These timing restrictions, the need to avoid hazardous weather conditions, and DWSF's contractual power delivery obligations require that the SFWF and SFEC are fully installed and operational within a few months after monopile installation is complete. Construction of the SFWF O&M facility could begin as early as late 2021, with the in-water work components requiring up to 5 months.

The total number of construction days for each project component would depend on a number of factors, including environmental conditions, planning, construction and installation logistics. The general installation schedule is provided in Table 2.2. This schedule is approximated based on several assumptions, including the estimated timeframe in which permits are received, anticipated regulatory seasonal restrictions, environmental conditions, planning, and logistics. The installation schedule includes both pile driving and non-pile driving activities.

Table 2.2. Anticipated Installation Schedule for South Fork Wind Farm and South Fork Export Cable Containing Activities Addressed in the Application

Proposed Action Element	Construction Milestone	Activity Duration	Anticipated Timeframe
SFWF	Monopile foundation installation	4 months	May to December 2023
	Inter-array cable installation	4 months	2023
	WTG installation	2 months	2023
	OSS installation	1 month	2023
	SFWF O&M facility	9 to 12 months (5 months for in-water work)	Late 2021 to 2022
SFEC	Onshore interconnection facility	6 to 9 months	September 2021 to May 2022
	Sea-to-shore transition	6 to 9 months	September 2021 to May 2022
	Offshore cable installation	2 months	2023
	Onshore cable installation	9 to 12 months	September 2021 to May 2022

2.1.1 South Fork Wind Farm

The SFWF would erect up to 15 WTGs within the proposed work area (Figure 1.2). The selected WTGs would be at least 6 MW and could be as large as 12 MW. The WTGs would be mounted on 26.2- or 36-foot (8- or 11-meter) monopile foundations driven up to 151 feet (46 meters) into the seabed using an impact hammer deployed on a jack-up or heavy-lift barge. The SFWF OSS would be supported by a single 26.2- or 36-foot (8- or 11-meter) monopile similar to the WTG foundation design and installed using the same construction methods. The substation connects the SFWF inter-array cable network to the SFEC transmission line.

The monopiles would be installed using an impact hammer with a maximum rated capacity of up to 4,000 kilojoules. Impact pile-driving activities at SFWF would take place between May 1 and December 31, with additional timing constraints as needed for the protection of Endangered Species Act (ESA)-listed marine mammals and sea turtles. Additional details on potential timing restrictions are discussed in Section 2.4. Up to 1 monopile would be installed per day. A standard installation scenario assumes that one pile is driven every other day such that 16 monopiles piles would be installed over a 30-day period. Under the most aggressive possible schedule up to six piles could be installed in a week (7 days) such that the 16 piles are installed over a 20-day period. A noise mitigation system (NMS) achieving minimum attenuation effectiveness of 10 decibels (dB_{peak} re: 1 micro Pascal [µPa]) at a reference distance of 10 meters would be employed to minimize underwater noise impacts. Scour protection in the form of rock blankets would be placed around each foundation. The scour protection radius would extend 78.8 or 111.5 feet (24 or 34 meters) outward from the center of each 26.2-foot or 36-foot (8-meter or 11-meter) pile, respectively, depending on the design alternative chosen.

The WTGs would be linked to the SFEC by the inter-array cable, a series of transmission cables linking each of the WTGs to the OSS. The 21.4-linear-mile (34.4-km, 18.6-nm) inter-array cable would have a transmission capacity of 34.5 or 66 kilovolts (kV), depending on the WTG alternative selected. A deep-sea cable laying vessel would be used to trench and bury the cable to a target depth of 4 to 6 feet (1.2 to 1.8 meters) below the bed surface using standard cable burying techniques. Specifically, the vessel will tow a jet plow that will use a high-pressure water jet to excavate the trench while simultaneously laying the cable. The cable would then be reburied as the suspended sediments and side of the trench settle and collapse. Where bed features like boulder fields or bedrock outcroppings prevent burial, the cable would be laid on the bed surface and armored with linked 19.7-foot-wide (6-meter-wide) concrete mattresses. The mattresses would cover the entire length of exposed cable to the edge of target burial depth. The cable approaches to each monopile foundation would be protected by rock blanketing similar to the scour protection, totaling approximately 10.8 acres (4.4 hectares) for all 16 foundations.

High-resolution geophysical (HRG) surveys would be conducted to support construction of the offshore components of the SFWF and the SFEC. Survey activities would include multibeam depth sounding, seafloor imaging, and shallow and medium penetration sub-bottom profiling within the wind farm area and export cable route. An estimated 621 linear miles (1,000 km, 540 nm) of pre-construction surveys plus in-fill and re-surveys may be required to finalize construction plans for the inter-array cable and the SFEC. Although the final survey plans would not be completed until construction is contracted, HRG surveys are anticipated to operate during any month of the year for a maximum of 60 vessel days of survey effort, assuming a survey rate of 43 linear miles (70 km, 37.8 nm) per day at an average vessel speed of 4 knots. Additional geotechnical surveys may occur for further sediment testing at specific WTG locations. The geotechnical surveys would include in situ testing, boring, and sampling at foundation locations.

Probable vessel classes used to construct the SFWF monopiles include heavy lift and derrick barge cranes, jack-up barges, material transport barges, a jack-up crane work vessel, and transport and anchor handling tugs. The total number of potential vessel trips is summarized in Table 2.3. A rock-dumping fallpipe vessel would be used to place scour protection, and a cable-laying vessel would be used to place the inter-array cable. A fuel-bunkering vessel would remain on station to refuel construction vessels and equipment. Transport vessels would be used to rotate construction crews to and from area ports. Small support vessels would be used for construction monitoring.

Table 2.3. Construction Phase Anticipated Number of Vessel Trips Outside of Rhode Island-Massachusetts

State/Origin	Potential Ports	Est. Max. Daily Trips	Est Max. Monthly Trips	Estimated Total	Likelihood of Use
New York	Montauk, Shinnecock Fish Dock	< 1	2	4	Unlikely
Connecticut	New London	< 1	6	50	Likely
Europe	Unknown at this time	N/A	2	6	Likely
Worldwide	Unknown at this time	N/A	1	2	Possible
Other United States ports	Paulsboro Marine Terminal (NJ), Port of Baltimore (MD), Sparrows Point (MD), Norfolk International Terminal (VA), Other Ports (Atlantic/Gulf of Mexico)	N/A	2	4	Unlikely
European ports	Unknown	N/A	Unknown	20	Possible

The SFWF includes the development of an onshore O&M facility, composed of office space for the operations center, warehouse and shop space for tools and replacement equipment, and a berthing area for crew transfer vessels (CTVs). The O&M facility would be located on an existing commercial marina property located immediately south and east of the inlet connecting Lake Montauk to Block Island Sound and the Atlantic Ocean in Lake Montauk Harbor, in Easthampton on Long Island, New York. In-water and construction elements include dredging to achieve required depths for berthing the CTV and removal and replacement of existing docks and mooring structures. An existing 95-foot-long by 8-foot-wide (29 meter by 2.4 meter) wooden dock would be removed and replaced by a 4-foot-wide by 28-foot-long (1.2 meter by 8.5

meter) boat ramp and aluminum stationary gangway and a 16-foot-wide by 100-foot-long (4.9 meter by 30 meter) floating pontoon, supported by five (5) 24-inch diameter steel piles. One additional 24-inch diameter steel pile would be installed with donut fendering and a mooring ring. The piles will be installed with a vibratory hammer unless difficult substrate conditions are encountered. An impact hammer may be used to complete pile installation on an as needed basis. Approximately 50 to 100 hammer strikes per pile may be required to achieve target depth and proof each pile to design load.

Construction dredging would deepen 0.034 acre (0.014 hectare) within the existing dredged berthing area from the current maintained depth of -5 feet (-1.5 meters) mean lower low water (MLLW) to -12.4 feet (-3.8 meters) MLLW. The overall berthing area footprint would remain unchanged. Initial dredging would require approximately 60 days to complete. Dredged materials would be placed on the beach west of the Montauk Harbor entrance (Placement Area) where sediment would be pumped to shore. The sediment would be dewatered in a contained area approximately 1,200 feet long by 25 feet wide (366 meter by 8 meter), placed landward of the plane of spring high water. The dewatered materials would then be distributed adjacent to the dewatering area between the planes of mean high water and spring high water to nourish the beach. Maintenance dredging of the berthing area would occur annually, generating up to approximately 2,500 cubic yards (1,911 cubic meters [m^3]) per event that would similarly be placed for beach nourishment. This site is currently used as a beneficial use disposal area for dredged materials from federal navigation channel maintenance in Montauk Harbor.

2.1.2 South Fork Export Cable

Each SFEC design alternative includes an offshore and an onshore component, linked by a sea-to-shore transition. The onshore component of the SFEC would have no effect on designated EFH and is therefore not considered further in this assessment. The Hither Hills route alternative would extend approximately 50 linear miles (80.4 km, 43.4 nm) from the SFWF OSS to the sea-to-shore transition point just west of Montauk, NY. The Beach Lane route alternative would extend approximately 61.8 linear miles (99.5 km, 53.7 nm) from the OSS to the sea-to-shore transition just west of East Hampton, NY (Figure 1.1). Two transmission voltage alternatives are being considered for the SFEC, 138 kV and 230 kV.

Each SFEC route and transmission voltage alternative would be constructed using the same method used for the inter-array cable and buried to a target depth of 4 to 6 feet (1.2 to 1.8 meters). DWSF estimates that substrate conditions will prevent burial of approximately 1.9 and 3.2 linear miles (3.0 and 5.2 km, 1.6 and 2.8 nm) of cable segments on the Hither Hills and Beach Lane route alternatives, respectively. These cable segments will be laid on the bed surface and armored with concrete mattresses. The installation and cable protection methods used are the same as those described in the previous section for the inter-array cable.

The sea-to-shore transition construction methods would be the same for each route alternative. The transition point would be constructed approximately 1,748.7 feet (533 meters) seaward of MLLW. A horizontal directional drill (HDD) would be used to tunnel approximately 65.6 feet (20 meters) beneath the beach to the offshore transition point, located approximately 19.7 feet (6 meters) beneath the seabed. Up to 26,500 cubic yards (20,260 m^3) of overlying substrates covering 1.81 acres (0.73 hectare) of seafloor would be excavated to a depth of 10 to 17 feet (3 to 5 meters) to expose the cable tunnel. The dredged materials would be stored on a hopper scow and used to backfill the excavated area once construction is complete. A temporary 75.7-foot by 26.2-foot (23- by 8-meter) cofferdam may be placed around the transition point to aid construction. Two alternative cofferdam designs are being considered, gravity cell and sheetpile. The gravity cell would be lowered into place from a barge using a crane. The sheetpile cofferdam would be constructed using approximately 200 18-inch (0.5-meter) interlocking steel sheetpiles installed using a vibratory hammer from a construction barge. Vibratory installation and removal would each require an estimated 18 hours of vibratory hammer operation over 2 to 3 days. The sea-to-shore transition cable would be threaded through the tunnel to the transition point and connected to the SFEC. The connected segments would then be sealed and reburied and the cofferdam removed. All excavated areas would then be backfilled using native materials as described above.

2.2 Project Operation

SFWF and SFEC operational parameters pertinent to this assessment are described below and summarized in Table 2.1. Additional information about project operation and maintenance requirements is provided in the project COP (Deepwater Wind, LLC 2020). The long-term impacts on the environment resulting from the presence of SFWF structures, electromagnetic field (EMF) and heat effects from the transmission cables, and the ongoing O&M of the SFWF and SFEC are quantified in Section 4.2.

2.2.1 South Fork Wind Farm

The SFWF would generate electricity whenever wind speeds exceed minimum operational cut-in for the selected WTG design alternative. The SFWF will be remotely monitored and operated from an onshore facility. SFWF WTGs will be regularly inspected and maintained by service technicians delivered by a dedicated CTV from the O&M facility. DWSF estimates approximately 7 routine maintenance trips to and from the SFWF each month over the 30-year lifetime of the project.

The monopile foundations are not expected to require maintenance over the lifetime of the project. Should unplanned maintenance of the WTGs be required, the associated vessel and activity requirements would be similar to those described for the installation of an individual WTG (i.e., vessel noise and anchoring impacts). Catastrophic failure of monopile foundations from unanticipated events, such as a large vessel allision, could occur but is not anticipated. This type of event would be considered an emergency and associated unplanned maintenance activities are not considered in this assessment.

O&M facility operation would include annual maintenance dredging of the 0.86-acre (0.35-hectare) berthing areas to maintain the desired depth of -12.1 feet (-3.7 meters) MLLW. The adjacent federal navigation channel, boat basin, and associated commercial and private mooring areas in Lake Montauk Harbor are periodically dredged on a four to five-year schedule. The harbor supports commercial fishing and recreational vessel fleet and an active U.S. Coast Guard (USCG) station and routine maintenance dredging is required to maintain access for deeper draft vessels. CTVs would depart and return from the O&M facility approximately 7 times per month throughout the 30-year lifetime of the project.

2.2.2 South Fork Export Cable

The SFEC will transmit electricity from the SFWF to Long Island whenever the WTGs are in operation throughout the 30-year lifespan of the project. Like the SFWF, the SFEC will be remotely monitored from an onshore facility. DWSF does not expect the SFEC to require planned maintenance but will maintain a stockpile of equipment and materials for emergency repairs as needed in the unlikely event of substation equipment failure or mechanical damage to the transmission cable (e.g., by a ship anchor). Should unplanned maintenance or repairs be required, support vessels could travel directly to the site from any global port as determined by the availability of appropriate capabilities. Unplanned emergency maintenance activities are not addressed in this assessment.

2.3 Project Decommissioning

The SFWF and SFEC would be decommissioned and removed when these facilities reach the end of their 30-year designed service life. A separate EFH consultation will be conducted for the decommissioning phase of the project. The same types of vessels used to construct the project would be employed for decommissioning. This process would emphasize the recovery of valuable materials for recycling. The WTGs would be removed and the monopiles cut off below the seabed and recovered to a barge for transport. A cable laying vessel would be used to remove as much of the inter-array and SFEC transmission cables from the seabed as practicable to recover and recycle valuable metals. Cable segments that cannot be easily recovered will be left buried below the seabed or rock armoring.

3 Environmental Baseline

The environmental baseline consists of existing EFH habitat conditions in the project area. DWSF conducted detailed surveys of the Project area to support preparation of the COP, which were subsequently updated in coordination with the National Marine Fisheries Service [NMFS] (Fugro 2018; Inspire Environmental 2020a; Stantec 2020). The updated surveys represent the most current information available for characterizing baseline conditions within the project area and are relied upon here supported by other appropriate sources of information where available.

Aquatic ecosystems in the project area are described using the Coastal and Marine Ecological Classification Standard (CMECS), a classification system based on biogeographic setting for the area of interest (Federal Geographic Data Committee [FGDC 2012]). CMECS provides a comprehensive framework for characterizing ocean and coastal environments and living systems using categorical descriptors for physical, biological, and chemical parameters relevant to each specific environment type (FGDC 2012). The CMECS biogeographic setting for the project area and surroundings is the Temperate Northern Atlantic Realm, Cold Temperate Northwest Atlantic Province, Virginian Ecoregion (FGDC 2012; Stantec 2020a). The CMECS aquatic setting, substrate and biotic components for the three project sub-areas are described in Table 3.1.

Table 3.1. Coastal and Marine Ecological Classification Standard (CMECS) Aquatic Setting, Substrate Group, and Biotic Subclasses in the Action Area

Project Element	CMECS Component				
	Aquatic Setting			Substrate Group	Biotic Subclass
	System	Subsystem	Tidal Zone		
SFWF and SFEC offshore	Marine	Offshore	Subtidal	• Gravel • Gravelly	• Soft Sediment Fauna • Attached Fauna • Inferred Fauna
SFEC nearshore		Nearshore	Subtidal	• Gravelly	• Soft Sediment Fauna • Inferred Fauna
SFWF O&M facility	Estuarine	Coastal	• Intertidal • Subtidal	• Sand • Muddy Sand	• Soft Sediment Fauna • Inferred Fauna • Aquatic Vascular Vegetation • Benthic Macroalgae • Emergent Tidal Marsh

The biotic component of CMECS classifies living organisms of the seabed and water column based on physical habitat associations across a range of spatial scales. This component is organized into a five-level branched hierarchy: biotic setting, biotic class, biotic subclass, biotic group, and biotic community. The biotic subclass is a useful classification category for characterizing the aquatic ecosystem in the action area. Biotic component classifications in the SFWF and SFEC footprints are defined by the dominance of life forms, taxa, or other classifiers observed in surveys of the site.

Biotic component classification in the O&M facility footprint is based on the Lake Montauk resource report compiled for the COP (Stantec 2020b, COP Appendix O).

3.1 Benthic Habitat Conditions

Regional and WEA-specific benthic habitat mapping (Collie and King 2016; Mid-Atlantic Regional Council on the Ocean [MARCO] 2019; Williams et al. 2006) provide useful characterization of benthic habitat conditions in the project area. The OCS within and surrounding the project area is characterized by a gradually sloping seabed from the shoreline to the SFWF, which is located in waters less than 164 feet (50 meters) deep. The Mid-Atlantic Regional Council on the Ocean (MARCO 2019), BOEM (Guida et al. 2017), New York State Department of Environmental Conservation (Nelson, Pope & Voorhis, LLC [NPV] 2014), and DWSF (Fugro 2018; Stantec 2020a) have conducted large-scale general benthic habitat mapping within the SFWF and O&M facility footprints and along the SFEC corridor. Inspire Environmental (2020a) has collected extensive side scan sonar and backscatter data to determine site-specific benthic habitat conditions as part of the EFH analysis. Inspire Environmental (2020a) identified four benthic habitat types in the area of direct effects: 1) glacial moraine, 2) coarse sediment, 3) sand and muddy sand, and 4) mud and sandy mud.

For the purposes of analysis, these four substrate classes are consolidated into two groups: 1) complex habitat and 2) non-complex habitat. Substrate groups are based on sediment grain size and composition, and their associated uses by marine organisms. Habitat conversion impacts resulting from the project are quantified in Section 4.2.1 using these three benthic habitat groups. Inspire Environmental (2020a) defined a third substrate group, potentially complex, which is considered a subset of complex benthic habitat for the purpose of this assessment. These three benthic habitat types are defined as follows:

- Complex benthic habitat: Benthic habitats where ledge, megaclasts, boulders, cobbles, and pebbles dominate the sea floor, and may also include finer material (e.g., pebbles in a sand matrix)
- Potentially complex benthic habitat: Benthic habitats that may contain a substantial portion of boulders, cobbles, and pebbles
- Non-complex benthic habitat: Benthic habitats that do not include a substantial portion of coarse-grained sediment

Potentially complex habitats include areas of high and mixed high and low backscatter return with greater than 50 percent of area having high return, and areas having acoustic signature continuity with adjacent complex habitats and are lacking sufficient ground truthing images.

Glacial moraine and coarse sediment are categorized under complex habitat because boulders, cobbles, and pebbles dominate the sea floor in these areas, along with finer material (e.g., pebbles in a sand matrix), thus providing a heterogeneous variety of hard surfaces and fine material that provide habitat for many different species. Sand/ muddy sand and mud/sandy mud areas lacking a substantial portion of coarse-grained sediment are categorized as non-complex habitat. It is important to note that within an area categorized as non-complex habitat there may be scattered (e.g., patchy) areas of gravels and small cobbles that constitute complex habitat. Inspire Environmental (2019a, 2019b, 2020a) provides photographic examples of each habitat type. Inspire Environmental (2020a) characterized benthic habitat composition within the maximum work area (MWA) for the SFWF and the SFEC route alternatives using these three habitat categories. The MWA is defined as the maximum area encompassing all bottom disturbing activities likely to result from project construction. The distribution of complex, potentially complex, and non-complex benthic habitats within the SFWF and SFEC footprints is shown in Figures 3.1 and 3.2, respectively. The surveyed area and proportional distribution of benthic habitat types within these respective footprints are summarized in Table 3.2.

Stantec (2020a) characterized benthic habitat conditions within the O&M facility footprint. Bottom sediments within the facility footprint and Lake Montauk in general are dominated by sand with varying proportions of silts and fine gravels (i.e., non-complex benthic habitat), with the later more prevalent in higher energy environments near the harbor mouth. NPV (2014) summarized available data on pollutants in greater Lake Montauk and identified no significant sediment contamination concerns. Dredged materials from Lake Montauk are routinely used for beach nourishment and other beneficial purposes, indicating that dredged materials meet testing requirements for these permitted uses (Stantec 2020a). DWSF has committed to pre-construction sediment sampling and analysis to determine if any contaminants are present above regulatory thresholds and develop appropriate best management practices.

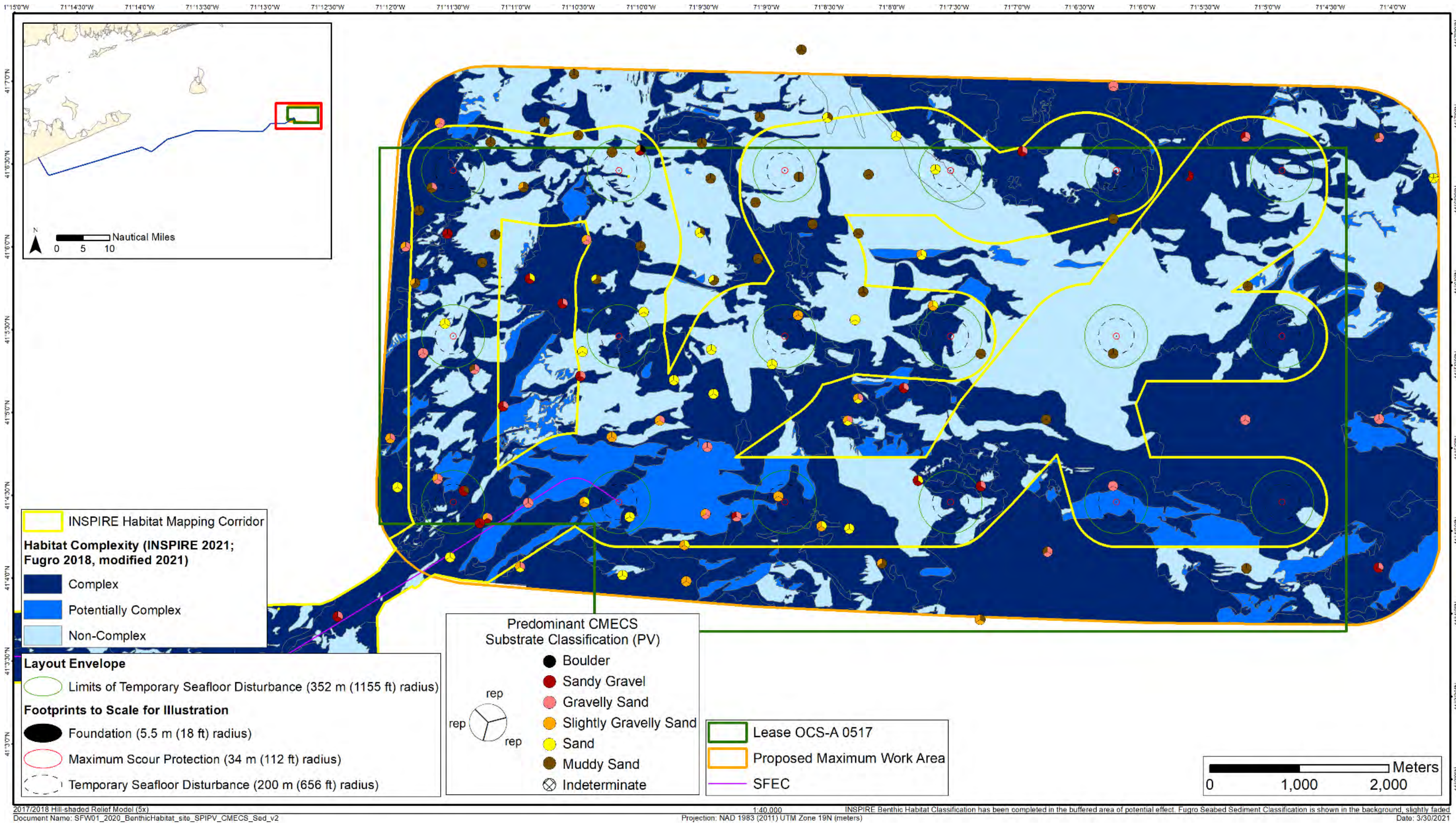

Figure 3.1. **Distribution of complex, potentially complex, and non-complex benthic habitats and CMECS substrate classifications within the SFWF project footprint.**

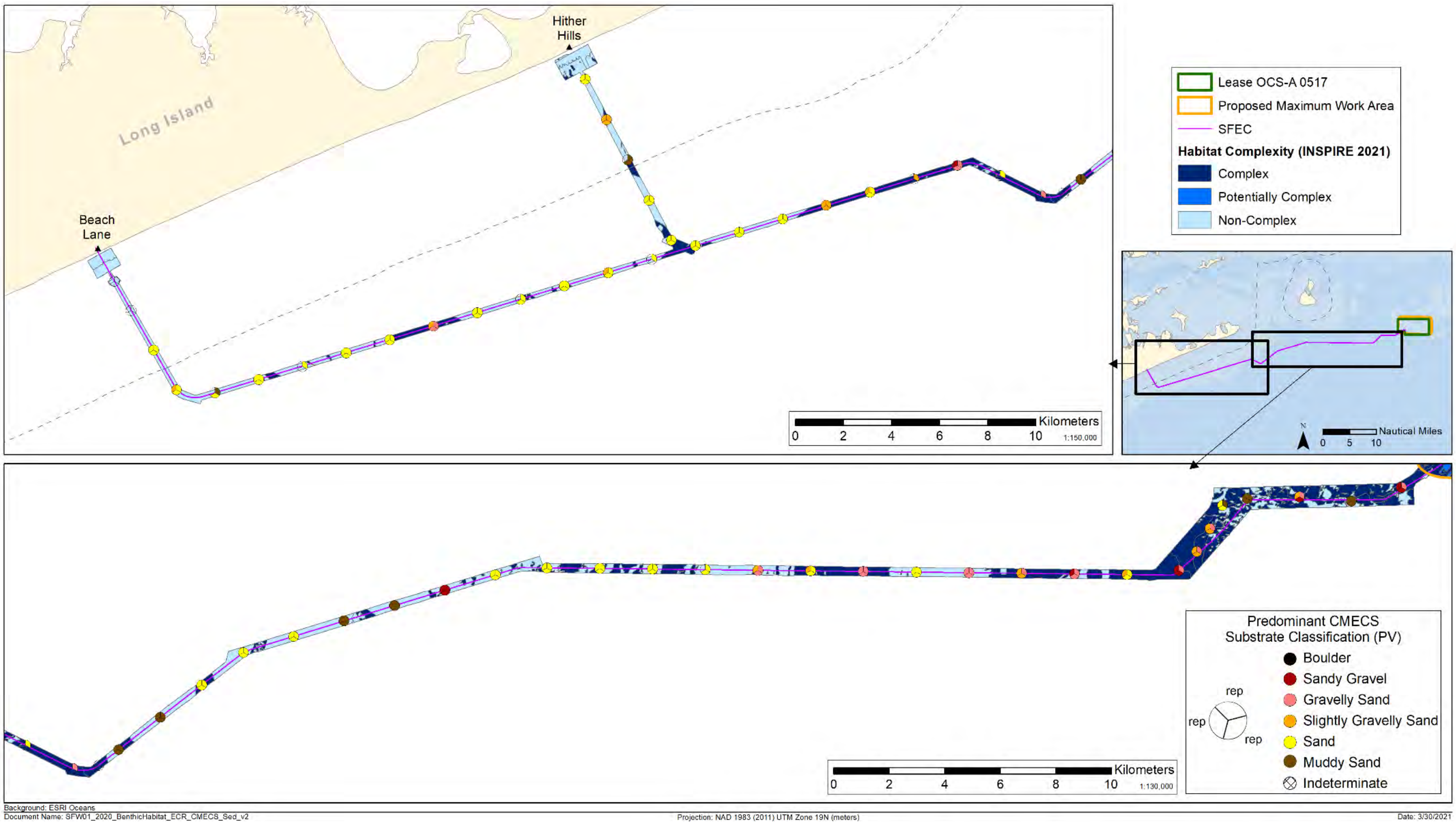

Figure 3.2. Distribution of complex, potentially complex, and non-complex benthic habitats and CMECS substrate classifications within the SFEC project footprint.

Table 3.2. Total Survey Acres and Proportional Composition of Benthic Habitat Types in the SFWF and SFEC MWAs

Project Area		Complex	Potentially Complex	Not Complex	Total
South Fork Wind Farm					
Lease Area	Area – acres (hectares)	7,503 (3,036)	1,092 (442)	4,615 (1,866)	13,210
	Percentage of Survey Area	57%	8%	35%	100%
Maximum Work Area	Area – acre (hectares)	9,860 (3,990)	1,348 (546)	5,861 (2,372)	17,069
	Percentage of Survey Area	58%	8%	34%	100%
South Fork Export Cable - Beach Lane - OSS to Sea-to-Shore Transition (inclusive)					
Cable Installation Corridor	Area – acres (hectares)	4,416 (1,787)	98 (40)	4,488 (1,816)	9002
	Percentage of Survey Area	49%	1%	50%	100%
South Fork Export Cable - Hither Hills - OSS to Sea-to-Shore Transition (inclusive)					
Cable Installation Corridor	Area – acres (hectares)	4,296 (1,738)	98 (40)	3,550 (1,437)	7,944
	Percentage of Survey Area	54%	1%	45%	100%

Benthic habitats are periodically exposed to natural and anthropogenic disturbance. Fine sediments in non-complex benthic habitat are often mobile and can be redistributed during large storm events, leading to shifts in the position of sand ripples and depressions. Benthic habitats in the SFWF and SFEC are also subjected to periodic disturbance by bottom-disturbing commercial fishing methods like bottom trawls, scallop and clam dredges, and lobster pots, which are the dominant gear types used in the project area (Deepwater Wind LLC 2020). Fisheries using bottom gear in the New England and Mid-Atlantic management regions accounted for total annual revenues over $900 million between 2008 and 2018. Fishing effort in the project area and surroundings are described in detail in Section 3.5.1 of the draft environmental impact statement for the SFWF and SFEC. Chronic disturbance by commercial fishing activities can impact benthic community structure by reducing species diversity and increasing recovery time (Nilsson and Rosenberg 2003; Rosenberg et al. 2003).

The proposed O&M facility would be located in Lake Montauk Harbor, a shallow coastal embayment surrounded by natural and developed shorelines. The facility is sited immediately north and east of the federally maintained navigation channel and boat basin at the northern end of the bay. The in-water portion of the facility covers approximately 1 acre (0.4 hectare). Subtidal depths within the O&M facility footprint are approximately -1.5 MLLW and the surrounding areas range from -2 feet to -19.7 feet (-0.6 meter to -6 meters) MLLW (Stantec 2020b; U.S. Army Corps of Engineers [USACE] 2018), and depths. The surrounding shorelines are mostly bulkhead, armored, or otherwise modified and intertidal habitats routinely dredged to maintain desired berthing depths. No eelgrass beds are located within the O&M facility footprint. A documented eelgrass bed is present along the eastern shore of inlet to Lake Montauk, approximately 375 feet (114 meters) at closest distance to northwest corner of the facility (NYSDEC 2018; Stantec

2020b). The U.S. Army Corps of Engineers [USACE] (2019) and (NPV 2014) summarized surveys from the early 1990s documenting the presence of extensive eelgrass beds to the south and east of Star Island. NPV (2014) summarized the results of a 2008 survey confirming eelgrass presence within that historical survey footprint, including documented beds approximately 900 feet (275 meters) from the southeast edge of the O&M facility footprint. Substrates within the O&M facility footprint and adjacent federal navigation channel are primarily fine to medium grained sand, with trace amounts of silt; however, areas experiencing less tidal action accumulate a greater proportion of fine sediments (Stantec 2020b; USACE 2020).

The dominant CMECS biotic subclass (i.e., co-dominant subclass) associated with complex benthic habitat across the SFWF and offshore SFEC is Attached Fauna (Inspire Environmental 2020a; Stantec 2020a). The Attached Fauna subclass often co-occurs with the Soft Sediment Fauna subclass. Invertebrates classified as Attached Fauna maintain contact with hard substrate surfaces, including firmly attached, crawling, resting, interstitial, or clinging invertebrates. Attached invertebrates could be found on, between, or under rocks or other hard substrates or substrate mixes. These invertebrates use pedal discs, cement, byssal threads, feet, claws, appendages, spines, suction, negative buoyancy, or other means to stay in contact with the hard substrate and may or may not be capable of slow movement over the substrate. Invertebrates typically associated with the Attached Fauna subclass include sea anemones, barnacles, corals, mussels, oysters, some crabs, small shrimp, amphipods, starfish, and sea urchins (FGDC 2012). Economically important species, notably lobster and squid, are also associated with the Attached Fauna subclass. These hard substrate areas serve as important nursery habitat for juvenile lobster and substrate upon which squid lay their eggs.

The dominant CMECS biotic subclass associated with non-complex benthic habitats is Soft Sediment Fauna (Inspire Environmental 2020a; Stantec 2020a). The Soft Sediment Fauna subclass includes any invertebrate that creates a permanent or semi-permanent home in the substrate. Invertebrates that move slowly over the sediment surface but are not capable of moving outside of the boundaries of the subclass within 1 day are also included. Most of the invertebrates associated with the Soft Sediment Fauna possess specialized organs for burrowing, digging, embedding, tube-building, anchoring, or locomotion in soft substrates. Invertebrates associated with the Soft Sediment Fauna subclass include worm-like invertebrates (e.g., oligochaetes, polychaetes, flatworms [Platyhelminthes], and nematodes [Nematoda]); burrowing amphipods, mysids, and copepods; crabs (Brachyura); sand dollars (Clypeasteroida); starfish (Asteroidea); and sea urchins (Echinoidea); bivalves (Bivalvia); snails (Gastropoda); burrowing anemonies (Anthozoa); (FGDC 2012; Inspire Environmental 2020a; Stantec 2020a). These species provide the prey base for several EFH species. Economically important species, including sea scallops, horseshoe crabs (Limulidae), surf clams, and the ocean quahog, are also associated with the Soft Sediment Fauna subclass.

Dominant CMECS biotic subclasses in Lake Montauk include Benthic Macroalgae, Aquatic Vascular Vegetation, and Emergent Tidal Marsh, as well as Soft Sediment Fauna (Stantec 2020b). Macroalgae is associated primarily with artificial hard surfaces (e.g., the jetty at the harbor mouth) and emergent tidal marsh vegetation is most prevalent along undeveloped shorelines at the southern end of the lake (NPV 2014). No eelgrass beds are located within the O&M facility footprint. Documented eelgrass beds were present along the eastern shore of inlet to Lake Montauk, approximately 375 feet (114 meters) and 900 feet (275 meters) at closest distance to northwest and southeast sides of the facility, respectively (NPV 2014; NYSDEC 2018). Scallops, crabs, shrimp, periwinkles, clams, oysters, and slipper shells are periodically identified as occurring within the lake. Grass shrimp are the most abundant species encountered in ongoing biological surveys (NPV 2014).

3.2 Pelagic Habitat Conditions

The aquatic component of the project area is located in coastal and open waters of the Atlantic OCS. The CMECS aquatic settings for the project area are marine nearshore and marine offshore, respectively. Water depth in SFWF ranges from 108.2 feet to 124.7 feet (33 to 38 meters) below MLLW, with an average depth of 115 feet (35 meters) MLLW. Water depths along the SFEC corridor range from 85.3 feet to 154.2 feet (26 to 47 meters) MLLW in the SFEC-OCS, and 29.5 to 85.3 feet (9 to 26 meters) MLLW in the SFEC-NYS. Inspire Environmental (2020a) conducted detailed bathymetric surveys of the SFWF and SFEC footprints to support COP development, surveyed water depths within these project area components are displayed in Figures 3.3 and 3.4, respectively.

Section 4.2.2 of the COP details existing pelagic habitat conditions (i.e., dissolved oxygen; chlorophyll; nutrient content; seasonal variations in algae or bacterial content; upwelling conditions; contaminants in water or sediment; and turbidity or water visibility). The SFWF and SFEC are located in temperate waters and, therefore, subjected to highly seasonal variation in temperature, stratification, and productivity. Overall, pelagic habitat quality within the SFWF and offshore components of the SFEC is considered fair to good (U.S. Environmental Protection Agency [USEPA] 2015). Baseline conditions for water quality are further described in Section 3.4, below.

Section 4.2.4 of the COP details oceanographic conditions in the SFWF, SFEC, and surrounding area. Circulation patterns in the project area and vicinity are influenced by water moving in from Block Island Sound and the colder water coming in from the Gulf of Maine with a net transport of water from Rhode Island Sound towards the southwest and west. While the net transport of water is to the southwest and west, bottom water may flow toward the north, particularly during the winter (Rhode Island Coastal Resources Management Council [RICRMC] 2010).

Lake Montauk near the O&M facility is considered a well-mixed estuary: the lake is tidally influenced, with salinity ranging from 28-32 parts per thousand (ppt) (USACE 2019, Stantec 2020). Though historically the lake was freshwater, an inlet was created in the late 1920s to connect to Block Island Sound and the Atlantic Ocean. The inlet is currently maintained as a 100-foot (30-meter) wide federal navigation channel, which is located immediately west of the O&M facility. Water circulation in the lake is highest at this inlet, with surface currents greater than 1.2 knots at peak flood tide (NOAA 2019).

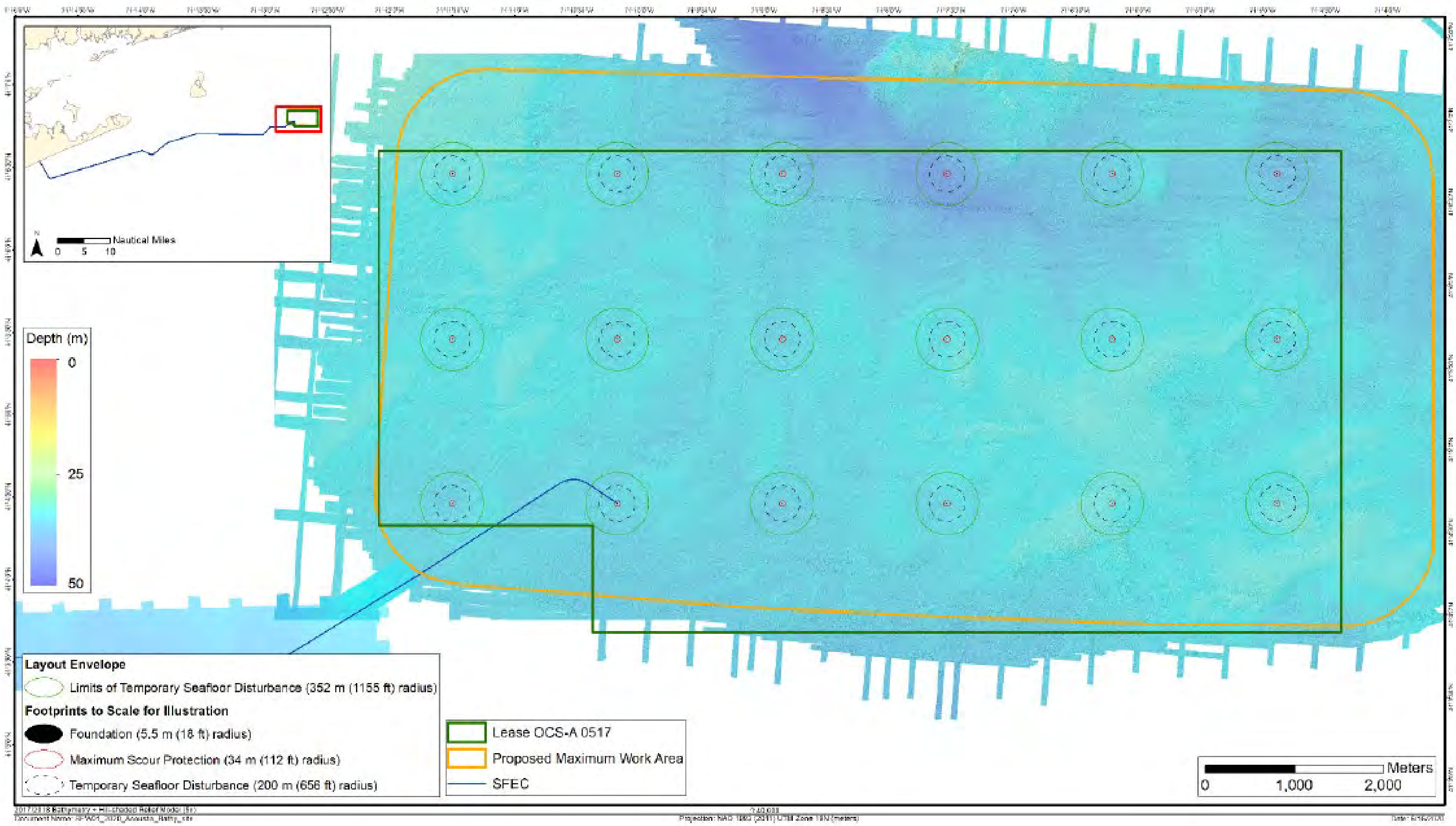

Figure 3.3. Surveyed bathymetry within the SFWF project footprint and vicinity (Inspire Environmental 2020a).

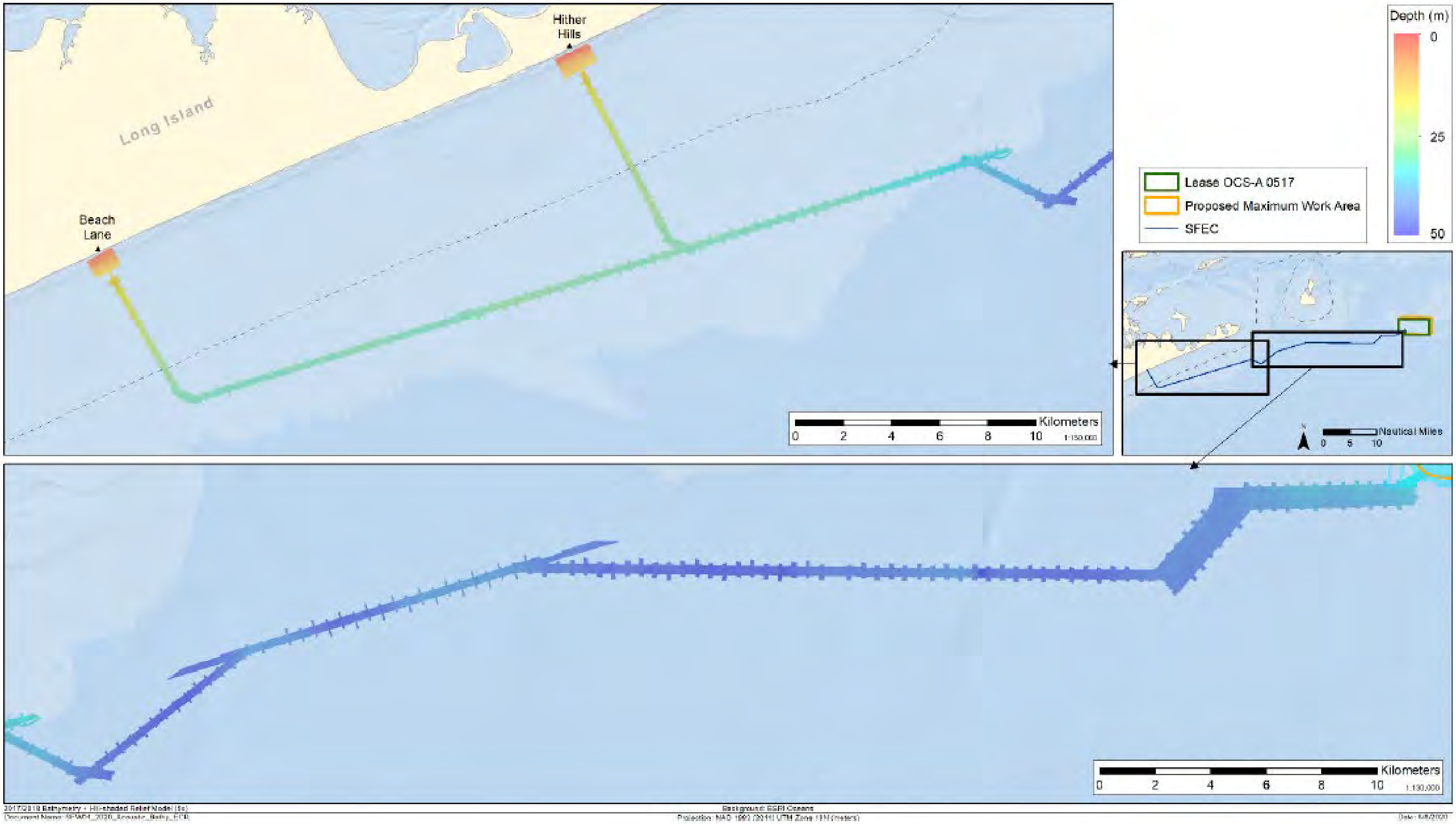

Figure 3.4. Surveyed bathymetry within the SFEC project footprint and vicinity (Inspire Environmental 2020a).

3.3 Underwater Noise

Kraus et al. (2016) surveyed the ambient underwater noise environment in the RI/MA WEA as part of a broader study of large whale and sea turtle use of marine habitats in this wind energy development area. The SFWF lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action, a diverse community of vocalizing cetaceans, and other organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes in proximity to the project area, also contributed to ambient noise levels.

Depending on location, average ambient underwater sound levels within the RI/MA WEA measured between November 2011 and March 2015 varied from 101 to 110 decibels (dB) within a 20 - 477 hertz (Hz) frequency band during 50 percent of the recording time. Peak ambient noise levels reached as high as 125 dB on the western edge of the SFWF in proximity to the Narraganset Bay and Buzzards Bay shipping lanes (Kraus et al. 2017). Large marine vessel traffic on these and other major shipping lanes to the east (Boston Harbor) and south (New York) are the dominant sources of underwater noise in the project vicinity. Large, deep draft vessels like container and cargo ships, cruise ships, tankers, and tugs typically account for over 99 percent of the baseline acoustic energy budget in the marine environment (Basset et al. 2012), meaning that these vessel classes account for the majority of underwater noise exposure experienced by fish and other marine organisms.

The O&M facility is in proximity to the federal navigation channel into Lake Montauk: background underwater noise within and around the facility is dominated by existing harbor traffic.

3.4 Water Quality

The SFWF and SFEC-OCS are located in offshore marine waters where available water quality data are limited. Broadly speaking, ambient water quality in these areas is expected to be generally representative of the regional ocean environment and subject to constant oceanic circulation that disperses, dilutes, and biodegrades anthropogenic pollutants from upland and shoreline sources (BOEM 2013).

The SFEC-NYS is located in coastal marine waters of New York State where water quality data are similarly limited but some useful information is available. The U.S. Environmental Protection Agency (USEPA) classified coastal water quality conditions nationally for the 2010 National Coastal Condition Assessment (NCCA) (USEPA 2015). The NCCA used physical and chemical indicators to rate water quality, including phosphorous, nitrogen, dissolved oxygen, salinity, water clarity, pH, and chlorophyll a. The most recent National Coastal Condition Report (NCCR) rated coastal water quality from Maine to North Carolina as “good” to “fair” (USEPA 2015). This survey included four sampling locations near the SFWF and SFEC, all of which were within Block Island Sound. USEPA (2015) rated all NCCR parameters in the fair to good categories at all four of these locations (USEPA 2015).

Water quality conditions in Lake Montauk generally meet state and federal requirements for contact recreation and shellfishing, although portions of the waterbody, including the O&M facility, are closed to shellfish harvest based on proximity to commercial and recreational moorage facilities. Water clarity, nutrient concentration, chlorophyll-a, and fecal coliform metrics met New York State standards in at least 93 percent of samples collected in the center of the lake from 1994 through 2011 (NPV 2014). Dissolved oxygen met state standards in all samples collected during this period. Fecal coliform levels exceed state standards at specific locations around the lake, associated predominantly with domestic pets and wildlife with septic systems being a minor source (NPV 2014).

For the purpose of this EFH assessment, total suspended sediment (TSS) is the pertinent water quality parameter likely to be measurably affected by the project. Ocean waters beyond 3 linear miles (4.8 km, 2.6 nm) offshore typically have low concentrations of suspended particles and low turbidity. Turbidity in Rhode Island Sound from five studies cited in USACE (2004) ranged from 0.1 to 7.4 milligrams/liter (mg/L) TSS. Bottom currents may re-suspend silt and fine-grained sands, causing higher suspended particle levels in benthic waters. Storm events, particularly frequent intense wintertime storms, may also cause a short-term increase in suspended sediment loads (BOEM 2013). Vinhateiro et al. (2018) assumed that ambient TSS levels in the aquatic component of the project area were generally low, less than 10 mg/L. However, Inspire Environmental (2020a) periodically encountered water column turbidity levels high enough to prevent observation of the benthos. This occurred throughout the project area, but most commonly in the shallower waters associated with the SFEC-NYS. Based on camera distance to the bed (Inspire Environmental 2020a) and observed relationships between TSS and visibility (West and Scott 2016), baseline TSS levels during these observations likely exceeded 100 mg/L. Collectively, this information indicates that baseline TSS and turbidity in the project area are generally low but could periodically exceed 100 mg/L near the seabed.

TSS levels are not routinely monitored in Lake Montauk. In general, TSS and turbidity levels are likely to be low in this enclosed waterbody, except on rare occasions when excessive algal blooms occur and during periodic maintenance dredging. TSS levels associated with dredging are useful for characterizing baseline TSS conditions associated with routine maintenance of the navigation channel and harbor. Anchor (2003) reviewed available literature on dredging-related water quality effects and found that maximum TSS concentrations during dredging ranged from 282 to 485 mg/L in proximity to dredging activities. USACE (2019) concluded that TSS levels from dredging of the federal Montauk Harbor navigation channel could reach as high as 475 mg/l. They concluded that water column TSS concentrations would return to baseline within an hour after dredging activities are completed. This baseline level of disturbance occurs on an approximate 5-year schedule, although disturbance from other dredging activities may occur more frequently. For example, DWSF has determined that the O&M facility berthing area accumulates sediment at a rate approximately 2 feet (0.6 meter) per year. Similar sediment accumulation rates likely occur at other private and commercial mooring facilities within the harbor, meaning that some maintenance dredging is likely occurring at various locations in the harbor every year.

3.5 Electromagnetic Fields

The natural magnetic field in the project area has a total intensity of approximately 512 to 517 milligauss (mG) or 51.2 to 51.7 micro Tesla (µT) at the seabed, based on modeled magnetic field strength from 2014 through 2019 (NOAA 2018b). The marine environment continuously generates additional ambient EMF effects. The motion of electrically conductive seawater through the Earth’s magnetic field induces voltage potential, creating electrical currents. Surface and internal waves, tides, and coastal ocean currents all create weak induced electrical and magnetic field effects. Their magnitude at a given time and location are dependent on the strength of the prevailing magnetic field, and site- and time-specific ocean conditions. Other external factors like electrical storms and solar events can also generate variable EMF effects.

Following methods described by Slater et al. (2010), a uniform current of 1 meter per second (m/s) flowing at right angles to the natural magnetic field occurring within the SFWF and SFEC corridor could induce a steady-state electrical field on the order of 51.5 microvolts per meter (µV/m). Modeled current speeds in the Project Area are on the order of 0.1 to 0.35 m/s at the seabed (Vinhateiro et al. 2018), indicating baseline current-induced electrical field strength on the order of 5 to 15 µV/m at any given time. Wave action will also induce electrical and magnetic fields at the water surface on the order of 10 to 100 µV/m and 1 to 10 mG (0.1 to 1 µT), respectively, depending on wave height, period, and other factors. While these effects dissipate with depth, wave action will likely produce detectable EMF effects up to 185 feet (56 m) below the surface (Slater et al. 2010).

At least seven submarine power and communications cables cross the project area in the SFEC-OCS and SFEC-NYS (NOAA 2011). Approximate cable paths crossing the SFEC corridor are shown in Figure 3.5 (displayed as pink wavy lines). While the type and capacity of those cables is not specified, the associated baseline EMF effects can be inferred from available literature. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 µV/m within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber-optic communications cables with optical repeaters would not produce EMF effects.

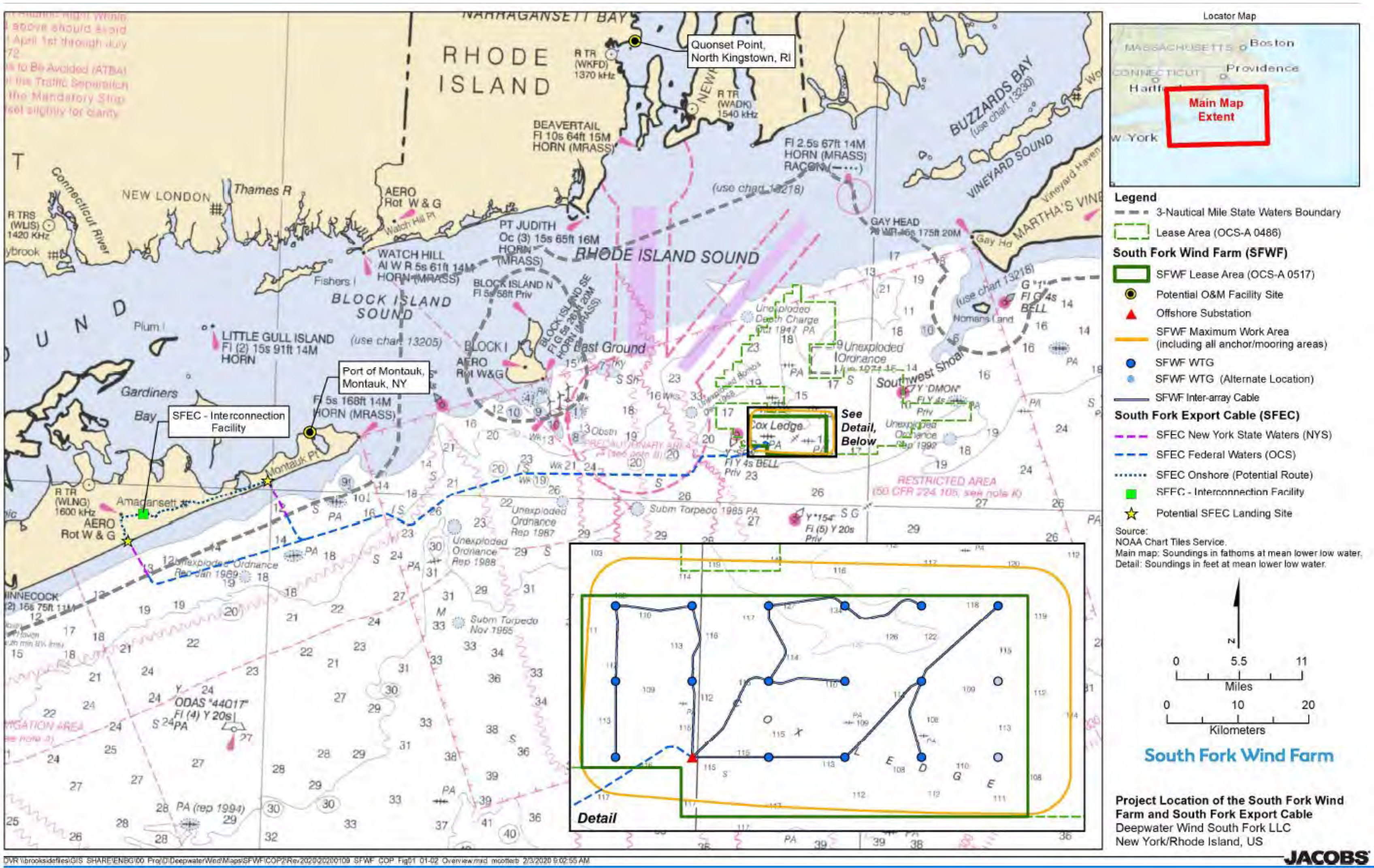

Figure 3.5. Charted depths and existing offshore cables within the project area and vicinity (Jacobs 2020).

4 Effects of the Action on Aquatic and Benthic Habitat

The Project includes three distinct phases, construction, O&M, and decommissioning, each having a specific range of environmental effects. Project decommissioning would occur at the end of the 30-year planned lifetime of the project and would be subject to separate EFH consultation at that time. Therefore, this EFH assessment only considers the effects on EFH resulting from project construction and O&M.

4.1 Project Construction

Project construction would result in short-term effects on the environment that could affect habitat suitability for managed species. Short-term effects range in duration from a few days to as long as 9 months, at which point the exposed habitats recover to prior levels of function. These effects include:

- Construction-related underwater noise impacts
- Crushing, burial, and entrainment effects
- Disturbance of bottom substrates, causing temporary elevation in water column suspended sediments and related water quality effects

The extent, severity, timing, and duration of short-term effects on aquatic habitats resulting from construction of the SFWF, SFEC, and O&M facility are described in the following sections.

4.1.1 Construction Noise Impacts

Popper et al. (2014) compiled available research on underwater noise effects on fish and other aquatic life and established thresholds for mortality and permanent injury, recoverable injury, and temporary threshold shift (TTS) for different types of noise sources based on life stages or hearing group specific sensitivity. NOAA (2016) identifies this resource as the current state of the science for characterizing underwater noise impacts on aquatic species.

Popper et al. (2014) have defined different thresholds for different fish species groups and life stages based on current understanding of sound sensitivity. Research on invertebrate sensitivity to underwater noise is more limited. Thresholds by sensitivity group are defined in the following sections. For the purpose of evaluating effects on EFH, any area exposed to construction-related underwater noise sufficient to cause lethal injury, recoverable injury, TTS, and/or behavioral effects is considered to be temporarily unsuitable for the affected fish or invertebrate species. This constitutes a temporary adverse effect on EFH lasting for the duration of the associated noise source.

Eggs and Larvae

Popper et al. (2014) defined eggs and larvae as a separate hearing group for the purpose of evaluating potential noise exposure thresholds on the basis that the sound sensitivity of these life stages is not well studied. Current understanding of noise impacts focuses on sensitivity to barotrauma and rectified diffusion injuries rather than hearing impacts. Noise effect thresholds for eggs and larvae used in this analysis are:

- Peak injury, lethal (L_{pk}): 210 dB re: 1 µPa
- Cumulative injury, lethal ($L_{E, 24hr}$): 207 dB re: 1 micro Pascal squared second (µPa^{2}s)
- Recoverable injury: None defined
- TTS: None defined
- Behavioral effects: Not applicable

Fish with Swim Bladder Involved in Hearing

Popper et al. (2014) identify specific injury thresholds for hearing specialist fish species. Hearing specialists are species such as Atlantic cod and other gadids that have a swim bladder that is directly connected to the inner ear through physiological structures or is in direct proximity to hearing organs and involved in hearing. Hearing specialization is often associated with intra-specific communication that can be disrupted by changes in the ambient noise environment. For example, spawning Atlantic cod communicate using low-frequency grunts to locate potential mates and signal fertility. Changes in ambient noise can interfere with communication and potentially disrupt spawning activity (Rowe and Hutchings 2006). Underwater noise sufficient to alter behavior or cause TTS could have disruptive effects on cod spawning (Dean et al. 2012).

Popper et al. (2014) and the Fisheries Hydroacoustic Working Group (FHWG 2008) define the following thresholds for instantaneous and cumulative injury, recoverable injury, TTS, and behavioral effects from exposure to impulsive noise sources like impact pile driving and HRG surveys:

- Peak injury, lethal (L_{pk}): 207 dB re: 1 µPa
- Cumulative injury, lethal ($L_{E, 24hr}$): 207 dB re: 1 µPa^{2}s
- Peak injury, recoverable (L_{pk}): 207 dB re: 1 µPa
- Cumulative injury, recoverable ($L_{E, 24hr}$): 203 dB re: 1 µPa^{2}s
- TTS ($L_{E, 24hr}$): 186 dB re: 1 µPa^{2}s
- Behavioral response (L_{pk}): 150dB re: 1 µPa

And for continuous noise sources like vessel engines, dredging, and vibratory pile driving:

- Lethal injury: Unlikely to occur
- Cumulative injury, recoverable ($L_{E, 48hr}$): 170 dB re: 1 µPa^{2}s
- TTS ($L_{E, 24hr}$): 158 dB re: 1 µPa^{2}s
- Behavioral response (L_{pk}): 150dB re: 1 µPa

Fish with Swim Bladder Not Involved in Hearing

Popper et al. (2014) identify specific injury thresholds for hearing generalist fish species. Hearing generalists are defined as those species having a swim bladder that is not directly involved with hearing. Popper et al. (2014) and FHWG (2008) define the following thresholds for instantaneous and cumulative injury, recoverable injury, TTS, and behavioral effects from exposure to impulsive noise sources like impact pile driving and HRG surveys:

- Peak injury, lethal (L_{pk}): 207 dB re: 1 µPa
- Cumulative injury, lethal ($L_{E,\ 24hr}$): 210 dB re: 1 µPa^{2}s
- Peak injury, recoverable (L_{pk}): 207 dB re: 1 µPa
- Cumulative injury, recoverable ($L_{E,\ 24hr}$): 203 dB re: 1 µPa^{2}s
- TTS ($L_{E,\ 24hr}$): 186 dB re: 1 µPa^{2}s
- Behavioral response (L_{pk}): 150dB re: 1 µPa

And for continuous noise sources like vessel engines, dredging, and vibratory pile driving:

- Lethal injury: Unlikely to occur
- Cumulative injury, recoverable ($L_{E,\ 48hr}$): Unlikely to occur
- TTS ($L_{E,\ 24hr}$): Unlikely to occur
- Behavioral response (L_{pk}): 150dB re: 1 µPa

Fish with No Swim Bladder

Popper et al. (2014) identify specific injury thresholds for fish species that lack swim bladders and gas-filled organs that are particularly sensitive to overpressure injuries. Popper et al. (2014) and FHWG (2008) define the following thresholds for instantaneous and cumulative injury, recoverable injury, TTS, and behavioral effects from exposure to impulsive noise sources like impact pile driving and HRG surveys:

- Peak injury, lethal (L_{pk}): 213 dB re: 1 µPa
- Cumulative injury, lethal ($L_{E,\ 24hr}$): 219 dB re: 1 µPa^{2}s
- Peak injury, recoverable (L_{pk}): 213 dB re: 1 µPa
- Cumulative injury, recoverable ($L_{E,\ 24hr}$): 216 dB re: 1 µPa^{2}s
- TTS ($L_{E,\ 24hr}$): 186 dB re: 1 µPa^{2}s
- Behavioral response (L_{pk}): 150dB re: 1 µPa

And for continuous noise sources like vessel engines, dredging, and vibratory pile driving:

- Lethal injury: Unlikely to occur
- Cumulative injury, recoverable ($L_{E,\ 48hr}$): 170 dB re: 1 µPa^{2}s
- TTS ($L_{E,\ 24hr}$): 158 dB re: 1 µPa^{2}s
- Behavioral response (L_{pk}): 150dB re: 1 µPa

Invertebrates

Noise thresholds for adult invertebrates have not been developed because of a lack of available data. In general, mollusks and crustaceans are less sensitive to noise-related injury than many fish because they lack internal air spaces and are less over-expansion or rupturing of internal organs, the typical cause of lethal noise related injury in vertebrates (Popper et al. 2001). Current research suggests that some invertebrate species groups, such as cephalopods (e.g., octopus, squid), crustaceans (e.g., crabs, shrimp), and some bivalves (e.g., scallops, ocean quahog) are capable of sensing sound through particle motion (Carroll et al. 2016; Edmonds et al. 2016; Hawkins and Popper 2014). Particle motion effects dissipate rapidly and are highly localized around the noise source. Studies of the effects of intense noise sources on invertebrates, similar in magnitude to those expected from Project construction, found little or no measurable effects even in test subjects within 3.3 feet (1 meter) of the source (Edmonds et al. 2016; Payne et al. 2007). Jones et al. (2020, 2021) evaluated squid sensitivity to high-intensity impulsive sound comparable to monopile installation. They observed that squid displayed behavioral responses to particle motion effects within 6.6 feet (2 meters) of high-intensity impulsive noise. They further theorized that squid in proximity to the seabed might be able to detect particle motion from impact pile driving imparted through sediments "several hundred meters" from the source, eliciting short-term behavioral responses lasting for several minutes. Other researchers have found evidence of cephalopod sensitivity to continuous low frequency sound exposure comparable to sound sources like vibratory pile driving (Andre et al. 2011).

Based on the available evidence, the following threshold distances are used to evaluate noise effects on EFH for invertebrates:

- Squid behavioral effects:
  - Within 1,640.4 feet (500 meters) of impact pile driving
  - Within 6.6 feet (2 meters) of HRG survey activities
- Bivalve behavioral effects:
  - Within 6.6 feet (2 meters) of impact pile driving

4.1.1.1 SFWF

DWSF characterized noise impacts anticipated to result from construction of the SFWF as part of COP development. Denes et al. (2021; COP Appendix J1) modeled the distance required to attenuate noise from impact pile driving and vessel noise below the various fish exposure thresholds identified above in Section 4.1.1. Zykov (2013) evaluated underwater noise impacts from HRG survey equipment and estimated the distance required to attenuate noise effects below various threshold ranges. These results are used herein to evaluate the extent of noise impacts from HRG surveys used to complete SFWF and SFEC construction.

Impact Pile Driving

The extent of underwater noise from impact pile driving for SFWF construction that exceeds the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.1. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.1.

Table 4.1. Extent of Underwater Noise Effects from Impact Pile Driving during SFWF Construction by Exposure Category and EFH Species Hearing Group

Exposure Category	EFH Species Category	26.2-foot (8-meter) Monopile Alternative Noise Exposure Area — acres (hectares)		36-foot (11-meter) Monopile Alternative Noise Exposure Area – acres (hectares)	
		Instantaneous	Total Cumulative	Instantaneous	Total Cumulative
Behavioral Effects	All finfish	118,749 (48,056)	201,171 (81,411)	120,928 (48,938)	204,037 (82,571)
	Squid	195 (79)	775 (314)	195 (79)	775 (314)
	Bivalves	< 0.02 (< 0.01)	0.9 (0.4)	< 0.02 (< 0.01)	0.9 (0.4)
TTS	All finfish	34,953 (14,145)	83,002 (33,590)	58,744 (23,773)	118,894 (48,115)
Recoverable Injury	Fish with swim bladder	262 (106)	6,365 (2,576)	163 (66)	7,455 (3,017)
	Fish with no swim bladder	42 (17)	124 (50)	326 (132)	346 (140)
Lethal Injury	Fish with swim bladder involved in hearing	262 (106)	1,618 (655)	163 (66)	7,455 (3,017)
	Fish with swim bladder not involved in hearing	262 (106)	558 (226)	163 (66)	2,839 (1,149)
	Fish with no swim bladder	42 (17)	0 (0)	12 (5)	183 (74)
	Eggs and Larvae	262 (106)	558 (226)	163 (66)	2,839 (1,149)

HRG Surveys

The extent of underwater noise from HRG surveys for SFWF and SFEC construction exceeding the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.2. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.1.

Table 4.2. Extent of Underwater Noise Effects from SFWF and SFEC HRG Surveys by Exposure Category and EFH Species Hearing Group

Habitat Exposure Category	EFH Species Category	HRG Survey Noise Exposure – SFWF and SFEC – acres (hectares)	
		Instantaneous	Total Cumulative
Behavioral Effects	All finfish	477 (193)	1,627,335 (658,559)
	Squid	< 0.002 (< 0.001)	4,151 (1,680) (SFWF and SFEC total)
	Bivalves	Insignificant	
TTS	All finfish	Within 16.4 feet (5 meters) of source	

Habitat Exposure Category	EFH Species Category	HRG Survey Noise Exposure – SFWF and SFEC – acres (hectares)	
		Instantaneous	Total Cumulative
Recoverable Injury	Fish with swim bladder	Insignificant	
	Fish with no swim bladder	Insignificant	
Lethal Injury	Fish with swim bladder involved in hearing	Insignificant	
	Fish with swim bladder not involved in hearing	Insignificant	
	Fish with no swim bladder	Insignificant	
	Eggs and Larvae	Insignificant	

Vessel Operations

The extent of underwater noise from construction vessel operations during SFWF construction exceeding the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.3. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.1.

Table 4.3. Extent of Underwater Noise Effects from SFWF Construction Vessels by Exposure Category and EFH Species Hearing Group

Habitat Exposure Category	EFH Species Category	Vessel Noise Exposure Area – acres (hectares)	
		Instantaneous	Total Cumulative
Behavioral Effects	All finfish	14.1 (5.7)	18,254 (7,378)
	Squid	Insignificant	
	Bivalves	Insignificant	
TTS	All finfish	Insignificant	
Recoverable Injury	Fish with swim bladder	Insignificant	
	Fish with no swim bladder	Insignificant	
Lethal Injury	Fish with swim bladder involved in hearing	Insignificant	
	Fish with swim bladder not involved in hearing	Insignificant	
	Fish with no swim bladder	Insignificant	
	Eggs and Larvae	Insignificant	

4.1.1.2 SFEC

DWSF characterized noise impacts anticipated to result from construction of the SFEC as part of COP development. Denes et al. (2021; COP Appendix J1) modeled the distance required to attenuate noise from vibratory pile driving and vessel noise below the various fish exposure thresholds identified above in Section 4.1.1. Information sources used to characterize noise effects from HRG surveys supporting SFEC construction are described in Section 4.1.1.1.

Vibratory Pile Driving

The construction of the SFEC sea-to-shore transition may involve the use of vibratory pile driving to install a temporary cofferdam. Denes et al. (2021) estimated the distance required to attenuate vibratory pile driving noise below the various impact thresholds described in Section 4.1.1. They determined that vibratory pile driving was unlikely to result in permanent injury to any hearing group but could result in recoverable injury and TTS effects on fish within the immediate proximity of the activity. Vibratory pile driving would likely result in behavioral effects on fish and invertebrates, with the extent of these effects varying based on sound sensitivity. The estimated extent of underwater noise from vibratory pile driving exceeding the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.4. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.2.

Table 4.4. Extent of Underwater Noise Effects from Vibratory Pile Driving Used for SFEC Sea-to-Shore Transition Construction by Exposure Category and EFH Species Hearing Group

Habitat Exposure Category	EFH Species Category	Vibratory Pile Driving Noise Exposure Area – acres (hectares)
		Total Cumulative
Behavioral Effects	All finfish	420 (170)
	Squid	1.5 (0.6)
	Bivalves	0.37 (0.15)
TTS	All finfish	44.5 (18)
Recoverable Injury	Fish with swim bladder	2.5 (1)
	Fish with no swim bladder	Insignificant
Lethal Injury	Fish with swim bladder involved in hearing	Insignificant
	Fish with swim bladder not involved in hearing	Insignificant
	Fish with no swim bladder	Insignificant
	Eggs and Larvae	Insignificant

HRG Surveys

Underwater noise from HRG surveys was estimated based on the linear extent of survey kilometers required for SFWF and SFEC construction. The COP does not specify how the total survey effort is distributed across the SFWF and SFEC alternatives; therefore, a total effect area estimate for the entire HRG survey effort is provided by habitat exposure category in Table 4.2.

Vessel Operations

The extent of underwater noise from construction vessel operations during SFEC construction exceeding the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.5. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.2.

Table 4.5. Extent of Underwater Noise Effects from SFEC Construction Vessels by Exposure Category and EFH Species Hearing Group

Habitat Exposure Category	EFH Species Category	Hither Hills Alternative – acres (hectares)		Beach Lane Alternative – acres (hectares)	
		Instantaneous	Total Cumulative	Instantaneous	Total Cumulative
Behavioral Effects	All finfish	14.16 (5.73)	5,402 (2,186)	14.16 (5.73)	6,637 (2,686)
	Squid	Insignificant	Insignificant	Insignificant	Insignificant
	Bivalves	Insignificant	Insignificant	Insignificant	Insignificant
TTS	All finfish	Insignificant	Insignificant	Insignificant	Insignificant
Recoverable Injury	Fish with swim bladder	Insignificant	Insignificant	Insignificant	Insignificant
	Fish with no swim bladder	Insignificant	Insignificant	Insignificant	Insignificant
Lethal Injury	Fish with swim bladder involved in hearing	Insignificant	Insignificant	Insignificant	Insignificant
	Fish with swim bladder not involved in hearing	Insignificant	Insignificant	Insignificant	Insignificant
	Fish with no swim bladder	Insignificant	Insignificant	Insignificant	Insignificant
	Eggs and Larvae	Insignificant	Insignificant	Insignificant	Insignificant

4.1.1.3 O&M Facility

Available monitoring data (CalTrans 2015; Laughlin 2017) indicate that vibratory installation of 24-inch steel piles during O&M facility construction would generate comparable noise levels to those described by Denes et al. (2021) for SFEC sea-to-shore transition cofferdam construction, estimated at 185 dB $_{SEL}$ (sound exposure level) re 1 µPa^2/Hz at 1 meter. If required, impact hammer installation of 24-inch steel piles would generate impulsive sound levels of approximately 207 dB_{peak} and 193 root mean square decibels (dB_{RMS}) at a reference distance of 10 meters without attenuation (Laughlin 2005). The O&M facility construction plan does not currently include a noise attenuation system. Dredging vessels and equipment used for O&M facility construction and maintenance will generate non-impulsive underwater noise on the order of 145 dB_{RMS} at a reference distance of 50 meters (Reine et al. 2014). BOEM used these value to estimate the potential extent of underwater noise effects likely to result from facility construction. The maximum extent of potential noise effects was estimated using the practical spreading loss model:

$$R1 \text{ (in meters)} = R2 \text{ (in meters)}*10^{(TL/15)}$$

Where:

R1 = The distance required to achieve the desired TL

R2 = The reference distance for the noise source (varies by source)

TL = Transmission loss difference between the reference noise level and the target threshold (145 dB_{RMS} – threshold value)

The result of this formula provides a threshold exposure radius that BOEM used to estimate the extent of noise effects from the perimeter of the O&M facility, as constrained by surrounding shorelines. The practical spreading loss model is a simplified formula that tends to overestimate sound propagation, particularly in shallow water. Therefore, the noise effect area estimates generated are conservatively large compared to those produced by the sophisticated noise propagation model used by Denes et al. (2021). The extent of underwater noise from O&M facility construction that exceed the effect thresholds defined in Section 4.1.1 are summarized below in Table 4.6. The resulting effects on EFH are summarized by hearing group in Section 6.1.1.3.

Table 4.6. Extent of Underwater Noise Effects from Vibratory Pile Driving and Dredging and Construction Vessels Used for O&M Facility Construction by Exposure Category and EFH Species Hearing Group

Habitat Exposure Category	EFH Species Category	Vibratory Pile Driving Noise Exposure Area – acres (hectares)	Impact Pile Driving Noise Exposure Area – acres (hectares)[‡]	Dredging and Vessel Noise Exposure Area – acres (hectares)
Behavioral Effects	All finfish	237 (96)	621 (252)	2,315 (937)
	Squid	0.20 (0.08)	40.0 (16.2)	Insignificant
	Bivalves	0.37 (0.15)	0.37 (0.15)	Insignificant
TTS	All finfish	22.2 (9)	15.8 (6.4)	956 (387)
Recoverable Injury	Fish with swim bladder	1.7 (0.7)	0.8 (0.3)	0
	Fish with no swim bladder	1.7 (0.7)	0.1 (0.04)	0
Lethal Injury	Fish with swim bladder involved in hearing	Insignificant	0.03 (0.01)	Insignificant
	Fish with swim bladder not involved in hearing	Insignificant	0.02 (0.008)	Insignificant
	Fish with no swim bladder	Insignificant	Insignificant	Insignificant
	Eggs and Larvae	Insignificant	0.03 (0.01)	Insignificant

‡ Assuming 100 pile strikes in a given construction day as needed to complete installation of selected piles.

4.1.2 Crushing, Burial and Entrainment Impacts

Crushing, burial, and entrainment impacts have the potential to occur during construction of the SFWF, SFEC, and O&M facility. These impacts result from the physical placement and installation of project infrastructure, cable installation methods, vessel anchorage, and dredging at the O&M facility. Specific project and construction parameters considered in the assessment of crushing, burial, and entrainment impacts include:

- Installation of monopiles and associated scour protection
- Inter-array cable installation and protection
- Vessel anchoring
- SFEC cable installation and protection

- SFEC sea-to-shore transition construction
- O&M facility dredging and overwater structure improvements

The spatial extent of potential crushing, burial, and entrainment impacts was determined based on the permanent footprint of each of these project components, plus relevant temporary impact areas (e.g., vessel anchorage area, boulder relocation, installation disturbance).

Additional details on project elements related to crushing, burial, and entrainment impacts and the potential extents of these impacts are provided in the following sections.

4.1.2.1 SFWF

SFWF construction includes three main components that have the potential to result in crushing, burial, and entrainment impacts: monopile and scour protection placement, inter-array cable installation, and vessel anchoring.

Monopile Installation and Scour Protection

As discussed above in Section 2.1, Orsted is considering two options for monopile foundation diameter: 26.2 feet and 36 feet (8 meters and 11 meters). The scour protection required around the base of each monopile depends on the monopile diameter. Refer to Table 4.7 for associated diameters and areas of impact. The total spatial extent of impact includes the permanent footprint of the monopiles and scour protection, and seabed preparation including limited (up to 0.2 acre [0.1 hectare]) boulder relocation around the base of the monopiles. Potential crushing, burial, and entrainment impacts could occur throughout the total footprint estimated for each option.

Table 4.7. Total Area Exposed to Temporary Crushing, Burial, and Entrainment Impacts for SFWF Monopile Diameter Alternatives

Monopile Alternative	Maximum Construction Disturbance Footprint by Benthic Habitat Type – acres (hectares)			
	Complex	Potentially Complex	Non-complex	Total
26.2- foot (8-meter) diameter	240.24 (97.22)	44.48 (18.00)	204.95 (82.94)	198.17
36-foot (11-meter) diameter	236.75 (95.81)	43.59 (17.64)	202.13 (81.80)	195.25

Monopile installation will occur from a jack-up lift barge or derrick barge. Impacts related to vessel anchorage are discussed further below. Specific crushing or burial impacts that may occur during monopile installation could result from boulder relocation when clearing the installation site or from the pile driving of the monopile itself, as it contacts the substrate. Scour protection, consisting of engineered rock, will be placed from a fallpipe vessel or stone dumping vessel. This placement could crush or bury EFH species utilizing benthic or epibenthic habitat within the spatial extent defined above.

Inter-Array Cable Installation

Inter-array cable construction components that have the potential to result in crushing, burial, and entrainment impacts include site preparation, boulder relocation, hydroplow installation of the cable, and placement of cable protection. The estimated extent of these temporary impacts is 370.9 acres (150.1 hectares). Assuming a 20 percent contingency, the maximum potential spatial extent of these impact mechanisms is 445 acres (180.1 hectares). Impact area by benthic habitat type is summarized in Table 4.8. This area includes the permanent footprint of the cable and protection, along with temporary impacts associated with the installation. The inter-array cable installation will involve installation via a mechanical plow or jet plow to a depth of 4 to 6 feet (1.2 to 1.8 meters). Use of the jet plow would result in potential entrainment impacts through surface-oriented water intake, in addition to the crushing and burial impacts possible through use of the mechanical plow. The permanent footprint of the inter-array cable is 2.5 acres (1 hectare); temporary disturbance due to the installation is 85 acres (34.4 hectares), assuming a 32.8-foot (10-meter) disturbance corridor along the entire length of the cable 21.4 linear miles (34.4 km, 18.6 nm). Cable protection associated with the inter-array cable is estimated to be required along 10 percent of the cable length, in addition to the 300 feet (91.4 meters) approaching each foundation. Placement of the concrete matting, fronded mattresses, rock bags, or rock for this cable protection would result in up to 20.5 acres (8.3 hectares) of crushing and burial impacts. Boulder relocation along the length of the cable would result in an additional 255 acres (103.2 hectares) of potential crushing or burial impacts. This estimation assumes a 131.2-foot (40-meter) corridor centered on the cable route in which boulder relocation may be required.

Table 4.8. Total Area Exposed to Temporary Crushing, Burial, and Entrainment Impacts during Inter-Array Cable Installation

Parameter	Maximum Construction Disturbance Footprint by Benthic Habitat Type – acres (hectares)			
	Complex	Potentially Complex	Non-complex	Total
Estimated impact area	155.2 (62.8)	37.0 (15.0)	178.6 (72.3)	150.1
Estimated impact area with 20% contingency	186.3 (75.4)	44.5 (18.0)	214.2 (86.7)	180.1

Vessel Anchoring

Vessel anchorage within the SFWF work area may result in crushing or burial impacts. The COP states that the potential spatial extent of bed disturbance from vessel anchoring is 821 acres (332 hectares). Actual estimates of temporary disturbance from anchoring depend on the vessel and activity. The derrick barge crane vessel used during monopile installation could disturb 9.1 acres (3.7 hectares) of seabed per monopile, due to placement of its 8-point, 12-ton delta flipper anchor twice at each foundation. Vessels that utilize anchors (rather than spud cans) to hold position generally have a greater potential to disturb the seabed and result in crushing or burial impacts.

Aside from monopile installation activities, vessels within the SFWF work area would primarily use dynamic positioning systems to hold position and would not have any crushing or burial impacts.

4.1.2.2 SFEC

SFEC construction includes three main components that have the potential to result in crushing, burial, or entrainment impacts: cable installation, cable protection, and the sea-to-shore transition.

SFEC Installation

As discussed above in Section 2.1, Orsted is considering two different landing sites for the SFEC: Hither Hills and Beach Lane. These options differ in the TL of cable that would be installed within federal waters. The difference in cable length results in proportionally different potential spatial extents of crushing, burial, or entrainment impacts. Refer to Table 4.9 for the cable lengths for each route option and associated impact area by benthic habitat type. These areas include both the permanent footprint of cable protection and the temporary disturbance area associated with cable installation. Cable will be installed to a depth of 4 to 6 feet (1.2 to 1.8 meters) via a mechanical plow or hydroplow. Entrainment impacts would occur through use of the jet plow, while crushing and burial impacts could occur as a result of either method. Temporary disturbance includes boulder relocation within 65.6 feet (20 meters) on each side of the cable centerline.

Table 4.9. Area of Crushing, Burial, and Entrainment Impacts for the SFEC Route Alternatives

SFEC Route Alternative	Total Length – linear miles (km, nm)	Estimate	Area of Potential Crushing, Burial, or Entrainment Impacts by Benthic Habitat Type – acres (hectares)			
			Complex	Potentially Complex	Non-complex	Total
Beach Lane	61.8 (99.5, 53.7)	Standard	371.6 (150.4)	9.4 (3.8)	292.6 (118.4)	272.7
		+20% contingency	446 (180.5)	11.4 (4.6)	351.1 (142.1)	327.2
Hither Hills	50 (80.4, 43.4)	Standard	363 (146.9)	9.4 (3.8)	237 (95.9)	246.6
		+20% contingency	435.6 (176.3)	11.4 (4.6)	284.4 (115.1)	295.9

Sea-to-shore Transition

The sea-to-shore transition will occur where the onshore segment of the SFEC (installed via HDD) meets the offshore segment of the SFEC. Cofferdam installation, dredging and sidecast, and vessel anchoring could result in crushing, burial and entrainment effects. The spatial extent of these potential crushing, burial, and entrainment impacts for the Beach Lane route alternative is 273.3 acres (110.6 hectares), all of which would be located in non-complex habitat. The spatial extent of impacts for the Hither Hills route alternative is 410.7 acres (166.2 hectares), 30.9 acres (12.5 hectares) in complex habitat and 379.8 acres (153.7 hectares) in non-complex habitat.

4.1.2.3 O&M Facility Construction

Construction at the O&M includes two components that may results in crushing, burial, or entrainment impacts: sheetpile installation and dredging operations.

Mooring Improvements

Installation of 6 24-inch diameter steel piles would expose 19 square feet (1.8 square meters [m^2]) of non-complex benthic habitat to crushing and entombment effects. The affected area would be dredged prior to pile installation (see below), meaning that any organisms within the affected footprint would likely have already been displaced or killed by dredging impacts.

Dredging Operations

Dredging at the O&M facility to a depth of -12.1 feet (-3.7 meters) MLLW would occur to allow for vessel berthing. The spatial extent of proposed dredging is 0.034 acre (0.014 hectare). Dredge entrainment impacts could occur throughout this area. Dredged materials would be dewatered in a contained area approximately 1,200 feet long by 26.2 feet wide (366 meters by 8 meters), placed landward of the plane of spring high water on the beach immediately to the west of the Montauk Harbor entrance. The dewatered materials would then be distributed adjacent to the dewatering area between the planes of mean high water and spring high water to nourish the beach.

4.1.3 Water Quality Impacts

The project could result in impacts on water quality through three mechanisms: temporary pulses of suspended sediments produced by bed disturbing activities, accidental spills from construction and O&M vessels, and releases of marine debris.

The latter two impact mechanisms are not expected to result in adverse effects on EFH and are not considered further in this assessment. The project includes EPMs and mitigation measures to avoid impacts on EFH from accidental spills and debris discharges during project construction and operation. The DWSF construction contractor would prepare and adhere to strict spill prevention, control, and countermeasures procedures during all Proposed Action phases, effectively avoiding the risk of substantial amounts of hydrocarbons entering the marine environment. BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with the construction and operation of offshore energy facilities (30 CFR 250.300). The USCG similarly prohibits the dumping of trash or debris capable of posing entanglement or ingestion risk (MARPOL, Annex V, Pub. L.100−220 (101 Stat. 1458)). Planned maintenance of the SFWF includes inspections for derelict fishing gear and other marine debris, which will be removed and transported to shore for upland disposal. Considering these planned EPMs and mitigation measures, the project is not likely to measurably alter the baseline levels of oil pollution and marine debris in the project area.

DWSF modeled suspended sediment effects from bed disturbance associated with the construction of the SFWF and SFEC as part of the COP. These results are presented in COP Appendix I (Vinhateiro et al. 2018) and summarized herein. Vinhateiro et al. (2018) developed a 3-dimensional hydrodynamic model and used project-specific bed substrate data to characterize initial TSS concentrations, plume dispersal, and depth of fine deposition resulting from inter-array cable and SFEC installation, and excavation and sidecast from the temporary cofferdam used to construct the SFEC sea-to-shore transition. The following specific project features were modeled:

- SFWF inter-array cable: A representative .9-linear-mile (1.4-km, .8-nm) segment excavated and reburied using a hydraulic trencher/mechanical plow
- SFEC: Excavation and reburial of a 61.1-linear-mile (98.3-km, 53-nm) section of the Beach Lane alternative route
- SFEC sea-to-shore transition: Excavation of the construction site using a suction/vacuum dredge with sidecast into adjacent surface waters.

For the EFH assessment, BOEM extrapolated the Vinhateiro et al. (2018) results for the modeled inter-array cable segment to the entire 21.4-linear-mile (34.4-km, 18.6-nm) length of the inter-array cable, and the modeled results for the SFEC Beach Lane route to the 48.7-linear mile (78.4-km, 42.3-nm) Hither Hills route. Comparison of the substrate conditions in the modeled segments to the remainder of the inter-array cable path and the divergent segment of the SFEC Hither Hills route (COP Appendix H1 [Fugro 2018]; COP Appendix N2 [Inspire Environmental 2020a]) indicates that substrate conditions on the extrapolated segments are generally similar to the modeled Beach Lane segment and would therefore likely produce similar suspended sediment effects per unit length. The modeled sediment impacts predicted by Vinhateiro et al. (2018) comport with observed TSS and sediment effects resulting from construction of the transmission cable for the Block Island Windfarm (Elliot et al. 2017) and are therefore considered usefully representative of likely construction effects.

In addition to the offshore components of the SFWF and SFEC, the construction of the SFWF O&M facility would require dredging of the 0.86-acre (0.35-hectare) berthing area from the existing depth of -5 feet (-1.5 meters) MLLW to the desired depth of -12.1 feet (-3.7 meters) MLLW. Dredging would produce localized TSS and sediment deposition effects within and in proximity to the construction site. TSS and sediment deposition effects resulting from O&M facility dredging are estimated from the available literature on dredging effects as described below.

4.1.3.1 SFWF

Vinhateiro et al. (2018) modeled a representative .9-linear-mile (1.4-km, .8-nm) segment of inter-array cable in the center of the SFWF that bisects a mix of sand and muddy sand, coarser sediments, and glacial moraine bed types. Modeled TSS concentrations and plume dispersal are shown in Figure 4.1. As shown, the modeled sediment plume from hydroplow excavation and reburial remains close to the seabed and the maximum TSS concentrations in the plume are relatively modest, ranging from 82 to 100 mg/L depending on current conditions at the seabed. Vinhateiro et al. (2018) modeled the area exposed to sediment deposition in three depth categories: 0.12 inch (3 millimeters [mm]), 0.4 inch (10 mm), and 1.2 inches (30 mm). These results are extrapolated to the entire 21.4-linear-mile (34.4-km, 18.6-nm) length of the inter-array cable in Table 4.10. As shown, the maximum predicted depth of sediment deposition is less than 1.2 inches (30 mm), with approximately 464 acres (188 hectares) exposed to 0.4 inch (10 mm) of sediment deposition, and 2,268 acres (918 hectares) exposed to 0.1 inch (3 mm) of deposition. These burial effects would be limited to within 29.5 to 98.4 feet (9 to 30 meters) of the cable path, respectively. These results indicate that sediment deposition effects are relatively modest, with burial depths generally limited to less than 3.4 inches (1 centimeter ([cm]) in the immediate vicinity of the cable path.

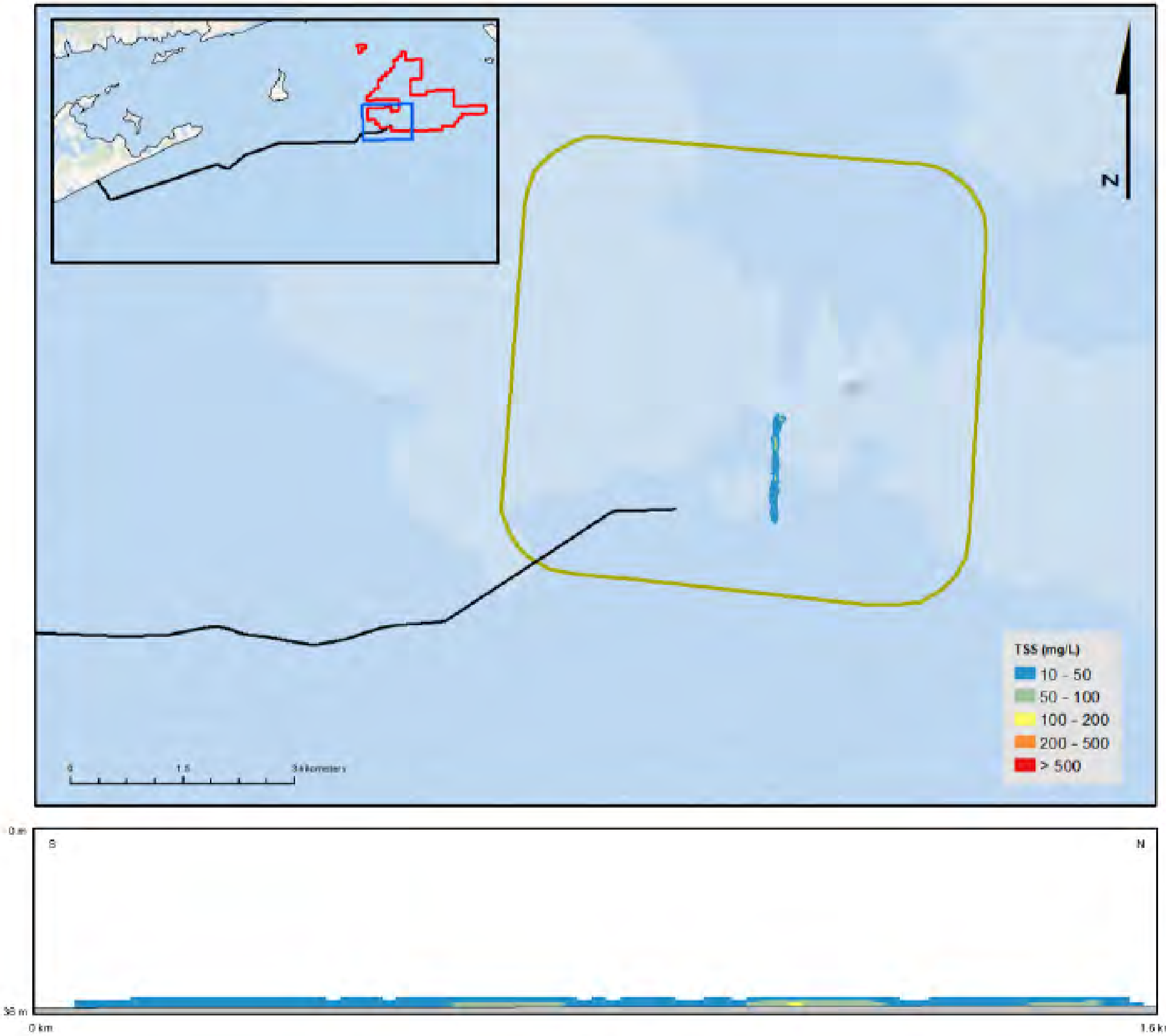

Figure 4.1. Modeled cumulative TSS concentrations (mg/L) and plume dispersal during for inter-array cable installation between two potential WTG locations. Top: plan view showing concentrations within the SFWF work area. Bottom: cross section of TSS plume dispersal along the burial route from south (left) to north (right). Maximum TSS concentrations during plume dispersal range from 82 to 100 mg/L depending on tidal current conditions. Source: Vinhateiro et al. (2018).

Table 4.10. Modeled Maximum TSS Concentrations and Estimated Extent of Sediment Deposition Effects from Inter-Array Cable Construction

Maximum TSS concentration	Area of Deposition Exceeding		Maximum Distance from Cable Path
82-100 mg/L within 5 feet (1.5 meters) of seabed	0.1 inch (3 mm)	Approx. 2,268 acres (918 hectares)	127.9 feet (39 meters)
	0.4 inch (10 mm)	Approx. 464 acres (188 hectares)	26.2 feet (8 meters)
	1.2 inches (30 mm)	0 acres (0 hectares)	0 feet (0 meters)

4.1.3.2 SFEC

SFEC construction includes two components likely to generate extensive suspended sediment effects: installation of the SFEC using a hydroplow, and dredging and refilling of the horizontal directional drilling pit within the temporary cofferdam at the SFEC sea-to-shore transition.

SFEC Installation

Vinhateiro et al. (2018) modeled cumulative TSS concentrations and sediment plume dispersal from hydroplow excavation and reburial of a 61.1-linear-mile (98.3-km, 53.1-nm) section of the SFEC Beach Lane alternative route. This SFEC route traverses a diversity of substrates, including two segments between the SFWF and the divergence point for the Hither Hills route alternative dominated by silt and mud sediments. These segments are clearly visible in the TSS plume dispersal modeling results displayed in Figure 4.2, generating the most extensive modeled sediment dispersal plumes and TSS concentrations ranging as high as 1,347 mg/L within 8.2 feet (2.5 meters) of the seabed. These effects are muted landward the divergence point for the Beach Lane and Hither Hills routes where sediments generally range to coarser sands. Substrate conditions on the Hither Hills route are similar to the Beach Lane route landward of the divergence point, with a slightly higher frequency of coarse sediment (Fugro 2018; Inspire Environmental 2020a; Vinhateiro et al. 2018). Based on these similar conditions, BOEM used the modeled results for the Beach Lane route to extrapolate the extent of sediment deposition for the Hither Hills route. Maximum predicted TSS effects from SFEC construction and estimated deposition depths for each route are presented in Table 4.11.

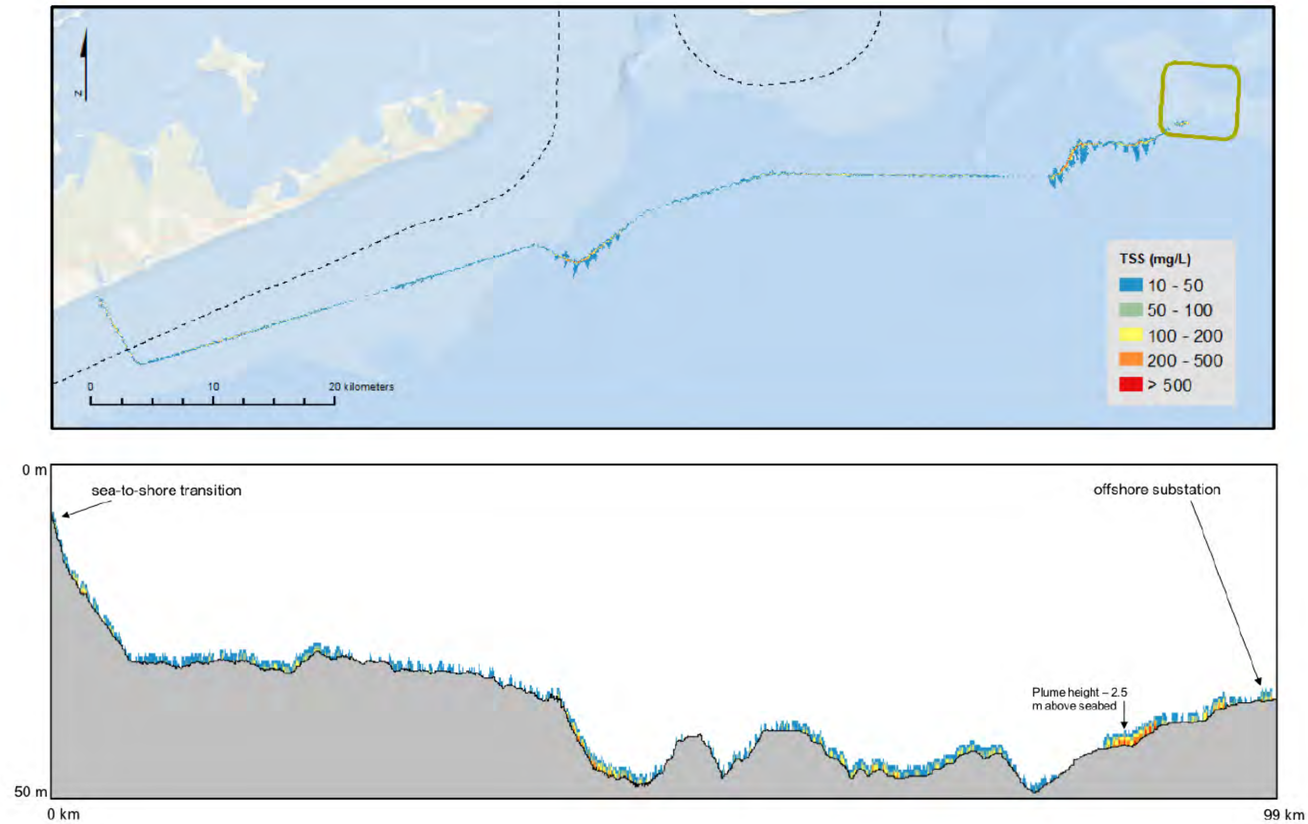

Figure 4.2. Modeled cumulative TSS concentrations (mg/L) for SFEC installation, Beach Lane Alternative. Top: plan view showing concentrations over the full burial route. Bottom: cross section views along the SFEC corridor between the sea-to-shore transition (left) and OSSPAM at the SFWF (right). The maximum TSS concentration over the full simulation period is 1,347 mg/L.

Table 4.11. Modeled Maximum TSS Concentrations and Estimated Extent of Sediment Deposition Effects from the SFEC Beach Lane and Hither Hills Route Alternatives

Maximum TSS concentration	Area of Deposition Exceeding	SFEC Route Alternative		Maximum Distance from Cable Path
		Beach Lane	Hither Hills	
1,347 mg/L within 8.2 feet (2.5 meters) of seabed	0.1 inch (3 mm)	1,030 acres (417 hectares)	Approx. 804.6 acres (325.6 hectares)	115 feet (35 meters)
	0.4 inch (10 mm)	4.2 acres (1.7 hectares)	Approx. 4.2 acres (1.7 hectares)	29.5 feet (9 meters)
	1.2 inches (30 mm)	0 acres (0 hectares)	0 acres (0 hectares)	0 feet (0 meters)

Sea-to-Shore Transition

Vinhateiro et al. (2018) modeled maximum TSS concentrations, suspended sediment dispersal, and deposition depths resulting from dredging and sidecast from the Beach Lane sea-to-shore transition site. The modeled scenario assumed that the site would be dredged to depth prior to placement of the temporary cofferdam, meaning that the results may overestimate the extent of predicted effects. Estimated TSS concentrations and plume dispersal are shown in Figure 4.3. Modeled maximum sediment concentrations and the predicted extent of sediment deposition effects are summarized in Table 4.12. The maximum TSS concentration reaches 562 mg/L at the point of dredging under spring tide conditions, dissipating rapidly within approximately 328 feet (100 meters) of the activity. As with the other forms of construction-related bed disturbance, the dispersal modeling indicates that the height of the TSS plume would generally be limited to within 6.6 feet (2 meters) above the seabed. The predicted extent of significant sediment deposition is limited to less than 5 acres (2 hectares), with 1.19 acres (0.48 hectare) exposed to burial depths greater than 1.2 inches (30 mm), approximately 1.38 acres (0.56 hectare) exposed to burial depths between 0.4 and 1.2 inches (10 and 30 mm), and 2.37 acres (0.96 hectare) exposed to burial depths less than 0.4 inch (10 mm). These results are considered to be representative of potential sea-to-shore transition construction effects for both the Beach Lane and Hither Hills route alternatives.

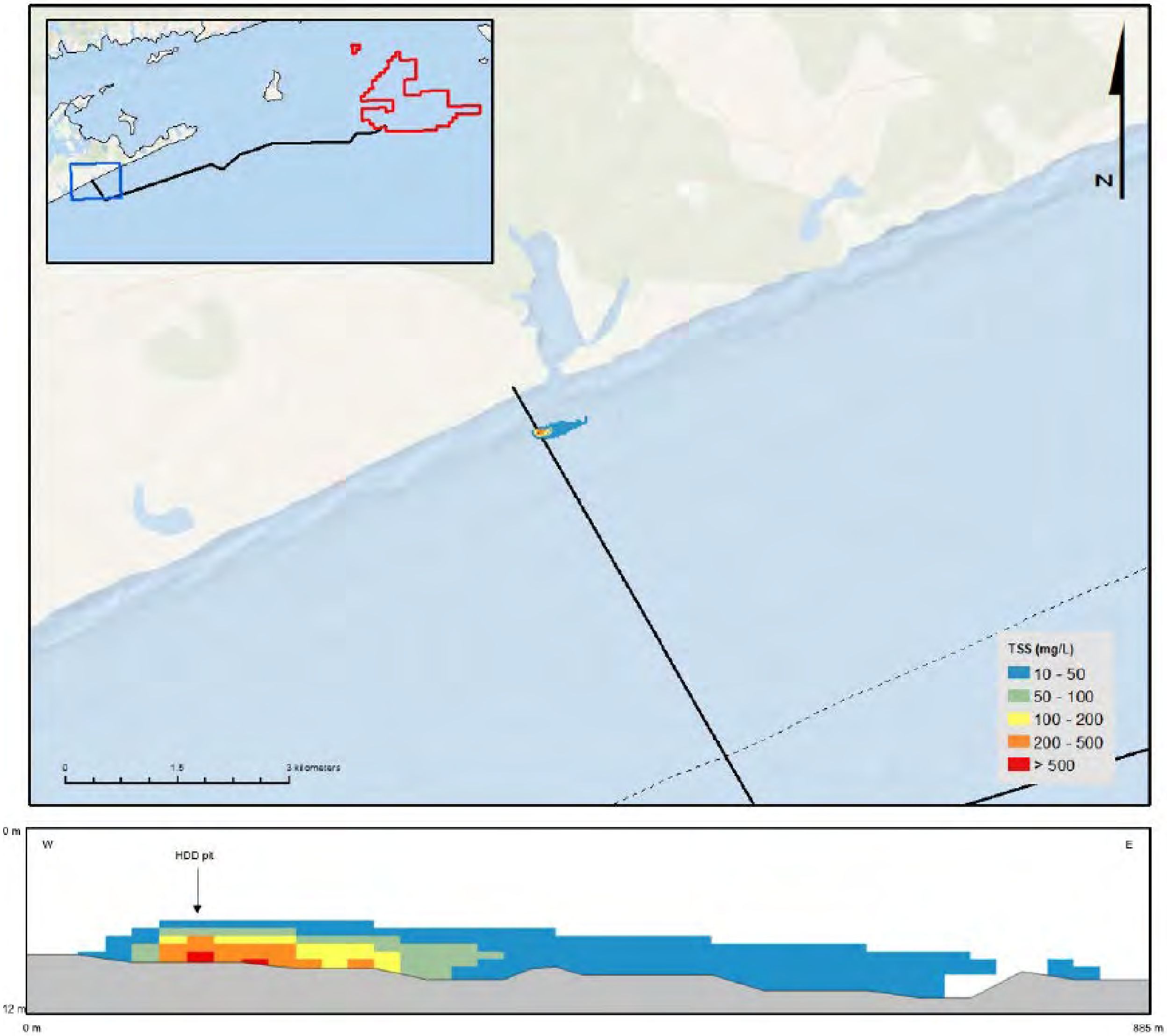

Figure 4.3. Modeled cumulative TSS concentrations (mg/L) for SFEC sea-to-shore transition construction. Top: plan view of plume concentrations. Bottom: cross section views of plume concentrations from west to east. The maximum TSS concentration over the full simulation period is 562 mg/L.

Table 4.12. Modeled Maximum TSS Concentrations and Estimated Extent of Sediment Deposition Effects from Sea-to-Shore Transition Construction

Maximum TSS concentration	Area of Deposition Exceeding		Maximum Distance from Dredging and Sidecast
562 mg/L within 6.6 feet (2 meters) of seabed	0.1 inch (3 mm)	Approx. 2.37 acres (0.96 hectare)	213.3 feet (65 meters)
	0.4 inch (10 mm)	Approx. 1.39 acres (0.56 hectare)	177.1 feet (54 meters)
	1.2 inches (30 mm)	1.19 acres (0.48 hectare)	144.4 feet (44 meters)

4.1.3.3 O&M Facility

Construction of the SFWF O&M facility includes dredging of a 0.034-acre (0.014-hectare) berthing area from -5 feet to -12.1 feet (-1.5 to -3.7 meters) MLLW. Anchor (2003) reviewed available literature on TSS levels generated by different types of dredging equipment and determined that typical maximum concentrations range from 282 to 485 mg/L depending on equipment type. This generally comports with the 562 mg/L concentration modeled by Vinhateiro et al. (2018) for dredging at the sea-to-shore transition site. The USACE (2020) evaluated potential suspended sediment effects from maintenance dredging of the federal Montauk Harbor navigation channel and determined that sediment plumes from cutterhead dredging would be limited to the bottom 6.6 feet (2 meters) of the water column, with maximum TSS concentrations of 282 mg/L dissipating to background within 1,148.3 feet (350 meters) of dredging activity. Given uncertainty about the potential type of dredging equipment used, potential TSS plumes from O&M facility construction are estimated to extend between 984.3 and 3,937 feet (300 and 1,200 meters) from the source for the purpose of this EFH assessment.

The O&M facility would be dredged annually to maintain a depth of at least -12.1 feet (-3.7 meters) MLLW over the life of the facility. TSS and sedimentation impacts of similar magnitude to those described above would be expected to occur on an annual basis.

4.2 Project Operation and Maintenance

Project construction would result in long-term effects on the environment that could affect habitat suitability for managed species. Long-term effects are those effects expected to last at least 1 year and could extend through the 30-year life of the project or longer. These effects include:

- Habitat conversion and associated effects on community structure and food web dynamics
- Operational noise effects
- EMF and heat effects from the inter-array and SFEC
- Hydrodynamic effects from the SFWF monopile foundations

The extent, severity, timing, and duration of long-term effects on aquatic habitats resulting from operation and maintenance of the SFWF, SFEC, and O&M facility are described in the following sections.

4.2.1 Long-Term Habitat Conversion

The installation of the SFWF and SFEC would alter water column and benthic EFH used by a variety of mid-Atlantic OCS fish and invertebrate species. The placement of the monopile foundations, excavation and reburial of transmission cables, placement of scour and cable protection, and relocation of unavoidable boulders along the inter-array cable and SFEC corridors would produce long-term effects on benthic habitat of varying significance and duration. In some cases, existing habitats will be converted to new habitat types and this habitat conversion would be effectively permanent.

The construction of the O&M facility would require dredging of sand and mud substrates in the existing berthing area to the desired depth necessary to support the crew transport vessels. Once constructed, the berthing area would be dredged annually to maintain this desired depth.

Four different habitat types are considered for the purpose of quantifying habitat conversion impacts.

- Water column: Pelagic habitats altered by the presence of the vertical monopile surfaces
- Complex benthic habitat: Benthic habitats where ledge, megaclasts, boulders, cobbles, and pebbles dominate the sea floor, and may also include finer material (Section 3.1)
- Potentially complex benthic habitat: Benthic habitats that may contain a substantial portion of boulders, cobbles, and pebbles, and/or are contiguous with adjacent complex habitat, have backscatter signals indicative of potential coarse habitat, and lack sufficient groundtruthing to confirm habitat status (Section 3.1)
- Non-complex benthic habitat: Benthic habitats that do not include a substantial portion of sediments > .08 inch (2 mm) in diameter (Section 3.1)

The type, extent, and duration of potential habitat conversion effects on each of these habitat types are described by project component in the following sections.

4.2.1.1 SFWF

The construction of the SFWF would alter the existing condition of the water column and seabed habitats through the following mechanisms:

- Boulder relocation from inter-array cable corridor and around the monopile foundations to prepare the seabed for construction
- Installation of 16 26.2- to 36-foot (8- to 11-meter) monopile foundations
- Installation of boulder scour protection and concrete mattresses protecting exposed cable segments

SFWF habitat conversion impacts are summarized by category in Table 4.13 and described in the following sections.

Table 4.13. Habitat Conversion Impact Area by SFWF Project Feature and Habitat Type

Project Feature/ Alternative	Element	Impact Area by Habitat Type – acres (hectares)				Water Column (meter²)
		Complex Benthic	Potentially Complex Benthic Habitat	Non-complex Benthic Habitat	Total Benthic	
26.2 foot (8-meter) monopile alternative	Monopile foundation	0.10 (0.04)	0.02 (0.01)	0.07 (0.03)	0.08	12,000
	Scour protection	3.48 (1.41)	0.86 (0.35)	2.62 (1.06)	2.81	--
	Boulder relocation	240.24 (97.22)	44.48 (18.00)	204.95 (82.94)	198.17	--
	Total	***98.67***	***18.37***	***84.03***	***201.06***	***12,000***
36-foot (11-meter) monopile alternative	Monopile Foundation	0.20 (0.08)	0.05 (0.02)	0.12 (0.05)	0.15	16,000
	Scour protection	6.84 (2.77)	1.75 (0.71)	5.39 (2.18)	5.66	--
	Boulder relocation	236.80 (95.81)	43.59 (17.64)	202.13 (81.80)	195.25	--
	Total	***98.67***	***18.37***	***84.03***	***201.06***	***16,000***
Inter-array cable standard estimate	Scour protection	39.34 (15.92)	9.36 (3.79)	45.02 (18.22)	37.93	**--**
	Boulder relocation	91.38 (36.98)	21.80 (8.82)	105.39 (42.65)	88.45	**--**
	Total	***52.90***	***12.61***	***60.87***	***126.38***	***--***
Inter-array cable standard +20 percent contingency	Scour protection	47.20 (19.10)	11.24 (4.55)	54.02 (21.86)	45.52	**--**
	Boulder relocation	109.66 (44.38)	26.17 (10.59)	126.47 (51.18)	106.14	**--**
	Total	***63.48***	***15.14***	***73.04***	***151.66***	***--***

Monopile Foundations

The introduction of 16 monopile foundations would alter pelagic habitats in the offshore OCS by introducing vertical hard surfaces into the water column. The 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives would displace approximately 31,557 and 59,663 cubic yards (24,127 and 45,616 m^3) of pelagic habitat and introduce approximately 129,166 and 172,223 square feet (12,000 and 16,000 m^2) of new hard surfaces to the water column, respectively, assuming an average inundation depth of 98.4 feet (30 meters). Over time the monopiles would become colonized by sessile invertebrates, such as mussels, tunicates, anemones, and sponges, creating complex habitat. These new habitats could have a variety of effects on fish and other aquatic species occurring in the vicinity. For example, pelagically oriented juvenile and adult fish may be attracted to the complex habitats formed on the vertical structures in search of cover and foraging opportunities. Surface and pelagically oriented eggs and larvae would be exposed to filter-feeding invertebrates in open water habitats where they did not previously exist. Fish concentrations around the monopile habitats may attract marine mammals and commercial and recreational fishers. These food web effects are discussed further in Section 4.2.4.

The monopile foundations would also displace benthic habitat within their respective footprints. This impact would be effectively permanent, lasting for the lifetime of the project until the monopiles are removed. The total amount of benthic habitat displaced by 16 monopiles would vary depending on the selected pile diameter, ranging from 0.12 to 0.37 total acre (0.08 to 0.15

total hectare) for the 26.2-foot and 36-foot (8-meter and 11-meter) design alternatives, respectively. These impacts would be distributed by benthic habitat type as follows:

- Complex benthic habitat:
  - 26.2-foot (8-meter) monopile: 0.10 acre (0.04 hectare)
  - 36-foot (11-meter) monopile: 0.20 acre (0.08 hectare)
- Potentially complex benthic habitat:
  - 26.2-foot (8-meter) monopile: 0.02 acre (0.01 hectare)
  - 36-foot (11-meter) monopile: 0.05 acre (0.02 hectare)
- Non-complex benthic habitat:
  - 26.2-foot (8-meter) monopile: 0.07 acre (0.03 hectare)
  - 36-foot (11-meter) monopile: 0.12 acre (0.05 hectare)

Foundation and Cable Protection

A ring of large boulders would be placed around each SFWF monopile foundation for scour protection. DWSF estimates that each monopile would require no more than 2,694 m^2 (0.67 acres, 0.27 hectare) of scour protection regardless of pile diameter, totaling no more than 10.6 total acres (4.3 total hectares) for all 16 foundations. Additional scour protection would be placed around the inter-array cable approaches to each monopile, requiring an additional 6.94 or 13.99 acres (2.81 or 5.66 hectares) of rock blanket armoring for all 16 26.2-foot and 49.2-foot (8-meter and 15-meter) monopile alternatives, respectively. The actual amount of scour protection required for each foundation and cable approach will vary depending on site-specific sediment characteristics. For example, the scour protection footprint for a given turbine may be reduced if it overlaps complex benthic habitat composed of cobbles and boulders with limited scour risk.

Inspire Environmental (2021) developed detailed estimates of impacts to benthic habitats resulting from monopile installation and placement of scour protection in the SFWF at the proposed turbine locations. These impacts would be distributed among benthic habitat types as follows:

- Complex benthic habitat:
  - 0.10 to 0.20 acre (0.04 to 0.08 hectare) displaced by monopile foundations, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively
  - 3.48 to 6.84 acres (1.41 to 2.77 hectares) modified by scour and cable approach protection, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively
- Potentially complex benthic habitat:
  - 0.02 to 0.05 acre (0.01 to 0.02 hectare) displaced by monopile foundations, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively

    - 0.86 to 1.75 acre (0.35 to 0.71 hectare) modified by scour and cable approach protection, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively
- Non-complex benthic habitat:
    - 0.07 to 0.12 acre (0.03 to 0.05 hectare) displaced by monopile foundations, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively
    - 2.62 to 5.39 acres (1.06 to 2.18 hectares) modified by scour and cable approach protection, 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively

These values represent the best available estimate of scour protection needs based on generic site conditions. However, foundation micrositing and substrate conditions encountered during construction may change scour protection requirements from the estimates presented herein.

Exposed segments of the inter-array cable would be covered with concrete mattresses to provide protection against accidental damage by vessel anchors. The TL of the exposed segments is approximately 5.8 linear miles (9.3 km, 5 nm). Per the COP, each concrete mattress would be approximately 39.4 feet (12 meters) wide and would extend over the entire length of cable segments shallower than target burial depth. This equates to a total of 13.8 acres (5.6 hectares) of concrete mattress cable protection, distributed by benthic habitat type as follows:

- Complex benthic habitat: 39.34 to 47.20 acres (15.92 to 19.10 hectares) modified by concrete mattresses (standard estimate and standard + 20 percent contingency, respectively)
- Potentially complex benthic habitat: 9.36 to 11.24 acres (3.79 to 4.55 hectares) modified by concrete mattresses (standard estimate and standard + 20 percent contingency, respectively)
- Non-complex benthic habitat: 45.02 to 54.02 acres (18.22 to 21.86 hectares) modified by concrete mattresses (standard estimate and standard + 20 percent contingency, respectively)

The benthic habitat impact quantities presented herein are the best available estimates based on current understanding of the localized substrate conditions at each planned WTG location. The habitat impact quantities could diverge slightly from current estimates based on micrositing requirements and/or substrate conditions discovered during construction.

Boulder Relocation

SFWF construction would include the relocation of existing boulders in selected locations. Boulders within a 1,312.3-foot-diameter (400-meter-diameter) circle around each monopile foundation and within 46 feet (14 meters) of the inter-array cable centerline would be relocated to prepare the seabed for pile installation and hydroplowing. Boulders constitute complex benthic habitat; therefore, boulder relocation could potentially alter the composition of both the original and relocated habitat. Up to 751.97 acres (304.31 hectares) of seabed could be affected by boulder relocation, depending on the monopile diameter alternative selected. Boulder relocation impacts would be distributed by habitat type as follows:

- Complex benthic habitat:
    - 240.24 to 236.75 acres (97.22 to 95.81 hectares) for the 26.2-foot and 36-foot (8-meter and 11-meter) monopiles, respectively
    - 91.38 to 109.66 acres (36.98 to 44.38 hectares) for inter-array cable installation, standard estimate and standard +20 percent contingency, respectively
- Potentially complex benthic habitat:
    - 44.48 to 43.59 acres (18.00 to 17.64 hectares) for the 26.2-foot and 36-foot (8-meter and 11-meter) monopiles, respectively
    - 21.79 to 26.17 acres (8.82 to 10.59 hectares) for inter-array cable installation, standard estimate and standard +20 percent contingency, respectively
- Non-complex benthic habitat:
    - 204.95 to 202.13 acres (82.94 to 81.80 hectares) for the 26.2-foot and 36-foot (8-meter and 11-meter) monopiles, respectively
    - 105.39 to 126.47 acres (42.65 to 51.18 hectares) for inter-array cable installation, standard estimate and standard +20 percent contingency, respectively

4.2.1.2 SFEC

The construction of the SFWF would alter the existing condition of seabed habitats through the following mechanisms:

- Boulder relocation to prepare the seabed along SFEC cable corridor for hydroplowing
- Installation of concrete mattresses to protect exposed cable segments

SFEC habitat conversion impacts are summarized by category for the Hither Hills and Beach Lane route alternatives in Table 4.14 and described in the following sections. Once constructed, the SFEC would have no effect on the overlying water column habitats.

Table 4.14. Habitat Conversion Impact Area by Project Feature and Habitat Type for the SFEC Hither Hills and Beach Lane Route Alternatives

Design Alternative	Estimate	Project Feature	Benthic Impact Area by Habitat Type – acres (hectares)			
			Complex	Potentially Complex	Non-complex	Total
Hither Hills	Standard	Cable protection	58.86 (23.82)	1.26 (0.51)	59.80 (24.20)	48.53
		Boulder relocation	195.66 (79.18)	5.61 (2.27)	87.45 (35.39)	116.85
		Total	***103.00***	***2.78***	***59.59***	***165.38***
	Standard +20 percent contingency	Cable protection	70.62 (28.58)	1.51 (0.61)	71.76 (29.04)	58.24
		Boulder relocation	234.80 (95.02)	6.74 (2.73)	104.45 (42.47)	140.21
		Total	***123.60***	***3.34***	***71.51***	***198.45***
Beach Lane	Standard	Cable protection	62.79 (25.41)	1.26 (0.51)	84.78 (34.31)	60.22
		Boulder relocation	195.66 (79.18)	5.61 (2.27)	87.45 (35.39)	116.85
		Total	***104.59***	***2.78***	***69.70***	***177.07***
	Standard +20 percent contingency	Cable protection	75.34 (30.49)	1.51 (0.61)	101.73 (41.17)	72.27
		Boulder relocation	234.80 (95.02)	6.74 (2.73)	104.94 (42.47)	140.21
		Total	***125.50***	***3.34***	***83.64***	***212.48***

Cable Protection

Exposed segments of the SFEC would be covered with concrete mattresses to provide protection against accidental damage by vessel anchors. The TL of the exposed segments is approximately 3.2 and 1.9 linear miles (5.2 and 3.0 km, 2.8 and 1.6 nm) for the Beach Lane and Hither Hills route alternatives, respectively. Inspire Environmental (2021) estimated 148.81 to 178.58 acres (60.22 to 72.27 hectares) of concrete mattress cable protection would be required for the Beach Lane route alternative, distributed by benthic habitat type as follows:

- Complex benthic habitat: 62.79 to 75.34 acres (25.41 to 30.49 hectares) for the standard and standard +20 percent contingency, respectively
- Potentially complex benthic habitat: 1.26 to 1.51 acres (0.51 to 0.61 hectare) for the standard and standard +20 percent contingency, respectively
- Non-complex benthic habitat: 84.78 to 101.73 acres (34.31 to 41.17 hectares) for the standard and standard +20 percent contingency, respectively

A total of 119.92 to 143.91 acres (48.53 to 58.24 hectares) of concrete mattress protection would be required for the Hither Hills route alternative, distributed by benthic habitat type as follows:

- Complex benthic habitat: 58.86 to 70.62 acres (23.82 to 28.58 hectares) for the standard and standard +20 percent contingency, respectively
- Potentially complex benthic habitat: 1.26 to 1.51 acres (0.51 to 0.61 hectare) for the standard and standard +20 percent contingency, respectively

- Non-complex benthic habitat: 72.15 to 72.99 acres (29.20 to 29.54 hectares) for the standard and standard +20 percent contingency, respectively

Boulder Relocation

SFEC construction would include the relocation of existing boulders within 46 feet (14 meters) of the inter-array cable centerline to prepare the seabed for hydroplowing. Boulders constitute complex benthic habitat; therefore, boulder relocation could potentially alter the composition of both the original and relocated habitat. Boulder relocation would be required on 288.74 to 346.47 acres (116.85 to 140.21 hectares) of seabed with impacts distributed by habitat type as follows:

- Complex benthic habitat: 195.66 to 234.80 acres (79.18 to 95.02 hectares) for the standard and standard +20 percent contingency, respectively
- Potentially complex benthic habitat: 5.61 to 6.74 acres (2.27 to 2.73 hectares) for the standard and standard +20 percent contingency, respectively
- Non-complex benthic habitat: 87.45 to 104.94 acres (35.39 to 42.47 hectares) for the standard and standard +20 percent contingency, respectively

Boulder relocation requirements are identical for the Beach Lane and Hither Hills route alternatives.

4.2.1.3 O&M Facility

Construction of the O&M facility includes dredging of the 0.034-acre (0.014-hectare) berthing area from the existing depth of -5 feet (-1.5 meters) MLLW to a desired depth of -12.1 feet (-3.7 meters) MLLW and replacement of existing overwater vessel mooring structures. Placement of 6 24-inch steel piles would permanently displace approximately 19 square feet (1.8 m^2) of non-complex benthic habitat. The project would remove an existing 0.022-acre (0.009-hectare) overwater structure and replace it with a pontoon floating dock and aluminum gangway covering 0.039 acre (0.016 hectare), comprising a net increase of 0.017 acre (0.007 hectare) in overwater structure area.

Following initial deepening during construction, the 0.034-acre (0.018-hectare) berthing area would be dredged annually to maintain the desired depth of -12.1 feet (-3.7 meters) MLLW (-13.5 feet [-4.1 meters] MLLW with allowable overdredge). This would more than double the depth of the existing benthic habitat below the bed surface and maintain this depth over the life of the project. Routine dredging would also alter the suitability of this habitat for EFH species that use non-complex benthic habitats, particularly during egg and larval life stages that are vulnerable to dredging, entrainment, and turbidity effects. The existing benthic habitat within the dredge footprint is composed of sand and mud. No eelgrass, macroalgae or other submerged aquatic vegetation (SAV) is present within the dredging footprint but eelgrass beds and other SAV are present approximately 375 feet (114 meters) to the northwest and 900 feet (275 meters) to the south and southeast of the O&M facility footprint (Section 3.1).

4.2.2 Operational Noise

Operational underwater noise sources resulting from the project include the SFWF WTGs, maintenance vessels servicing the SFWF, and annual maintenance dredging of the O&M facility berthing area. Underwater noise effects generated by these project elements are described below.

The SFEC would produce no noise during operation and would not require planned maintenance. Therefore, there are no underwater noise effects anticipated from SFEC operation.

4.2.2.1 SFWF

The SFWF would produce continuous non-impulsive noise when the turbines are in operation, in the form of low-frequency sound transmitted from the direct drive generator through the steel monopile foundation into the environment. These noise effects would occur whenever the turbines are in operation over the 30-year lifespan of the project, interrupted only by periods where prevailing winds are below effective operational speed.

WTG Operation

The SFWF would employ current generation direct-drive WTG designs that are generally associated with lower underwater noise levels than older-generation WTGs with gearboxes. Much of the currently available information on operational noise is based on monitoring of older-generation designs employed in European windfarms. Although useful for characterizing the general range of WTG operational noise effects, this information is not necessarily representative of the noise effects produced by current-generation direct-drive systems (Elliot et al. 2019; Tougaard et al. 2020). Typical noise levels produced by older-generation geared WTGs range from 110 to 130 dB_{RMS} with 1/3-octave bands in the 12.5- to 500-Hz range, sometimes louder under extreme operating conditions (Betke et al. 2004; Jansen and de Jong 2016; Madsen et al. 2006; Marmo et al. 2013; Nedwell and Howell 2004; Tougaard et al. 2009). Operational noise increases concurrently with ambient wind and wave noise, meaning that noise levels usually remain indistinguishable from background within a short distance from the source under typical operating conditions.

More recently, Elliot et al. (2019) summarized findings from hydroacoustic monitoring of operational noise from the Block Island Wind Farm (BIWF). The BIWF is composed of five Haliade 150 6-MW direct-drive WTGs on jacketed foundations located approximately 18.6 linear miles (30 km, 16.2 nm) west of the proposed SFWF. Operational noise from the direct-drive WTGs at the Block Island Windfarm were generally lower than those observed for older generation WTGs. Elliot et al. (2019) presented a representative high operational noise scenario at an observed wind speed of 15 m/s (approximately 33 miles per hour). They determined that the operating turbines produced sound levels on the order of 110 to 125 dB_{RMS}, occasionally reaching as high as 128 dB_{RMS}, in the 10-Hz to 8-kHz range and particle acceleration effects on the order of 10 to 30 dB re 1 micrometer per second squared ($\mu m/s^2$) at a reference distance of 50 meters. These values are considered usefully representative of the underwater noise effects likely to result from SFWF operations.

Maintenance Vessel Operation

The SFWF would be routinely serviced by maintenance crews transported from the Montauk O&M facility on a 95-foot-long CTV. The CTV would transit the 42.8-linear-mile (68.9-km, 37.2-nm) corridor between the O&M facility approximately 7 times per month, or an estimated 2,500 vessel trips over the life of the project.

Underwater noise level produced by CTVs is estimated at 160 dB_{RMS} re: 1 micro Pascal per second squared ($\mu Pa/sec^2$) at a reference distance of 1 meter. This value is based on observed noise levels generated by working commercial vessels of similar size and class to the CTVs (Kipple and Gabriele 2003; Takahashi et al. 2019). 160 dB_{RMS} is below the injury thresholds described in Section 4.1.1 for all fish and invertebrate hearing groups, indicating that CTV noise is unlikely to cause injury-level effects on any fish species. This value does exceed the 158-dB threshold for TTS effects on hearing specialist fish species, but this threshold assumes 24 hours of continuous exposure. An individual fish is unlikely to remain in proximity to a moving CTV for extended periods; therefore, this type of exposure is unlikely to occur.

The 160 dB_{RMS} source level does exceed the 150 dB_{RMS} behavioral effects threshold, which assumes instantaneous exposure and applies to all juvenile and adult fish species. Applying the practical spreading loss model, underwater noise from the transport vessels would attenuate to the 150-dB threshold within 16.4 feet (5 meters) of the vessel hull. Assuming a 10-foot (3-meter) draft, this indicates that CTV operations could result in behavioral-level noise effects on individual fish that occur in near-surface (within 16.4 to 26.2 feet [5 to 8 meters]) along the 42.8-linear-mile (68.9-km, 37.2-nm) transit corridor.

4.2.2.2 O&M Facility

Sources of underwater noise from operation of the O&M facility include routine CTVs and annual maintenance dredging. Underwater noise from CTV operations would be the same as those described above, with the recognition that Montauk Harbor is a busy commercial port and with higher baseline underwater noise levels than those on the transit corridor to the SFWF. Because the O&M facility would displace berthing currently used by small fishing and other commercial vessels, the 7 CTV vessel trips per month are not likely to significantly increase baseline levels of vessel traffic and associated underwater noise within Montauk Harbor. Therefore, the underwater noise effects from CTV operations are likely to be insignificant relative to baseline conditions.

Annual maintenance dredging of the O&M facility would generate underwater noise levels in excess of baseline. These noise effects would be similar to those described for construction dredging in Section 4.1.1.3.

4.2.3 EMF and Heat Effects

The SFWF inter-array cable and SFEC would generate EMF effects and heat when transmitting electricity. The O&M facility includes no features that would generate significant EMF effects. Once operational, the SFEC and SFWF inter-array cable would generate induced magnetic field and electrical field effects at and near the seabed along their respective lengths. Electricity transmission through the cables would also generate heat, sufficient to increase the temperature of the surrounding sediments and potentially the water column in immediate proximity to the cable. These effects would be most intense at locations where the cables cannot be buried and are laid on the bed surface covered by an armoring blanket.

The COP considers two design alternatives for each transmission cable: a 34.5- or 66-kV design for the inter-array cable, and a 138-kV or 230-kV design for the SFEC. COP Appendix K1 (Exponent Engineering 2018) presents results for the modeled EMF effects from the 34.5-kV and 138-kV alternatives for the inter-array cable and SFEC, respectively. They concluded that the modeled alternatives would produce EMF effects equivalent or greater than the 66-kV and 230-kV alternatives, respectively, due to differences in transmission amperage. Therefore, the results presented herein are representative of the EMF effects that could result from each inter-array cable and SFEC design alternative. All cable design alternatives would transmit electricity as high voltage alternating current (HVAC) at a frequency of 60 Hz, an important factor to consider when evaluating potential biological effects.

The following metrics are used to evaluate potential EMF and heat effects:

- Magnetic field strength, measured in mG
- Electrical field strength, measured in µV/m
- Induced electrical field strength, receptor specific based on body size, measured in µV/m
- Substrate heating effect, measured in degrees Celsius above ambient (+ degrees Celsius [°C])

The magnitude, extent, and duration of EMF effects from the SFWF inter-array cable and the SFEC are described below.

EMF effects must be considered in context with baseline EMF conditions within the project area and vicinity. The earth’s magnetic field strength in the vicinity of the SFWF and SFEC at the seabed is on the order of 5,100 mG (NOAA 2018b). Following the methods described by Slater et al. (2010), a uniform current of 1 m/s flowing at right angles to the natural magnetic field in the action area could induce a steady-state electrical field on the order of 51.5 µV/m. Modeled current speeds in the action area are on the order of 0.1 to 0.35 m/s at the seabed (Vinhateiro et al. 2018), indicating baseline current-induced electrical field strength on the order of 5 to 15 µV/m at any given time. Wave action would also induce electrical and magnetic fields at the water surface on the order of 10 to 100 µV/m and 1 to 10 mG, respectively, depending on wave height, period, and other factors. Although these effects dissipate with depth, wave action would likely produce detectable EMF effects up to 184 feet (56 meters) below the surface (Slater et al. 2010).

4.2.3.1 SFWF

The inter-array cable would be a 34.5-kV or 66-kV, 3-phase AC cable. The desired transmission voltage will be determined based on the final WTG specifications selected for the SFWF. The inter-array cable would be contained in grounded metallic shielding to minimize electrical field effects and buried to target depths of 4 to 6 feet (1.2 to 1.8 meters). Cable segments that cross unavoidable hard substrates will not be buried and will be laid on the bed surface covered with a concrete mattress for protection. EMF effects in these areas would be greater than for buried cable segments. EMF diminishes rapidly with distance and would become indistinguishable from baseline conditions within 26.2 feet (8 meters) of both buried and exposed cable segments (Exponent Engineering 2018). Induced magnetic and electrical field effects for buried and exposed segments of the inter-array cable are summarized in Table 4.15.

Hughes et al. (2015) and Emeana et al. (2016) evaluated the thermal effects of buried electrical transmission cables on the surrounding seabed. They determined that the surrounding water would rapidly dissipate heat from exposed cable segments, resulting in minimal heat effects on the underlying substrates. In contrast, buried cables can significantly increase the temperature of the surrounding sediments, with the magnitude and extent of heating effects varying depending on transmission voltage and sediment permeability. In medium to low permeability sediments (e.g., sand and mixed sand/mud), the typical buried HVAC electrical cable will heat the surrounding sediments within 1.3 to 2 feet (0.4 to 0.6 meters) of the cable surface by +10 to 20°C above ambient conditions (Table 4.15). Temperature effects diminished rapidly with distance beyond these points, suggesting that burial of the transmission cables to target depths of 4 to 6 feet (1.2 to 1.8 meters) would avoid adverse thermal effects on EFH shellfish species.

Table 4.15. Induced Magnetic and Electrical Field Effects from Buried and Exposed Segments of the SFWF Inter-Array Cable

Installation	Total Cable Length – linear miles (km, nm)	Magnetic Field		Electrical Field		Substrate Heating
		At seabed	1 m above seabed	At seabed	1 m above seabed	
Buried to Target depth	15.6 (25.1, 13.6)	21 mG	9 mG	1.4 µV/m	0.9 µV/m	+10 to +20°C within 0.4 to 0.6 m of cable
On bed surface	5.8 (9.3, 5)	65.1 Mg	27.9 mG	4.3 µV/m	2.8 µV/m	

4.2.3.2 SFEC

The SFEC would be a 138-kV or 230-kV 3-phase AC cable operating at 60 Hz. The desired transmission voltage will be determined based on the final WTG specifications selected for the SFWF. Like the inter-array cable, the SFEC would be contained in grounded metallic shielding to minimize electrical field effects and buried to target depths of 4 to 6 feet (1.2 to 1.8 meters).

Cable segments that cross existing transmission lines and unavoidable areas of hard substrate will not be buried and will be laid on the bed surface covered with a concrete blanket for protection. EMF effects in these areas will be greater than for buried cable segments. EMF diminishes rapidly with distance and would become indistinguishable from baseline conditions within 26.2 feet (8 meters) of both buried and exposed cable segments (Exponent Engineering 2018). There are 7 existing transmission lines on the SFEC cable path common to both the Hither Hills and Beach Lane route alternatives.

Anticipated EMF and heat effects from the SFEC Hither Hills and Beach Lane route alternatives are summarized in Table 4.16. The potential heat effects are expected to be similar to those described above for the inter-array cable, based on available research on the observed and modeled heating effects of buried undersea cables (Emeana et al. 2016; Hughes et al. 2015).

Table 4.16. Induced Magnetic and Electrical Field Effects from Buried and Exposed Segments of the SFWF Inter-Array Cable

Installation	Total Cable Length		Magnetic Field		Electrical Field		Substrate Heating
	Hither Hills Alterative – linear miles (km, nm)	Beach Lane Alternative – linear miles (km, nm)	At seabed	1 m above seabed	At seabed	1 m above seabed	
Buried to Target depth	48.1 (77.4, 41.8)	58.6 (94.3, 50)	30 mG	21 mG	2.1 mV/m	1.4 mV/m	+10 to +20°C within 0.4 to 0.6 m of cable
On bed surface	1.9 (3.0, 1.6)	3.2 (5.2, 2.8)	76.6 mG	53.6 mG	5.4 mV/m	3.6 mV/m	

4.2.4 Hydrodynamic Effects

Placement of monopiles and WTGs has the potential to influence local hydrodynamics. By adding vertical structure that spans the water column, there is potential for alteration to vertical and horizontal water velocity and circulation. Rhode Island Sound and the SFWF area are considered seasonally stratified, with warmer waters and higher salinity leading to strong stratification in the late summer and early fall. Storms and upwelling in the fall result in increased mixing and deterioration of the stratified layers. Presence of the monopiles in the water column can introduce small-scale mixing and turbulence that also results in some loss of stratification (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing towards stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). On the Middle Atlantic Bight, increased mixing could influence the strength and persistence of the Cold Pool, a band of cold, near-bottom water that exists at depth from the spring to fall. However, the turbulence introduced by each monopile is not expected to significantly affect the Cold Pool due to the strength of the stratification [temperature differences between the surface and the Cold

Pool reach 10°C (Lentz 2017)]. Temperature anomalies created by mixing at each monopile would likely resolve quickly due to strong forcing towards stabilization (Schultze et al. 2020).

In addition to potential effects to stratification, monopiles can also influence current speed and direction. Monopile wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). The turbulence of tidal current wakes resulting from the presence of the monopile was found to decrease logarithmically moving away from the monopile (Li et al. 2014). Thus, while impacts to current speed and direction decrease rapidly, there is evidence of hydrodynamic effects out to a kilometer away from a monopile. This evidence is in contrast to other work that suggests the influence of a monopile is primarily limited to within 328 to 656 feet (100 to 200 meters) of the pile (Schultze et al. 2020). The discrepancy likely relates to local conditions, wind farm scale, and sensitivity of the analysis. Relevant here are the impacts that could reduce the suitability of EFH for managed species.

Evidence on the spatial extent of impacts is largely equivocal. NOAA consensus on other projects in the region is that effects would be limited to within a few hundred meters of the monopile (NMFS 2019). Here, the conservative assumption is made that effects could occur within 656 to 1,312.3 feet (200 to 400 meters) downstream of each monopile. Given the space between the monopiles 1.1 linear mile (1.8 km, 1 nm), hydrodynamic effects of one monopile are not expected to influence the effects of another. Thus, there are no anticipated hydrodynamic effects of the monopile array, simply local effects of each individual monopile.

There are no hydrodynamic effects associated with SFEC or O&M facility construction or operations.

5 Essential Fish Habitat in the Project Area and Vicinity

The project area includes EFH designations developed by the NEFMC, the MAFMC, and the NOAA Fisheries Office of Sustainable Fisheries.

EFH species descriptions and habitat designations presented in this report were drawn from the following sources:

- Species descriptions provided in COP Appendix O (Ch2MHill 2018)
- Final Omnibus Essential Fish Habitat Amendment 2 (NEFMC 2017)
- Final Amendment 10 Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NOAA 2017).
- Individual species descriptions for selected EFH species obtained from the NOAA Essential Fish Habitat Mapper from March 1 to March 15, 2021 (https://www.habitat.noaa.gov/protection/efh/efhmapper/)

EFH species occurrence in the project area is summarized in Section 5.1. Species and life stage-specific descriptions of designated EFH occurrence in the project area are provided in Section 5.2.

NOAA and MAFMC have also identified subsets of EFH designated as habitat areas of particular concern (HAPCs). HAPCs are considered high-priority areas for conservation, management, or research because they are rare, sensitive, stressed by development, or important to ecosystem function. Designated HAPCs that are known or may potentially occur in the project area and vicinity are specific habitats for juvenile Atlantic cod and summer flounder. HAPC descriptions for these species and occurrence in the project area are described below in Sections 5.2.1.1 and 5.2.2.1, respectively.

5.1 Essential Fish Habitat Designations Within the Project Area

The project area includes designated EFH for 40 different fish and invertebrate species, with the distribution of designated habitats varying by species and life stage. The fishery resources are managed under several federal fishery management plans (FMPs), including the Sea Scallop FMP, Monkfish FMP, Northeast Multispecies (large- and small-mesh) FMP,10 Skate FMP, and Red Crab FMP (NEFMC 2019); Surfclam/Ocean Quahog FMP, Mackerel/Squid/Butterfish FMP, Spiny Dogfish FMP, Bluefish FMP, Golden and Blueline Tilefish FMP, and River Herring FMP (MAFMC 2019); Highly Migratory Species FMP (NMFS 2020a); and Lobster FMP, Jonah Crab FMP, Atlantic Herring FMP, and Summer Flounder/Scup/Black Sea Bass FMP (Atlantic States Marine Fisheries Commission [ASMFC] 2019).

Designated EFH occurrence by species and life stage is summarized in Tables 5.1 and 5.2.

Table 5.1. EFH Occurrence in the Project Area for Designated Fish and Invertebrate Species and Life Stages by Project Component

EFH Species	Designated EFH for Species and Life Stages by Project Component											
	Eggs			Larvae			Juvenile			Adult		
	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Gadids												
Atlantic cod (*Gadus morhua*)	●	●		●	●		●	●		●	●	
Haddock (*Melanogrammus aeglefinus*)		--		●	●		●	●		●	●	
Pollock (*Pollachius virens*)	●	●		●	●		●	●			--	
Red hake (*Urophycis chuss*)	●	●		●	●		●	●		●	●	
Silver hake (*Merluccius bilinearis*)	●	●		●	●		●	●			--	
White hake (*Urophycis tenuis*)	●			●			●	●			--	
Flatfish												
Summer flounder (*Paralichthys dentatus*)	●	●		●	●			●	●	●	●	●
Windowpane flounder (*Scophthalmus aquosus*)	●	●		●	●		●	●	●	●	●	●
Winter flounder (*Pseudopleuronectes americanus*)		●	●	●	●	●	●	●	●	●	●	●
Witch flounder (*Glyptocephalus cynoglossus*)	●	●		●	●			--		●	●	
Yellowtail flounder (*Limanda ferruginea*)	●	●		●	●		●	●		●	●	●
Other Finfish												
Atlantic sea herring (*Clupea harengus*)		--		●	●		●	●	●	●	●	●
Monkfish (*Lophius americanus*)	●	●		●	●		●	●		●	●	
Ocean pout (*Macrozoarces americanus*)	●	●			n/a		●	●		●	●	
Atlantic butterfish (*Peprilus triacanthus*)	●	●		●	●		●	●	●	●	●	●
Atlantic mackerel (*Scomber scombrus*)	●	●	●	●	●	●	●	●	●		●	●
Black sea bass (*Centropristis striata*)	●	●	●	●	●	●	●	●	●	●	●	●

EFH Species	Designated EFH for Species and Life Stages by Project Component											
	Eggs			Larvae			Juvenile			Adult		
	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bluefish (*Pomatomus saltatrix*)	•	•		•	•		•	•		•	•	•
Scup (*Stenotomus chrysops*)			•			•	•	•	•	•	•	•
Highly Migratory Species												
Albacore tuna (*Thunnus alalunga*)	--			--			•	•	•	•	•	
Bluefin tuna (*Thunnus thynnus*)	--			--			•	•		•	•	
Skipjack tuna (*Katsuwonus pelamis*)	--			--			•	•		•	•	•
Yellowfin tuna (*Thunnus albacares*)	--			--			•	•		•	•	
Skates												
Barndoor skate (*Dipturus laevis*)	--			--			•	•		•	•	
Little skate (*Leucoraja erinacea*)	--			--			•	•	•	•	•	•
Winter skate (*Leucoraja ocellate*)	--			--			•	•	•	•	•	•
Invertebrates												
Atlantic sea scallop (*Placopecten magellanicus*)	•	•		•	•		•	•		•	•	
Atlantic surf clam (*Spisula solidissima*)	--			--				•			•	
Ocean quahog (*Artica islandica*)	--			--			•	•		•	•	
Longfin squid (*Loligo pealeii*)	•	•	•	n/a			•	•	•	•	•	•

Table 5.2. EFH Occurrence in the Project Area for Designated Shark Species and Life Stages by Project Component

EFH Species	Life Stages Occurring in Designated EFH Quadrangles in the Project Footprint											
	Neonate/YOY			Juvenile			Subadult			Adult		
	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Basking shark (*Cetorhinus maximus*)	•	•		•	•		n/a			•	•	
Blue shark (*Prionace glauca*)	•	•		•	•		n/a			•	•	
Common thresher shark (*Alopias vulpinus*)	•	•		•	•		n/a			•	•	
Dusky shark (*Carcharhinus obscurus*)	•	•		•	•		n/a			•	•	
Sand tiger shark (*Carcharias taurus*)	•	•	•	•	•	•	n/a			--		
Sandbar shark (*Carcharhinus plumbeus*)		•		•	•	•	n/a			•	•	•
Shortfin mako shark (*Isurus oxyrinchus*)	•	•		•	•		n/a			•	•	
Tiger shark (*Galeocerdo cuvieri*)	--				•		n/a				•	
White shark (*Carcharodon carcharias*)	•	•		•	•		n/a			•	•	
Spiny dogfish (*Squalus acanthias*)	--			--			•	•	•	•	•	•
Smooth dogfish (*Mustelus canis*)	•	•	•	•	•	•	•	•	•	•	•	•

YOY = young-of-year

5.2 EFH Species and Life Stage Descriptions

Designated EFH occurrence in the project area was determined using the NOAA Essential Fish Habitat Mapper and reflects information current through March 15, 2021. Species and life stage EFH descriptions for designated EFH within the project area are provided in the following sections by species grouping.

5.2.1 Gadids

Six gadid species have designated EFH for one or more life stages in the project area: Atlantic cod, haddock, red hake, silver hake (whiting), and white hake. Species and EFH descriptions are provided below.

5.2.1.1 Atlantic Cod

Atlantic cod are managed as two separate stocks managed by NOAA: Gulf of Maine and Georges Bank and southward. These two stocks rarely mix (Fahay et al. 1999a). Cod range from Cape Chidley, Labrador, to Cape Henry, Virginia, and can be found at depths between 32.8 and 492.1 feet (10 and 150 meters) during both cold and warm seasons. The highest concentrations of cod are on Georges Bank and the western portion of the Gulf of Maine (Fahay et al. 1999a). Cod are historically an important commercial and recreational species and are still fished at low levels; however, as of the 2015 stock assessment, both the stocks are considered overfished and are currently subject to overfishing (NEFMC 2015). This fish species prefers muddy, gravelly, or rocky substrates. In New York State waters, cod can be found year-round but peak in winter and spring both nearshore and offshore. Cod typically move south and into deeper water in the winter and spring, and spawn nearshore in the winter months (Collette and Klein-MacPhee 2002).

Atlantic cod are a species of particular concern for resource managers. The SFWF overlaps Cox Ledge, an area of concern for fishery managers because it may provide important spawning habitat for this species. The NEFMC approved designating portions of Cox Ledge as special habitat management areas to protect EFH for a number of managed fish species. NOAA acknowledged the importance of Cox Ledge because of its habitat value, but disapproved this designation because the habitat protection measures that were approved by the NEFMC would not have been effective in minimizing the habitat impacts of fishing (83 *Federal Register* 15240; NEFMC 2018; NOAA 2017a).

DWSF has conducted reconnaissance-level surveys to determine Atlantic cod use of the project area and vicinity as spawning habitat (Inspire Environmental 2019c, 2020b). They documented gravid adult cod occurrence within the SFWF and SFEC corridor, indicating that complex and potentially complex benthic habitats within the project footprint may support cod spawning. BOEM is currently funding a 3-year study (#AT-19-08) of commercial fish species use of the SFWF and surroundings to address these and related uncertainties. This study was initiated in 2019 and is being conducted collaboratively by NMFS and a team of researchers from state resource agencies, universities, and non-profit organizations (BOEM 2019). It includes a tagging and telemetry component to characterize how cod use Cox Ledge and surrounding habitats during their life cycle. This information will inform the future management about Cox Ledge and surroundings.

Eggs: EFH is the pelagic waters around the perimeter of the Gulf of Maine, Georges Bank, and the eastern portion of the continental shelf off southern New England. Cod eggs are most often observed beginning in the fall, with peaks in the winter and spring. Designated EFH for cod eggs includes the SFWF and SFEC footprints.

Larvae: EFH is the pelagic waters of the Gulf of Maine, Georges Bank, and the eastern portion of the continental shelf off southern New England. Cod larvae are most often observed in the spring. Designated EFH for cod larvae includes the SFWF and SFEC footprints.

Juveniles: EFH is intertidal and sub-tidal benthic habitats in the Gulf of Maine, southern New England, and on Georges Bank, to a maximum depth of 393.7 feet (120 meters), including high salinity zones in selected bays and estuaries. Structurally complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna, are essential habitats for juvenile cod. In inshore waters, young-of-the-year (YOY) juveniles prefer gravel and cobble habitats and eelgrass beds after settlement, but in the absence of predators also utilize adjacent unvegetated sandy habitats for feeding. Survival rates for YOY cod are higher in more structured rocky habitats than in flat sand or eelgrass; growth rates are higher in eelgrass. Older juveniles move into deeper water and are associated with gravel, cobble, and boulder habitats, particularly those with attached organisms. Gravel is a preferred substrate for YOY juveniles on Georges Bank and they have also been observed along the small boulders and cobble margins of rocky reefs in the Gulf of Maine. Designated EFH for cod juveniles includes the SFWF and SFEC footprints.
Adults: EFH is sub-tidal benthic habitats in the Gulf of Maine, south of Cape Cod, and on Georges Bank, between 98.4 and 525 feet (30 and 160 meters), including high salinity zones in selected bays and estuaries. Structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae are essential habitats for adult cod. Adult cod are also found on sandy substrates and frequent deeper slopes of ledges along shore. Designated EFH for spawning adult cod south of Cape Cod includes the SFWF and SFEC footprints.

HAPC: Inshore juvenile cod HAPC includes inshore areas from 0 to 65 feet (0 to 20 meters) depth below mean higher high water in the Gulf of Maine and southern New England, including the contiguous shoreline of southern Massachusetts and portions of Rhode Island. HAPC includes all complex and potentially complex benthic habitats, as well as encrusting epifauna and SAV associated with these habitats, that provide favorable conditions for juvenile settlement and a diversity of prey organisms. Inshore juvenile cod HAPC does not occur within the construction and operational footprint of the SFWF, SFEC, or the O&M facility and would therefore not be affected by the project.

5.2.1.2 Haddock

Haddock are managed by NOAA as three stocks—Gulf of Maine, Georges Bank, and Brown’s Bank (Cargnelli et al. 1999a)—and range from Cape Charles, Virginia to Labrador, Canada. Haddock are most concentrated on George’s Bank, the Scotian Shelf, and the southern Grand Bank. Haddock are found at depths ranging from 49.2 to 1,148.3 feet (15 to 350 meters) and there is a very minimal seasonal difference between depths aside from a slightly wider range of depths in the fall (Cargnelli et al. 1999a). As of the 2015 stock assessment, the Georges Bank and Gulf of Maine stocks are not overfished and are not subject to overfishing (NEFSC 2015). These finfish prefer gravely, pebbly, clay, and sandy substrates and avoid ledges and large rocks

(Collette and Klein-MacPhee 2002). Haddock are found within New York State waters in winter and spring and spawn in areas of a large amount of suitable substrate in nearshore areas.

Eggs: Designated EFH for haddock eggs does not include the project area.

Larvae: Surface waters in selected EFH quadrangles from Georges Bank southwest to the middle Atlantic south to Delaware Bay. Designated EFH for haddock larvae includes the SFWF and SFEC footprints.

Juvenile: Sub-tidal benthic habitats between 131.2 and 459.3 feet (40 and 140 meters) in the Gulf of Maine, on Georges Bank and in the Mid-Atlantic region, and as shallow as 65.6 feet (20 meters) along the coast of Massachusetts, New Hampshire, and Maine. EFH for juvenile haddock occurs on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel. YOY juveniles settle on sand and gravel on Georges Bank, but are found predominantly on gravel pavement areas within a few months after settlement. As they grow, they disperse over a greater variety of substrate types on the bank. YOY haddock do not inhabit shallow, inshore habitats. Designated EFH for juvenile haddock includes the SFWF and SFEC footprints.

Adults: Sub-tidal benthic habitats between 164 and 525 feet (50 and 160 meters) in the Gulf of Maine, on Georges Bank, and in southern New England. EFH for adult haddock occurs on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel substrates. They also are found adjacent to boulders and cobbles along the margins of rocky reefs in the Gulf of Maine. Designated EFH for adult haddock includes the SFWF and SFEC footprints.

5.2.1.3 Pollock

Atlantic pollock are a gadid species commonly found on the Scotian Shelf, Georges Bank, in the Great South Channel, and in the Gulf of Maine (Cargnelli et al. 1999a). The geographic distribution, life history, and habitat characteristics by life stage are described in NOAA Technical Memorandum NMFS-NE-131 (Cargnelli et al. 1999a). Pollock are managed by the NEFMC Northeast Multispecies Fishery Management Plan. Eggs and larvae are the only life stages of pollock with designated EFH in occurring in the project area (NEFMC 2017).

Eggs: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in southern New England, including several bays and estuaries. Designated EFH includes the SFWF and SFEC footprints.

Larvae: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in southern New England, including several bays and estuaries. Designated EFH includes the SFWF and SFEC footprints.

Juvenile: Inshore and offshore pelagic and benthic habitats from the intertidal zone to 590 feet (180 meters) in the Gulf of Maine, in Long Island Sound, and Narragansett Bay; between 131.2 and 590 feet (40 and 180 meters) on western Georges Bank and the Great South Channel; and in mixed and full salinity waters in a number of bays and estuaries north of Cape Cod. EFH for juvenile pollock consists of rocky bottom habitats with attached macroalgae (rockweed and kelp) that provide refuge from predators. Shallow-water eelgrass beds are also essential habitats for YOY pollock in the Gulf of Maine. Older juveniles move into deeper water into habitats also occupied by adults. Designated EFH includes the SFWF and SFEC footprints.

Adults: Designated EFH for adult pollock does not include the project area.

5.2.1.4 Red Hake

Red hake are managed by the NEFSC and are present in two stocks: a northern and southern. Differentiation of the two stocks occurs at George’s Bank (Steimle et al. 1999c). Red hake range from Newfoundland to North Carolina; however, most are concentrated around George’s Bank. During warmer seasons, red hake are common at depths greater than 328 feet (100 meters), and during colder months, their depth range is from 98.4 to 1,214 feet (30 to 370 meters) (Steimle et al. 1999c). According to the 2014 stock assessment, the Gulf of Maine, and Northern Georges Bank (northern), and Southern Georges Bank and Mid-Atlantic (southern) stocks are not considered overfished and are not subject to overfishing (NEFMC 2015). This groundfish species prefers deep water environments with bottom habitat consisting of both soft and pebbly substrate. Spawning occurs uniformly from George’s Bank to Nova Scotia and typically occurs nearshore as early as June and continues through fall (Collette and Klein-MacPhee 2002).

Eggs and Larvae: Pelagic habitats in the Gulf of Maine, on Georges Bank, the continental shelf off southern New England, the middle Atlantic south to Cape Hatteras, and selected bays and estuaries. Designated EFH includes the SFWF and SFEC footprints.

Juveniles: Intertidal and sub-tidal benthic habitats throughout the region on mud and sand substrates, to a maximum depth of 262.5 feet (80 meters), including selected bays and estuaries. Bottom habitats providing shelter are essential for juvenile red hake, including: mud substrates with biogenic depressions, substrates providing biogenic complexity (e.g., eelgrass, macroalgae, shells, anemone and polychaete tubes), and artificial reefs. Newly settled juveniles occur in depressions on the open seabed. Older juveniles are commonly associated with shelter or structure and often inside live bivalves. Designated EFH includes the SFWF and SFEC footprints.

Adults: Bottom habitats in depressions with a substrate of sand and mud in the Gulf of Maine, on Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where red hake adults are found: water temperatures below 12 °C, depths from 32.8 to 426.5 feet (10 to 130 meters), and a salinity range from 33 to 34 ppt. Designated EFH for red hake adults includes the SFWF and SFEC footprints.

5.2.1.5 Silver Hake

NOAA manages silver hake (whiting) in U.S. waters as two stocks: one stock occurs in the Gulf of Maine to northern George's Bank and the second stock occurs from southern George's Bank to Cape Hatteras, North Carolina (Morse and Berrien 1999). Silver hake are found from Cape Sable, Nova Scotia, to Cape Hatteras, North Carolina, and are concentrated in deep basins in the Gulf of Maine and along the continental slope in winter and spring. These demersal finfish are generally present from 420 to 600.4 feet (128 to 183 meters) deep (Collette and Klein-MacPhee 2002). Silver hake are commercially and recreationally important and as of the 2013 stock assessment, the stocks are not overfished and are not subject to overfishing (NEFMC 2014). Silver hake have been found associated with all bottom types, from gravel to fine silt and clay, but mainly with silts and clay (Scott 1982). Silver hake is found in the SFWF and SFEC in the winter and spring and major spawning areas are within coastal Gulf of Maine, Southern George's Bank, and waters that are south of Rhode Island.

Eggs and larvae: Pelagic habitats from the Gulf of Maine to Cape May, New Jersey, including Cape Cod and Massachusetts Bays. Designated EFH for silver hake eggs includes the SFWF and SFEC footprints.

Juveniles: Pelagic and benthic habitats in the Gulf of Maine, including selected coastal bays and estuaries, and on the continental shelf as far south as Cape May, New Jersey, at depths greater than 32.8 feet (10 meters) in coastal waters in the Mid-Atlantic and between 131.2 and 1,312.3 feet (40 and 400 meters) in the Gulf of Maine, on Georges Bank, and in the middle continental shelf in the Mid-Atlantic, on sandy substrates. Juvenile silver hake are found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juveniles in the New York Bight settle to the bottom at mid-shelf depths on muddy sand substrates and find refuge in amphipod tube mats. Designated EFH for silver hake juveniles includes the SFWF and SFEC footprints.

Adults: Designated EFH for adult silver hake does not occur in the project area.

5.2.1.6 White Hake

White hake are an abundant groundfish species found predominantly along the edge of the OCS between Cape Hatteras and Cape Cod, becoming more prevalent on coastal shelf and inshore waters moving northward into the Gulf of Maine.

Eggs: Pelagic habitats in the Gulf of Maine, including Massachusetts and Cape Cod bays, and the outer continental shelf and slope. Designated EFH includes the SFWF footprint.

Larvae: Pelagic habitats in the Gulf of Maine, in southern New England, and on Georges Bank. Early-stage white hake larvae have been collected on the continental slope but cross the shelf-slope front and use nearshore habitats for juvenile nurseries. Larger larvae and pelagic juveniles have been found only on the continental shelf. Designated EFH includes the SFWF footprint.

Juveniles: Intertidal and sub-tidal estuarine and marine habitats in the Gulf of Maine, on Georges Bank, and in southern New England, including mixed and high salinity zones in a number of bays and estuaries north of Cape Cod, to a maximum depth of 984.2 feet (300 meters). Pelagic phase juveniles remain in the water column for about two months. In nearshore waters, EFH for benthic phase juveniles occurs on fine-grained, sandy substrates in eelgrass, macroalgae, and unvegetated habitats. In the Mid-Atlantic, most juveniles settle to the bottom on the continental shelf, but some enter estuaries, especially those in southern New England. Older YOY juveniles occupy the same habitat types as the recently settled juveniles but move into deeper water (> 164 feet [50 meters]). Designated EFH for juvenile white hake in the project area includes the SFWF and SFEC footprints.

Adult: Designated EFH for adult white hake does not include the project area.

5.2.2 Flatfish

Five flatfish species—summer, windowpane, winter, witch and yellowtail flounder—have designated EFH in the project area. Species and EFH descriptions are provided below.

5.2.2.1 Summer Flounder

Summer flounder are a demersal species known to have a range from Maine to South Carolina but predominantly concentrate south of Cape Cod and are split and managed in several stocks, chiefly one stock north of Cape Hatteras and one south (Packer et al. 1999a). Summer flounder are present in New England waters during the warmer seasons of summer and fall and have been found at depths between 48 and 450 feet (15 and 137 meters). Summer flounder is a commercially and recreationally important flatfish in New England (Collette and Klein-MacPhee 2002). Summer flounder prefer sandy or muddy bottom habitats. Not much is known about spawning; it is believed to occur offshore in open ocean areas along the shelf (Packer et al. 1999a). MAFMC et al. (1998) have defined HAPC for summer flounder, as described below.

Eggs: EFH includes the pelagic waters found over the continental shelf (from the coast out to the limits of the Exclusive Economic Zone [EEZ]), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of the all the ranked 10-minute squares for the area where summer flounder eggs are collected in the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) survey. In general, summer flounder eggs are found between October and May, being most abundant between Cape Cod and Cape Hatteras, with the heaviest concentrations within 9 linear miles (14.5 km, 7.8 nm) of shore off New Jersey and New York.

Eggs are most commonly collected at depths of 29.5 to 361 feet (9 to 110 meters). Designated EFH for summer flounder eggs includes the SFWF and SFEC footprints.

Larvae: North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where summer flounder larvae are collected in the MARMAP survey. EFH includes inshore waters and estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the Estuarine Living Marine Resources (ELMR) database, in the "mixing" (defined in ELMR as 0.5 to 25.0 ppt) and "seawater" (defined in ELMR as greater than 25 ppt) salinity zones. In general, summer flounder larvae are most abundant nearshore 11.8 to 50 linear miles ([19 to 80.5 km, 10.4 to 43.4 nm] from shore) at depths between 29.5 to 229.7 (9 to 70 meters). They are most frequently found in the northern part of the Mid-Atlantic Bight from September to February, and in the southern part from November to May. Designated EFH for summer flounder larvae includes the SFWF and SFEC footprints.

Juveniles: North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. EFH includes inshore waters and estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 3 °C and salinities from 10 to 30 ppt range. Designated EFH for juvenile summer flounder includes the SFEC and O&M facility footprints.

Adults: North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. Includes inshore waters and estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the OCS at depths of 500 feet (152 meters) in colder months. Designated EFH for adult summer flounder adults includes the SFWF, SFEC, and O&M facility footprints.

HAPC: All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, wherever they may occur within adult and juvenile summer flounder EFH. Accordingly, HAPC for summer flounder may be present within the SFWF, SFEC and O&M facility footprints.

5.2.2.2 Windowpane Flounder

Windowpane flounder is managed as two stocks by the NEFMC: a northern stock in the Gulf of Maine-George's Bank and a southern stock, Southern New England-Middle Atlantic Bight (Chang et al. 1999). Windowpane spawning occurs from April to December along areas of the northwest Atlantic. This species is coastally oriented with a habitat range extending from just below the tide line to 151 feet (46 meters) deep (Collette and Klein-MacPhee 2002). According to the 2015 stock assessment (NEFSC 2015), the northern stock is overfished but not experiencing overfishing. This species is typically associated with non-complex benthic habitats (Collette and Klein-MacPhee 2002).

Eggs and larvae: Pelagic habitats on the continental shelf from Georges Bank to Cape Hatteras and in mixed and high salinity zones of coastal bays and estuaries throughout the region. Designated EFH for windowpane flounder eggs and/or larvae includes the SFWF and SFEC footprints.

Juveniles: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida, including mixed and high salinity zones in selected bays and estuaries. EFH for juvenile windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 197 feet (60 meters). YOY juveniles prefer sand over mud. Designated EFH for juvenile windowpane flounder includes the SFWF, SFEC, and O&M facility footprints.

Adults: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to Cape Hatteras, including mixed and high salinity zones in selected bays and estuaries. EFH for adult windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 229.7 (70 meters). Designated EFH for adult windowpane flounder includes the SFWF, SFEC, and O&M facility footprints.

5.2.2.3 Winter Flounder

Winter flounder is managed in three different stocks: The Gulf of Maine, George's Bank, and the Middle Atlantic (Pereira et al. 1999). Winter flounder ranges from Labrador to Georgia but are highly concentrated nearshore from Massachusetts to New Jersey and are present in the George's Bank area year-round. They range between 2,907 and 4,5,21 feet (886 and 1,378 meters) deep in their range (Collette and Klein-MacPhee 2002). Winter flounder prefer muddy, sandy, cobbled, gravely, or boulder substrate in mostly nearshore environments (Pereira et al. 1999). Winter flounder spawn on sandy bottom in shallow habitats.

Eggs: EFH comprises sub-tidal estuarine and coastal benthic habitats from mean low water to 16.4 feet (5 meters) depth from Cape Cod to Absecon Inlet (39° 22' N), and as deep as 229.7 feet (70 meters) on Georges Bank and in the Gulf of Maine, including mixed and high salinity zones in selected bays and estuaries. The eggs are adhesive and deposited in clusters on the bottom. Essential habitats for winter flounder eggs include mud, muddy sand, sand, gravel, macroalgae, and SAV. Bottom habitats are unsuitable if exposed to excessive sedimentation which can reduce hatching success. Designated EFH for winter flounder eggs includes the SFEC and O&M facility footprints.

Larvae: Estuarine, coastal, and continental shelf water column habitats from the shoreline to a maximum depth of 229.7 feet (70 meters) from the Gulf of Maine to Absecon Inlet (39° 22' N), and including Georges Bank including mixed and high salinity zones in selected bays and estuaries. Larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites where they metamorphose and settle to the bottom as juveniles. They are initially planktonic but become increasingly less buoyant and occupy the lower water column as they get older. Designated EFH for winter flounder larvae includes the SFWF, SFEC, and O&M facility footprints.

Juveniles: Estuarine, coastal, and continental shelf benthic habitats from the Gulf of Maine to Absecon Inlet (39° 22' N), and including Georges Bank, and in mixed and high salinity zones in selected bays and estuaries. EFH for juvenile winter flounder extends from the intertidal zone (mean high water) to a maximum depth of 197 feet (60 meters) and occurs on a variety of bottom types, such as mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass. YOY juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. They tend to settle to the bottom in soft-sediment depositional areas where currents concentrate late-stage larvae and disperse into coarser-grained substrates as they get older. Designated EFH for winter flounder larvae includes the SFWF, SFEC, and O&M facility footprints.

Adults: Estuarine, coastal, and continental shelf benthic habitats extending from the intertidal zone (mean high water) to a maximum depth of 229.7 feet (70 meters) from the Gulf of Maine to Absecon Inlet (39° 22' N), and including Georges Bank, and in mixed and high salinity zones in selected bays and estuaries. EFH for adult winter flounder occurs on muddy and sandy substrates, and on hard bottom on offshore banks. In inshore spawning areas, EFH includes a variety of substrates where eggs are deposited on the bottom. Designated EFH for winter flounder larvae includes the SFWF, SFEC, and O&M facility footprints.

5.2.2.4 Witch Flounder

Witch flounder stocks are managed under NOAA Fisheries Multispecies FMP and range from the Gulf of Maine to Cape Hatteras, North Carolina (Cargnelli et al. 1999b). Witch flounder are present year-round and tend to concentrate near the southwest portion of the Gulf of Maine (Collette and Klein-MacPhee 2002). Witch flounder is a commercial and recreational species, and as of the 2015 stock assessment is considered overfished and experiencing overfishing (NEFSC 2015). Spawning occurs from May through September and peaks in July and August.

Eggs: Selected pelagic habitats on the continental shelf throughout the northeast region. Witch flounder eggs are most often observed during the months from March through October. Designated EFH for witch flounder eggs includes the SFWF and SFEC construction footprints.

Larvae: Selected pelagic habitats on the continental shelf throughout the northeast region. Witch flounder larvae are most often observed from March through November, with peaks in May to July. Designated EFH for witch flounder larvae includes the SFWF and SFEC construction footprints.

Juvenile: Designated EFH for juvenile witch flounder does not include the project area.

Adult: Sub-tidal benthic habitats between 115 and 1,312.3 feet (35 and 400 meters) in the Gulf of Maine and as deep as 4,921.3 feet (1,500 meters) on the outer continental shelf and slope, with mud and muddy sand substrates. Designated EFH for adult witch flounder includes the SFWF and SFEC construction footprints.

5.2.2.5 Yellowtail Flounder

Yellowtail flounder is separated into five stocks for management purposes: Southern New England, George's Bank, Cape Cod, Nova Scotia, and Grand Bank (Johnson et al. 1999b). These five stocks are distributed along the Atlantic coast from St. Lawrence, Labrador, to the Chesapeake Bay. Yellowtail flounder are most abundant within the western half of George's Bank. Yellowtail flounder are present in George's Bank from March to August; the finfish tend to move east in the spring and summer and west in the fall and winter (Johnson et al. 1999b). Yellowtail flounder are commercially and recreationally important. As of the 2015 stock assessment (NEFSC 2015), the Southern New England/Mid-Atlantic stock and the Cape Cod/Gulf of Maine stock are considered overfished and subject to overfishing. These bottom-dwelling finfish prefer a mixture of sand and mud (Collette and Klein-MacPhee 2002). Spawning occurs in both inshore areas as well as on offshore on George's Bank in July.

Eggs: Selected sub-tidal benthic habitats between 15 and 1,312.3 feet (35 and 400 meters) depth in the Gulf of Maine, on Georges Bank, and the Mid-Atlantic region as far south as the upper Delmarva Peninsula. Designated EFH for yellowtail flounder eggs includes the SFWF and SFEC construction footprints.

Larvae: Selected coastal marine and continental shelf pelagic habitats in the Gulf of Maine, and from Georges Bank to Cape Hatteras, including the high salinity zones of bays and estuaries. Designated EFH for yellowtail flounder larvae includes the SFWF and SFEC footprints.

Juveniles: Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic, including the high salinity zones of selected bays and estuaries. EFH for juvenile yellowtail flounder occurs on sand and muddy sand between 65.6 and 262.5 feet (20 and 80 meters). In the Mid-Atlantic, YOY juveniles settle to the bottom on the continental shelf, primarily at depths of 131.2 to 229.7 feet (40 to 70 meters), on sandy substrates. Designated EFH for juveniles includes the SFWF and SFEC footprints.

Adults: Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic, including the high salinity zones of selected bays and estuaries. EFH for adult yellowtail flounder occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 82 and 295.3 feet (25 and 90 meters). Designated EFH for adults includes the SFWF, SFEC, and O&M facility footprints.

5.2.3 Other Finfish

The project area includes designated EFH for one or more life stages of the following finfish species: Atlantic herring, monkfish, ocean pout, butterfish, Atlantic mackerel, black sea bass, bluefish, and scup. Species and EFH descriptions are provided below.

5.2.3.1 Atlantic herring

Atlantic herring is managed as a single stock composed of a complex of two major spawning components on George's Bank and in the Gulf of Maine. Atlantic herring have a range from Labrador, Canada, to Cape Hatteras, North Carolina, and are highly concentrated in George's Bank, the Gulf of Maine, and Nantucket Shoals (Reid et al. 1999). The Atlantic herring is typically present in the winter and average depths of about 118.1 to 390.9 feet (36 to 110 meters) (Collette and Klein-MacPhee 2002). Atlantic herring have and continue to be an important commercial fishery in New England as their stock biomass has exponentially increased since the 1980s (Reid et al. 1999). Herring tend to prefer open waters and almost always travel in schools (Collette and Klein-MacPhee 2002). Spawning grounds are limited to rocky, gravelly, or pebbly bottom and on clay, but never on soft mud from 10 to 180.5 feet (3 to 55 meters) deep (Collette and Klein-MacPhee 2002).

Eggs: Designated EFH for Atlantic herring eggs does not include the project area.

Larvae: EFH is the pelagic waters in the Gulf of Maine, Georges Bank, and southern New England that comprise 90 percent of the observed range of Atlantic herring larvae. Generally, the following conditions exist where Atlantic herring larvae are found: sea surface temperatures below 16 °C, water depths from 164 to 295.3 feet (50 to 90 meters), and salinities around 32 ppt. Atlantic herring larvae are observed between August and April, with peaks from September through November. Designated EFH for larval Atlantic herring includes the SFWF and SFEC footprints.

Juveniles: EFH is the pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where Atlantic herring juveniles are found: water temperatures below 10 °C, water depths from 49.2 to 443 feet (15 to 135 meters), and a salinity range from 26 to 32 ppt.

Designated EFH for juvenile Atlantic herring includes the SFWF, SFEC, and O&M facility footprints.

Adults: EFH is the pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where Atlantic herring adults are found: water temperatures below 10 °C, water depths from 65.6 to 426.5 feet (20 to 130 meters), and salinities above 28 ppt. Designated EFH for adult Atlantic herring includes the SFWF, SFEC, and O&M facility footprints.

5.2.3.2 Monkfish

Monkfish are managed as two stocks by NOAA Fisheries: northern and southern. This species is present on the mid-Atlantic OCS from the tideline down to 2,158.8 feet (658 meters) during summer and fall (Collette and Klein-MacPhee 2002). Monkfish are common and are found in abundance on Brown's and George's Banks. Monkfish prefer hard sand, pebbly bottom, gravel, and broken shells for their habitats (Collette and Klein-MacPhee 2002).

Eggs: EFH is the surface waters of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras, North Carolina. Generally, the following conditions exist where monkfish egg veils are found: sea surface temperatures below 18 °C and water depths from 49.2 to 3,280.8 feet (15 to 1,000 meters). Egg veils are most often observed from March through September. Designated EFH for monkfish eggs has been includes the SFWF and SFEC footprints.

Larvae: EFH is the pelagic waters of the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras, North Carolina. Generally, the following conditions exist where monkfish larvae are found: water temperatures 15 °C and water depths from 82 to 3,281 feet (25 to 1,000 meters). Monkfish larvae are most often observed from March through September. Designated EFH for monkfish larvae includes the SFWF and SFEC construction footprints.

Juveniles: EFH is bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud along the OCS in the middle Atlantic, the mid-shelf off southern New England, and all areas of the Gulf of Maine. Generally, the following conditions exist where monkfish juveniles are found: water temperatures below 13 °C, depths from 82 to 656 feet (25 to 200 meters), and a salinity range from 29.9 to 36.7 ppt. Designated EFH for juveniles includes the SFWF and SFEC footprints.

Adults: EFH is bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud along the OCS in the middle Atlantic, the mid-shelf off southern New England, along the outer perimeter of Georges Bank and all areas of the Gulf of Maine. Generally, the following conditions exist where monkfish adults are found: water temperatures below 15 °C, depths from 82 to 656 feet (25 to 200 meters), and a salinity range from 29.9 to 36.7 ppt. Designated EFH for monkfish adults includes the SFWF and SFEC footprints.

5.2.3.3 Ocean Pout

The ocean pout is currently managed in two stocks—northern and southern—and ranges from Labrador, Canada, to Virginia (Steimle et al. 1999b). This finfish is typically present in southern New England from late summer to winter. According to the 2015 stock assessment, ocean pout is overfished and is not currently experiencing overfishing (NEFSC 2015). Ocean pout are present in habitats that contain sandy mud, sticky sand, broken bottom, or on pebbles and gravel (Collette and Klein-MacPhee 2002). The finfish spawn in protected habitats, such as rock crevices and man-made artifacts, where it lays eggs in nests that it guards (Steimle et al. 1999b).

Eggs: EFH is hard bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and high salinity zones in estuaries on the middle Atlantic south to Delaware Bay. Because of low fecundity, relatively few eggs (< 4,200) are laid in gelatinous masses, generally in hard-bottom sheltered nests, holes, or crevices where they are guarded by either female or both parents. Generally, ocean pout eggs are found in water depths less than 328 feet (100 meters). Ocean pout egg development takes 2 to 3 months during late fall and winter. Designated EFH for ocean pout eggs includes the SFWF and SFEC footprints.

Larvae: Ocean pout have no true larval life stage; therefore, this component of EFH was removed in Omnibus EFH Amendment 2 (NEFMC 2017).

Juveniles: Intertidal and sub-tidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high salinity zones of a number of bays and estuaries north of Cape Cod, extending to a maximum depth of 393.7 feet (120 meters). Designated EFH for ocean pout juveniles includes the SFWF and SFEC construction footprints.

Adults: Sub-tidal benthic habitats between 65.6 to 459.3 feet (20 and 140) meters in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high salinity zones of selected bays and estuaries north of Cape Cod. EFH for adult ocean pout includes mud and sand, particularly in association with structure forming habitat types; i.e. shells, gravel, or boulders. In softer sediments, they burrow tail first and leave a depression on the sediment surface. Ocean pout congregate in rocky areas prior to spawning and frequently occupy nesting holes under rocks or in crevices in depths less than 328 feet (100 meters). Designated EFH for ocean pout adults includes the SFWF and SFEC.

5.2.3.4 Butterfish

The Atlantic butterfish is a pelagic, surface-dwelling fish that tends to form schools and ranges from Newfoundland to Florida but is primarily found from the Gulf of Maine south to Cape

Hatteras, North Carolina (Cross et al. 1999). Butterfish are managed as one stock in the northern region (New England to Cape Hatteras) and two stocks south of Cape Hatteras. Butterfish are present in New England waters from spring to fall and are found from the surface to 180 feet (54 meters) deep in the summer, but as deep as 690 feet (210 meters) in the winter (Collette and Klein-MacPhee 2002). Butterfish are a commercially and recreationally important fish, mostly targeted by pound nets, floating traps, purse seins, and otter trawls. Butterfish prefer sandy bottom environments rather than rocky environments. Spawning occurs on the continental shelf and nearshore areas and is very common in Long Island Sound and the New York Bight (Cross et al. 1999).

Eggs: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to the south shore of Long Island, New York, in Chesapeake Bay, and on the continental shelf and slope, primarily from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic butterfish eggs is generally found over bottom depths of 4,921.3 feet (1,500 meters) or less where average temperatures in the upper 656.2 feet (200 meters) of the water column are 6.5 to 21.5 °C. Designated EFH for butterfish eggs includes the SFWF and SFEC footprints.

Larvae: EFH is pelagic habitats in inshore estuaries and embayments in Boston harbor, from the south shore of Cape Cod to the Hudson River, and in Delaware and Chesapeake bays, and on the continental shelf from the Great South Channel (western Georges Bank) to Cape Hatteras, North Carolina. EFH for Atlantic butterfish larvae is generally found over bottom depths between 134.5 and 1,148.23 feet (41 and 350 meters) where average temperatures in the upper 656. 2 feet (200 meters) of the water column are 8.5 to 21.5 °C. Designated EFH for butterfish larvae includes the SFWF and SFEC footprints.

Juveniles (≤ 4.3 inches [11 cm] fork length [FL]): EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, in inshore waters of the Gulf of Maine and the South Atlantic Bight, and on the inner and outer continental shelf from southern New England to South Carolina. EFH for juvenile Atlantic butterfish is generally found over bottom depths between 32.8 and 918.6 feet (10 and 280 meters) where bottom water temperatures are between 6.5 and 27 °C and salinities are above 5 ppt. Juvenile butterfish feed mainly on planktonic prey. Designated EFH for butterfish juveniles includes the SFWF, SFEC, and O&M facility footprints.

Adults (≥ 4.7 inches [12 cm] FL): EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, inshore waters of the Gulf of Maine and the South Atlantic Bight, on Georges Bank, on the inner continental shelf south of Delaware Bay, and on the OCS from southern New England to South Carolina. EFH for adult Atlantic butterfish is generally found over bottom depths between 32.8 and 820.2 feet (10 and 250 meters) where bottom water temperatures are between 4.5 and 27.5 °C and salinities are above 5 ppt. Spawning probably does not occur at temperatures below 15 °C. Adult butterfish feed mainly on planktonic prey, including squids and fishes. Designated EFH for adult butterfish includes the SFWF, SFEC, and O&M facility footprints.

5.2.3.5 Atlantic Mackerel

The Atlantic Mackerel is a pelagic, schooling species that is managed as one stock under the MAFMC through the Squid-Mackerel-Butterfish FMP. The mackerel ranges from the Gulf of St. Lawrence to Cape Lookout, North Carolina (Studholme et al. 1999). This finfish species is migratory throughout New England waters, appearing in near-surface waters in the spring and summer. In New York State waters, mackerel have been reported at depths of 59 to 118 feet (18 to 36 meters) (Collette and Klein-MacPhee 2002). The current trend of mackerel stock biomass is increasing (Studholme et al. 1999). Mackerel tend to congregate in open waters towards the surface and in nearshore environments. Mackerel spawn off the coast in deeper waters across from a range between Cape Hatteras to the Gulf of St. Lawrence covering almost the entire continental shelf. Spawning occurs in early summer and continues until the water temperature reaches 8 °C. There is no preferred breeding habitat (Collette and Klein- MacPhee 2002).

Eggs: EFH is pelagic habitats in inshore estuaries and embayments from Great Bay, New Hampshire, to the south shore of Long Island, New York, inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina (mostly north of 38°N). EFH for Atlantic mackerel eggs is generally found over bottom depths of 328 feet (100 meters) or less with average water temperatures of 6.5 to 12.5 °C in the upper 49.2 feet (15 meters) of the water column. Designated EFH for Atlantic mackerel eggs includes the SFWF, SFEC, and O&M facility footprints.

Larvae: EFH is pelagic habitats in inshore estuaries and embayments from Great Bay, New Hampshire, to the south shore of Long Island, New York, inshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina (mostly north of 38°N). EFH for Atlantic mackerel larvae is generally found over bottom depths between 68.9 and 328 feet (21 and 100 meters) with average water temperatures of 5.5 to 11.5 °C in the upper 256.2 feet (200 meters) of the water column. Designated EFH for Atlantic mackerel larvae includes the SFWF, SFEC, and O&M facility construction footprints.

Juveniles (≤ 9.8 inches [25 cm] FL): EFH is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay and Penobscot Bay, Maine, to the Hudson River, in the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for juvenile Atlantic mackerel is generally found over bottom depths between 32.8 and 328 feet (10 and 110 meters) and in water temperatures of 5 to 20 °C. Juvenile Atlantic mackerel feed primarily on small crustaceans, larval fish, and other pelagic organisms. Designated EFH for Atlantic mackerel juveniles includes all or portions of quadrangles 3, 4, 5, 6, 7, 8, 10, and 13 within the SFWF, SFEC, and O&M facility footprints.

Adults (≥ 10.2 inches [26 cm] FL): EFH is pelagic habitats in inshore estuaries and embayments from Passamaquoddy Bay, Maine, to the Hudson River, and on the continental shelf from Georges Bank to Cape Hatteras, North Carolina. EFH for adult Atlantic mackerel is generally found over bottom depths less than 558 feet (170 meters) and in water temperatures of 5 to 20 °C. Spawning occurs at temperatures above 7 °C, with a peak between 9 and 14 °C. Adult Atlantic mackerel are opportunistic predators feeding primarily on a wider range and larger individuals of pelagic crustaceans than juveniles, but also on fish and squid. Designated EFH for Atlantic mackerel adults includes the SFEC and O&M facility footprints.

5.2.3.6 Black Sea Bass

The black sea bass is a demersal finfish species that range from Nova Scotia to Florida and is managed in three stocks: northern, southern and the Gulf of Mexico (Steimle et al. 1999a). The depth range of the black sea bass extends from the tide line down to 420 feet (128 meters). This finfish is found in New England and off Long Island, New York, near the shore in early May, and then does not appear again until October and November (Collette and Klein-MacPhee 2002). Black sea bass prefer structured habitats such as reefs, shipwrecks, and lobster pots along the continental shelf (Steimle et al. 1999a). Black sea bass spawn in May along the North Carolina coast, then spawn from the middle of May until the end of June in New Jersey, New York, and southern New England waters (Collette and Klein-MacPhee 2002).

Eggs: EFH is the estuaries where black sea bass eggs were identified in the ELMR database as common, abundant, or highly abundant for the "mixing" and "seawater" salinity zones. Generally, black sea bass eggs are found from May through October on the continental shelf, from southern New England to North Carolina. Designated EFH for black sea bass eggs occurs in proximity to the O&M facility.

Larvae: 1) North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all ranked 10-minute squares of the area where black sea bass larvae are collected in the MARMAP survey. 2) EFH also is estuaries where black sea bass were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater salinity zones. Generally, the habitats for the transforming (to juveniles) larvae are near the coastal areas and into marine parts of estuaries between Virginia and New York. Larval sea bass settle in benthic habitats during juvenile transformation, favoring structurally complex inshore habitat such as sponge beds. Designated EFH for black sea bass larvae includes the SFWF, SFEC, and O&M facility footprints.

Juveniles (< 7.5 inches [19 cm] TL): 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the ELMR database for the mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer than 6.1 °C with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, man-made structures in sandy shelly areas; offshore clam beds and shell patches may also be used during the wintering. Designated EFH for juvenile black sea bass includes the entirety of the SFWF, SFEC and O&M facility footprints.

Adults (≥ 7.5 inches [19 cm] TL): 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the10 ten-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 6.1 °C seem to be the minimum requirements. Structured habitats (natural and man-made), sand, and shell are usually the substrate preference. Designated EFH for adult black sea bass includes the SFWF, SFEC, and O&M facility footprints.

5.2.3.7 Bluefish

Bluefish range from Nova Scotia to Bermuda and are often observed as a schooling species that seasonally migrates to the mid-Atlantic bight during the spring (Fahay et al. 1999b). Bluefish are organized and managed in one stock and are present in New England waters from spring to fall concentrated at mid-shelf depths (Collette and Klein-MacPhee 2002). Bluefish are targeted by recreational anglers (Collette and Klein-MacPhee 2002). Bluefish prefer open water environments and can be found both nearshore and offshore. Bluefish spawn in late spring through August predominantly in deeper offshore waters (Collette and Klein-MacPhee 2002).

Eggs: 1) North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) at mid-shelf depths, from Montauk Point, New York, south to Cape Hatteras in the highest 90 percent of the area where bluefish eggs were collected in the MARMAP surveys. 2) South of Cape Hatteras, EFH is 100 percent of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida, at mid-shelf depths. Bluefish eggs are generally not collected in estuarine waters and thus there is no EFH designation inshore. Generally, bluefish eggs are collected between April through August in temperatures greater than 18 °C and normal shelf salinities (> 31 ppt). Designated EFH for bluefish eggs includes the SFWF and SFEC construction footprints.

Larvae: 1) North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) most commonly above 59 feet (15 meters), from Montauk Point, New York, south to Cape Hatteras, in the highest 90 percent of the area where bluefish larvae were collected during the MARMAP surveys. 2) South of Cape Hatteras, EFH is 100 percent of the pelagic waters greater than 45 feet (14 meters) over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida. 3) EFH also includes the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N. Bluefish larvae are not generally collected inshore so there is not EFH designation inshore for larvae. Generally, bluefish larvae are collected April through September in temperatures greater than 18 C in normal shelf salinities (> 30 ppt). Designated EFH for bluefish larvae includes the SFWF and SFEC footprints.

Juveniles: 1) North of Cape Hatteras, EFH is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts, south to Cape Hatteras, in the highest 90 percent of the area where juvenile bluefish are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is 100 percent of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida. 3) EFH also includes the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N. 4) Inshore, EFH is all major estuaries between Penobscot Bay, Maine, and St. Johns River, Florida. Generally, juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones (Nelson et al. 1991; Jury et al. 1994; Stone et al. 1994). Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed (Fahay 1998). Designated EFH includes the SFWF and SFEC footprints.

Adults: 1) North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts, south to Cape Hatteras, in the highest 90 percent of the area where adult bluefish were collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is 100 percent of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida. 3) Inshore, EFH is all major estuaries between Penobscot Bay, Maine, and St. Johns River, Florida. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones (Nelson et al. 1991; Jury et al. 1994; Stone et al. 1994). Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish are generally found in normal shelf salinities (greater than 25 ppt). Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.3.8 Scup

Scup are demersal finfish that have a range from the Gulf of Maine to North Carolina. Scup were managed historically in two stocks, but recent discoveries have deemed that there is little to no separation between regions; scup are currently managed as one stock within the Middle Atlantic Bight (Steimle et al. 1999d). Scup are known to congregate in nearshore areas of New England from early April to December, at depths between 269 and 420 feet (82 and 128 meters) (Collette and Klein-MacPhee 2002). Scup are an important food species for other commercially important species (Collette and Klein- MacPhee 2002). Scup prefer smooth to rocky bottom habitats and usually form schools around such bottoms. Spawning occurs nearshore and in relatively shallow waters over sandy bottom between May and August (Steimle et al. 1999d).

Eggs and larvae: EFH is estuaries where scup eggs were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, scup eggs are found from May through August in southern New England to coastal Virginia, in waters between 12.7 and 22.8 °C and in salinities greater than 15 ppt. Designated EFH includes the O&M facility footprint.

Juveniles: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup has been identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Juvenile scup, in general during the summer and spring, are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel, and eelgrass bed type substrates and in water temperatures greater than 7 °C and salinities greater than 15 ppt. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults: Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90 percent of all the ranked 10-minute squares of the area where adult scup are collected in the NEFSC trawl survey. Inshore, EFH is the estuaries where scup has been identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 7 °C. Designated EFH includes the SFWF, SFEC, and O&M facility construction footprints.

5.2.4 Highly Migratory Species

The project area includes designated EFH for four highly migratory tunas—albacore, bluefin, skipjack, and yellowfin—during one or more life stages. Species and EFH descriptions are provided below.

5.2.4.1 Albacore Tuna

Albacore tuna is a global, pelagic species that is managed in three stocks (North Atlantic, South Atlantic, and Mediterranean) and has a wide range from north to south, Newfoundland to the Gulf of Mexico, and east to west, from the western Atlantic to the Mediterranean (NOAA 2009b). Albacore tuna spawn in the spring and summer in the western tropical areas of the Atlantic, and then they move northward and use the central and northern portions of the Atlantic as their wintering area. Albacore tuna prefer open ocean and can adapt to a wide variety of oceanic properties. The northern stock of albacore tuna is commercially and recreationally important and is currently overfished (NOAA 2009b).

Juveniles (< 35.4 inches [90 cm] FL): EFH extends offshore of the U.S. east coast from north of Cape Hatteras to Cape Cod and includes the mid-east coast of Florida. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults (≥ 35.4 inches [90 cm] FL): Offshore, pelagic habitats of the Atlantic Ocean from the outer edge of the U.S. EEZ through Georges Bank to pelagic habitats south of Cape Cod, and from Cape Cod to Cape Hatteras, North Carolina. EFH also includes offshore pelagic habitats near the outer U.S. EEZ between North Carolina and Florida, and offshore pelagic habitats associated with the Blake Plateau. EFH also includes offshore pelagic habitats in the western and central Gulf of Mexico. Designated EFH includes the SFWF footprint.

5.2.4.2 Bluefin Tuna

Bluefin tuna are managed in two stocks: western and eastern and range from Labrador to the Gulf of Mexico (NOAA 2009b). The bluefin tuna migrates from the spawning ground in the Gulf of Mexico in the spring, moving north into New England and Canada through the summer and beginning of fall; the tuna can be found off the coast of New Jersey, Long Island, and southern New England in June (Collette and Klein-MacPhee 2002). Bluefin tuna are found at depths ranging from near the surface to 300 feet (91 meters) deep, and tend to jump out of the water singly or in schools when near the surface. Bluefin tuna is considered overfished but remains an important commercial and recreational target species that is caught using longlines, purse seines, traps, and various hand gears (NOAA 2009b). Bluefin tuna inhabit open ocean environments with variable temperature and salinity levels, given the wide geographic range they cover through migration.

Juveniles (< 73 inches [185 cm] FL): Coastal and pelagic habitats of the Mid-Atlantic Bight and the Gulf of Maine, between southern Maine and Cape Lookout, from shore (excluding Long Island Sound, Delaware Bay, Chesapeake Bay, and Pamlico Sound) to the continental shelf break. EFH in coastal areas of Cape Cod are located between the Great South Passage and shore. EFH follows the continental shelf from the outer extent of the U.S. EEZ on Georges Bank to Cape Lookout. EFH is associated with certain environmental conditions in the Gulf of Maine (16 to 19 °C; 0 to 131.2 feet [40 meters] deep). EFH in other locations associated with temperatures ranging from 4 to 26 °C, often in depths of less than 65.6 feet (20 meters) (but can be found in waters that are 131.2 to 328 feet [40 to 100 meters] in depth in winter). Designated EFH includes the SFWF and SFEC footprints. Designated EFH does not include the O&M facility.

Adults (≥ 73 inches [185 cm] FL): EFH is located in offshore and coastal regions of the Gulf of Maine; the mid-coast of Maine to Massachusetts; on Georges Bank; offshore pelagic habitats of southern New England; from southern New England to coastal areas between the mouth of Chesapeake Bay and Onslow Bay, North Carolina; and from coastal North Carolina south to the outer extent of the U.S. EEZ, inclusive of pelagic habitats of the Blake Plateau, Charleston Bump, and Blake Ridge. EFH also consists of pelagic waters of the central Gulf of Mexico from the continental shelf break to the seaward extent of the U.S. EEZ between Apalachicola, Florida, and Texas. Designated EFH includes the SFWF and SFEC footprints. Designated EFH does not include the O&M facility.

5.2.4.3 Skipjack Tuna

The skipjack tuna is a global, pelagic species that is managed in two units or stocks (eastern and western) and has a range from Newfoundland to Brazil (NOAA 2009b). Skipjack tuna spawn opportunistically in warm waters near the equator from spring to fall, with most spawning occurring in the summer. Skipjack tuna are commercially and recreationally important and are typically caught using surface gear. At this time, the overfishing status of this tuna is unknown. Skipjack tuna prefer convergences and tend to associate with birds, drifting objects, whales, and sharks. Designated EFH for spawning, eggs, and larvae is restricted to the Gulf of Mexico and Atlantic waters off the coast of Florida.

Juveniles (< 18 inches [45 cm] FL): Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank (off Massachusetts); coastal and offshore habitats between Massachusetts and South Carolina; localized in areas off Georgia and South Carolina; and from the Blake Plateau through the Florida Straits. Also, in offshore waters in the central Gulf of Mexico from Texas through the Florida Panhandle. In all areas juveniles are found if waters greater than 65.6 feet (20 meters). Designated EFH includes the SFWF and SFEC construction footprints. Designated EFH does not include the O&M facility.

Adults (≥ 18 inches [45 cm] FL): Coastal and offshore habitats between Massachusetts and Cape Lookout, North Carolina and localized areas in the Atlantic off South Carolina and Georgia, and the northeast coast of Florida. EFH in the Atlantic Ocean also located on the Blake Plateau and in the Florida Straits through the Florida Keys. EFH also includes areas in the central Gulf of Mexico, offshore in pelagic habitats seaward of the southeastern edge of the West Florida Shelf to Texas. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.4.4 Yellowfin Tuna

Yellowfin tuna are circumglobal and have a wide range. The population ranges from the central region of the Gulf of Mexico from Florida to Southern Texas and from the mid-east coast of Florida and Georgia to Cape Cod. They are also located south of Puerto Rico. The species is managed as a single stock. Yellowfin tuna travel in schools and prefer the upper 39.4 inches (100 cm) of the water column in open ocean. Spawning occurs throughout the year between 15°N and 15°S latitude and in the Gulf of Mexico and the Caribbean in May through November and are believed to spawn serially.

Juveniles (< 42 inches [108 cm] FL): Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. Offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau. Locally distributed in the Florida Straits and off the southwestern edge of the West Florida Shelf. Also, in the central Gulf of Mexico from Florida Panhandle to southern Texas. Localized EFH southeast of Puerto Rico. Designated EFH includes the SFWF and SFEC footprints. Designated EFH does not include the O&M facility.

Adults (≥ 42 inches [108 cm] FL): Offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. Also, in offshore and coastal habitats from Cape Cod to North Carolina, and offshore pelagic habitats of the Blake Plateau. EFH in the Gulf of Mexico spans throughout much of the offshore pelagic habitat from the West Florida Shelf to the continental shelf off southern Texas. Designated EFH includes the SFWF footprint.

5.2.5 Skates

The project area includes designated EFH for three skate species: barndoor skate, little skate, and winter skate. Species and EFH descriptions are provided below.

5.2.5.1 Barndoor Skate

Barndoor skate are a large, long-lived skate species occurring from Newfoundland, Canada, to North Carolina (Packer et al. 2003a). A detailed description of the geographic distribution, life history, and habitat characteristics by life stage is in NOAA Technical Memorandum NMFS-NE-173 (Packer et al. 2003a). Barndoor skate are managed through the Northeast Skate Complex FMP. EFH is defined as anywhere within the geographic description and maps/tables found in Section 2.2.4.3 of the Omnibus Essential Fish Habitat Amendment 2 that meets the requirements detailed in the text descriptions (NEFMC 2017).

Juveniles and Adults: Benthic habitats on the continental shelf, primarily on Georges Bank and in southern New England, in depths of 131.2 to 1,312.3 feet (40 to 400 meters), and on the continental slope to a maximum depth of 2,460.6 feet (750 meters). EFH for juvenile and adult barndoor skates occurs on mud, sand, and gravel substrates. Both life stages are usually found on the continental shelf in depths less than 525 feet (160 meters), but the adults also occupy benthic habitats between 984.3 to 1,312.3 feet (300 and 400 meters) on the outer shelf. Designated EFH includes the SFWF and SFEC construction footprints.

5.2.5.2 Little Skate

The little skate is a demersal species that has a range from Nova Scotia to Cape Hatteras and is highly concentrated in the Mid-Atlantic Bight and on George’s Bank. On George’s Bank, the little skate is found year-round and tolerates a wide range of temperatures (Packer et al. 2003a), and prefers sandy or pebbly bottom, but is also found on mud and ledges (Collette and Klein-MacPhee 2002). The little skate is present in New England year-round, and mating may take place at any time throughout the year, although there is evidence that most egg cases are found fully or partially developed from late October to January and from June to July. The average female little skate spawns twice per year, once in the spring and once in the fall (Packer et al. 2003a).

Juveniles: Intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 262.5 feet (80 meters) and including high salinity zones in selected bays and estuaries. EFH for juvenile little skates occurs on sand and gravel substrates, but they are also found on mud. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults: Intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 328 feet (100 meters) and including high salinity zones in selected bays and estuaries. EFH for adult little skates occurs on sand and gravel substrates, but they are also found on mud. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.5.3 Winter Skate

The winter skate has a range from the southern coast of Newfoundland to Cape Hatteras and has concentrated populations on George’s Bank and the northern section of the Mid-Atlantic Bight (Packer et al. 2003b). The winter skate has very similar temperature ranges and migration patterns as the little skate. The winter skate is not heavily targeted for commercial fishing but is often bycatch in otter trawls (Collette and Klein-MacPhee 2002).

Juveniles: Sub-tidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 295.3 feet (90 meters), including the high salinity zones of selected bays and estuaries. EFH for juvenile winter skates occurs on sand and gravel substrates, but they are also found on mud. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults: Sub-tidal benthic habitats in coastal waters in the southwestern Gulf of Maine, in coastal and continental shelf waters in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 262.5 feet (80 meters), including the high salinity zones of selected bays and estuaries. EFH for adult winter skates occurs on sand and gravel substrates, but they are also found on mud. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.6 Invertebrates

The project area includes designated EFH for one or more life stages of four invertebrate species: Atlantic sea scallop, Atlantic surf clam, ocean quahog, and inshore longfin squid. Species and EFH descriptions are provided below.

5.2.6.1 Atlantic Sea Scallop

The Atlantic sea scallop is managed under NEFMC’s Sea Scallop Management Plan and focuses on the stock present within the Gulf of Maine, George’s Bank, and the Middle Atlantic Bight (Hart and Chute 2004). The sea scallop occurs along the continental shelf at depths ranging from 59 to 360.9 feet (18 to 110 meters) and is generally found in seabed areas with coast substrates consisting of gravel, shells, and rocks; the species prefers areas with low levels of inorganic suspended particles (Packer et al. 1999b). The sea scallop spawning season is in September and they rely on the currents to spread eggs and larvae in different areas. Sea scallop abundance has increased dramatically in recent years and supports a profitable commercial fishery (NEFMC, 2017).

Eggs: Benthic habitats in inshore areas and on the continental shelf in the vicinity of adult scallops. Eggs are heavier than seawater and remain on the seafloor until they develop into the first free-swimming larval stage. Designated EFH includes the SFWF and SFEC footprints.

Larvae: Benthic and water column habitats in inshore and offshore areas throughout the Greater Atlantic region south to Cape Hatteras. Any hard surface can provide an essential habitat for settling pelagic larvae (“spat”), including shells, pebbles, and gravel. They also attach to macroalgae and other benthic organisms such as hydroids. Spat attached to sedentary branching organisms or any hard surface have greater survival rates; spat that settle on shifting sand do not survive. Designated EFH includes the SFWF and SFEC footprints.

Juveniles: Benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic in depths of 59 to 360.9 feet (18 to 110 meters). Juveniles (0.2- to 0.5-inch [5 to 12-mm]) shell height) leave the original substrate on which they settle (see spat, above) and attach themselves by byssal threads to shells, gravel, and small rocks (pebble, cobble), preferring gravel. As they grow older, they lose their byssal attachment. Juvenile scallops are relatively active and swim to escape predation. While swimming, they can be carried long distances by currents. Bottom currents stronger than 10 cm/sec retard feeding and growth. In laboratory studies, maximum survival of juvenile scallops occurred between 1.2 and 15°C and above salinities of 25 ppt. On Georges Bank, age 1 juveniles are less dispersed than older juveniles and adults and are mainly associated with gravel-pebble deposits. Essential habitats for older juvenile scallops are the same as for the adults (gravel and sand). Designated EFH includes the SFWF and SFEC footprints.

Adults: Benthic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic. Essential habitats for older juvenile and adult sea scallops are found on sand and gravel substrates in depths of 59 to 360.9 feet (18 to 110 meters), but they are also found in shallower water and as deep as 360.9 feet (180 meters) in the Gulf of Maine. In the Mid-Atlantic they are found primarily between 147.7 and 246 feet (45 and 75 meters) and on Georges Bank they are more abundant between 196.9 and 295.3 feet (60 and 90 meters). They often occur in aggregations called beds which may be sporadic or essentially permanent, depending on how suitable the habitat conditions are (temperature, food availability, and substrate) and whether oceanographic features (fronts, currents) keep larval stages in the vicinity of the spawning population. Bottom currents stronger than 25 cm/sec (half a knot) inhibit feeding. Growth of adult scallops is optimal between 10 and 15 °C and they prefer full strength seawater. Designated EFH includes the SFWF and SFEC footprints.

5.2.6.2 Atlantic Surf Clam

The Atlantic surf clam is a bivalve mollusk that occupies areas along the continental shelf from southern portions of the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli et al. 1999e). The surf clam is managed under the MAFMC. Surf clams spawn in the summer and early fall and is not associated with temperature or temperature changes. The surf clam prefers sandy habitats along the continental shelf (Cargnelli et al. 1999e).

Juveniles and adults: Throughout the substrate, to a depth of 3.3 feet (1 meter) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90 percent of all the ranked 10-minute squares for the area where surf clams were caught in the NEFSC surf clam and ocean quahog dredge surveys. Surf clams generally occur from the beach zone to a depth of about 200 feet (61 meters), but beyond about 125 feet (38 meters), abundance is low. Designated EFH includes the SFEC construction footprint.

5.2.6.3 Ocean Quahog

The ocean quahog is a bivalve mollusk that is found in a range from Newfoundland to Cape Hatteras distributed along the continental shelf (Cargnelli et al. 1999d). The highest concentrations of quahogs are offshore south of Nantucket to the Delmarva Peninsula. The quahog prefers medium to fine sandy bottom with mud and silt. The ocean quahog is slow to mature. Spawning occurs from spring to fall with multiple annual spawning events (Cargnelli et al. 1999d).

Juveniles and adults: Throughout the substrate, to a depth of 3 feet (0.9 meter) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90 percent of all the ranked 10-minute squares for the area where ocean quahogs were caught in the NEFSC surf clam and ocean quahog dredge surveys. Distribution in the western Atlantic ranges in depths from 29.5 feet (9 meters) to about 800.5 feet (244 meters). Ocean quahogs are rarely found where bottom water temperatures exceed 15.5 °C and occur progressively further offshore between Cape Cod and Cape Hatteras. Designated EFH includes the SFWF and SFEC footprints.

5.2.6.4 Longfin Squid

The longfin squid is a pelagic, schooling species that has a general range from Newfoundland to the Gulf of Venezuela but is abundant enough to be considered commercially important from George's Bank to Cape Hatteras (Cargnelli et al. 1999c). This population is managed in a single stock. Longfin squid are typically found in waters that have a temperature of at least 9 °C; therefore, they move with a pattern of seasonal migrations. They move offshore in late fall and overwinter along the edge of the continental shelf; they move both inshore and north as the water temperatures raise with the seasons. Most eggs are spawned in May and hatch in July, although there are two broods, an early spring and late summer (Cargnelli et al. 1999c).

Eggs: EFH for longfin squid eggs occurs in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, generally where bottom water temperatures are between 10°C and 23°C, salinities are between 30 and 32 ppt, and depth is less than 164 feet (50 meters). Eggs have also been collected in bottom trawls in deeper water at various places on the continental shelf. Like most loliginid squids, longfin squid egg masses or "mops" are demersal and anchored to the substrates on which they are laid, which include a variety of hard bottom types (e.g., shells, lobster pots, piers, fish traps, boulders, and rocks), SAV (e.g., Fucus sp.), sand, and mud. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Juveniles (pre-recruits ≤ 3 inches [8 cm] dorsal mantle length [DML]): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, and Raritan Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 19.7 and 525 feet (6 and 160 meters) where bottom water temperatures are 8.5 to 24.5 °C and salinities are 28.5 to 36.5 ppt. Pre-recruits migrate offshore in the fall where they overwinter in deeper waters along the edge of the shelf. They make daily vertical migrations, moving up in the water column at night and down in the daytime. Small immature individuals feed on planktonic organisms while larger individuals feed on crustaceans and small fish. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults (recruits ≥ 3.5 inches [9 cm] DML): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in inshore waters of the Gulf of

Maine, and in embayments such as Narragansett Bay, Long Island Sound, Raritan Bay, and Delaware Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 19.7 and 656.2 feet (6 and 200) meters where bottom water temperatures are 8.5 to 14°C and salinities are 24 to 36.5 ppt. Recruits inhabit the continental shelf and upper continental slope to depths of 1,312.3 feet (400 meters). They migrate offshore in the fall and overwinter in warmer waters along the edge of the shelf. Like the prerecruits, they make daily vertical migrations. Individuals larger than 4.7 inches (12 cm) feed on fish and those larger than 6.3 inches (16 cm) feed on fish and squid. Females deposit eggs in gelatinous capsules which are attached in clusters to rocks, boulders, and aquatic vegetation and on sand or mud bottom, generally in depths less than 164 feet (50 meters). Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.7 Sharks

The project area includes designated EFH for one or more life stages of 10 shark species. These are the basking, blue, dusky, sand tiger, sandbar, shortfin mako, tiger, and white sharks, and the spiny and smooth dogfish. Basking, dusky, sand tiger, and white sharks are classified as "prohibited," meaning that sport and commercial fishery retention is not allowed. Species and EFH descriptions are provided below.

5.2.7.1 Basking Shark

The basking shark is the second largest fish in the world, its size exceeded only by the whale shark. Like the whale shark, it is a filter-feeding plankton eater. In the northwestern and eastern Atlantic basking sharks occur in coastal regions from April to October, usually with a peak in sightings from May until August (Kenney et al. 1985; Southall et al. 2005; Witt et al. 2012). The temporal and spatial distribution of basking sharks in both the northwestern and eastern Atlantic are thought to be influenced by seasonal water stratifications, temperature, and prey abundance (Owen 1984; Sims and Merrett 1997; Sims and Quayle 1998; Sims 1999; Sims et al. 2003; Skomal et al. 2004; Cotton et al. 2005; Witt et al. 2012). Basking sharks are known to migrate from the Northern to the Southern Hemisphere (Skomal et al. 2009).

Neonate/YOY (≤ 82.7 inches [210 cm] FL), Juveniles (83 to 349.2 inches [211 to 887 cm] FL), and Adults (> 349 inches [888 cm] FL): Insufficient data is available to differentiate EFH between size classes; therefore, EFH designations for all life stages have been combined and are considered the same. Atlantic east coast from the Gulf of Maine to the northern Outer Banks of North Carolina, and from mid-South Carolina to coastal areas of northeast Florida. Aggregations of basking sharks were observed from the south and southeast of Long Island, east of Cape Cod, and along the coast of Maine, in the Gulf of Maine and near the Great South Channel, approximately 51.3 linear miles (95 km, 59 nm) southeast of Cape Cod, Massachusetts, as well as approximately 46.6 linear miles (75 km, 40.5 nm) south of Martha's Vineyard and 48.6 linear miles (90 km, 56 nm) south of Moriche's Inlet, Long Island. These aggregations tend to be associated with persistent thermal fronts within areas of high prey density. Designated EFH includes the SFWF and SFEC footprints.

5.2.7.2 Blue Shark

The blue shark is a common, cosmopolitan species occurring in tropical, subtropical and temperate waters around the globe. It is a pelagic species that inhabits clear, deep, blue waters, usually in temperatures of 10 to 20 °C, at depths greater than 590.5 feet (180 meters) (Castro 1983). Its migratory patterns are complex and encompass great distances. Queiroz et al. (2012) showed that blue sharks occupy productive marine zones for extended periods and structure diel activity patterns across multiple spatio-temporal scales in response to particular habitat types, including diving to depths of 3,805.8 feet (1,160 meters). Howey (2010) and Campana et al. (2011) found that blue sharks in the northwest Atlantic showed restricted movements over the continental shelf during the summer months and moved offshore in the fall. This offshore movement coincided with a greater usage of the water column and diel depth patterns, possibly to follow the vertical migrations of prey species. Males and females are known to segregate in many areas (Strasburg 1958; Gubanov and Grigoryev 1975). Strasburg (1958) showed that blue sharks are most abundant in the Pacific between 40° and 50° N latitude.

Neonate/YOY (≤ 29.9 inches [76 cm] FL): In the Atlantic in areas offshore of Cape Cod through New Jersey, seaward of the 98.4-foot (30-meter) bathymetric line (and excluding inshore waters such as Long Island Sound). EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine. Designated EFH includes the SFWF and SFEC footprints.

Juvenile (30.3 to 72.4 inches [77 to 184 cm] FL) and Adult (≥ 72.8 inches [185 cm] FL): Localized areas in the Atlantic Ocean in the Gulf of Maine, from Georges Bank to North Carolina, South Carolina, Georgia, and off Florida. Designated EFH includes the SFWF and SFEC footprints.

5.2.7.3 Common Thresher Shark

The common thresher shark is found in both coastal and oceanic and cool and warm waters (NOAA 2009b). The thresher shark has a range from the south Atlantic to the Gulf of Maine. Female threshers give birth to young once a year in the spring.

Neonate/YOY, Juveniles, and Adults: EFH is located in the Atlantic Ocean, from Georges Bank (at the offshore extent of the U.S. EEZ boundary) to Cape Lookout, North Carolina; and from Maine to locations offshore of Cape Ann, Massachusetts. EFH occurs with certain habitat associations in nearshore waters of North Carolina, especially in areas with temperatures from 18.2 to 20.9 °C and at depths from 15.1 to 44.5 feet (4.6 to 13.7 meters) (McCandless et al. 2002). Designated EFH includes the SFWF and SFEC footprints.

5.2.7.4 Dusky Shark

The dusky shark has a range among warm and temperate coastal waters in the Atlantic, Pacific, and Indian oceans (McCandless et al. 2014). The dusky shark prefers both inshore waters and deeper waters along the continental shelf edge. Dusky sharks often use coastal waters as nurseries. The shark species gives birth in the Chesapeake Bay in Maryland in June and July (NOAA 2009b).

Neonate/YOY: EFH includes areas along the Atlantic east coast of Florida to the mid-coast of Georgia, and South Carolina to southern Cape Cod. Designated EFH includes the SFWF and SFEC footprints.

Juveniles and adults: EFH designation for juvenile and adult life stages have been combined and are considered the same. EFH includes localized areas in the central Gulf of Mexico, southern Texas, the Florida Panhandle, mid-west coast of Florida, and Florida Keys. EFH also includes the Atlantic east coast of Florida and South Carolina to southern Cape Cod. Designated EFH includes the SFWF and SFEC footprints.

5.2.7.5 Sand Tiger Shark

Sand tiger sharks occur off the coast of the northwest Atlantic and have been known to make transoceanic migrations (NOAA 2009b) and in North America they are rarely encountered north of the Mid-Atlantic Bight. Nurseries for tiger sharks are most likely offshore, although little is known about the pupping grounds.

Neonate/YOY and Juvenile: EFH also includes the Atlantic from the mid-east coast of Florida to Virginia. Designated EFH includes the SFWF, SFEC, and O&M facility construction footprints.

Adult: Designated EFH for adult sand tiger sharks does not include the project area.

5.2.7.6 Sandbar Shark

The sandbar shark ranges within subtropical and warm temperate waters with the North Atlantic population ranging from Cape Cod to the western Gulf of Mexico. The sandbar shark prefers bottom habitats and is most common in 65.6 to 180.4 feet (20 to 55 meters) of water, but occasionally found at depths of about 656.2 feet (200 meters). In the United States, sandbar shark nursery areas consist of shallow coastal waters from Cape Canaveral, Florida, to Martha's Vineyard, Massachusetts. The sandbar shark stock assessment considered the species to be overfished in 2006; the stock was reassessed in 2008 and was deemed to be vulnerable to overfishing. (NOAA 2009b)

Neonate/YOY: EFH includes Atlantic coastal areas localized along Georgia and South Carolina, and from Cape Lookout to Long Island, New York. Designated EFH includes the SFEC construction footprint.

Juveniles: EFH includes localized areas along the Atlantic coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New England. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Adults: EFH includes the Atlantic coastal areas throughout Florida to southern New England. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.7.7 Shortfin Mako Shark

The shortfin mako shark is an oceanic species found in warm and warm-temperate waters throughout all oceans. It feeds on fast-moving fishes such as swordfish, tuna, and other sharks (Castro 1983) as well as clupeids, needlefishes, crustaceans, and cephalopods (Maia et al. 2007a). MacNeil et al. (2005) found evidence of a dietary shift from cephalopods to bluefish in the spring.

Neonate/YOY, Juveniles, and Adults: EFH designation for all life stages are combined and are considered the same. EFH includes localized areas in the central Gulf of Mexico and the Florida Keys. In the Atlantic, EFH includes localized areas off Florida, South Carolina, and Maine, and from Cape Lookout through southern New England. Designated EFH includes the SFWF and SFEC footprints.

5.2.7.8 Tiger Shark

The tiger shark inhabits warm waters in both deep oceanic and shallow coastal regions (Castro, 1983). In the western North Atlantic Ocean, tiger sharks occur in coastal and offshore waters from approximately 40° to 0° N latitude, and have been documented to make transoceanic migrations (Driggers et al. 2008). Tiger sharks typically remain within in the upper 164 feet (50 meters) of the water column, but are known to periodically make dives to depths more than 656.2 feet (200 meters). The species is most commonly observed at shallow depths (upper 16.4 feet [5 meters]). In the North Atlantic they are rarely encountered north of the Mid-Atlantic Bight (Skomal 2007). Juvenile tiger sharks were shown to prefer seagrass flats in the Gulf of Mexico on the west coast of Florida (Bethea et al. 2014). The tiger shark is one of the larger species of sharks, reaching over 216.5 inches (550 cm) TL and over 900 kilograms. Its characteristic tiger-like markings and unique teeth make it one of the easiest sharks to identify (Castro 1983).

Neonate and YOY (≤ 39.8 inches [101 cm] FL): Designated EFH does not include the project area.

Juveniles (40.2–104.7 inches [102–266 cm] TL) and adults (> 104.7 inches [266 cm] TL): EFH in the Atlantic Ocean extends from offshore pelagic habitats associated with the continental shelf break at the seaward extent of the U.S. EEZ boundary (south of Georges Bank, off Massachusetts) to the Florida Keys, inclusive of offshore portions of the Blake Plateau. EFH in the Gulf of Mexico includes pelagic and coastal habitats between Tampa Bay, Florida Bay, and Florida Keys, and the edge of the West Florida Shelf; and an area extending from off eastern Louisiana, Mississippi, and Alabama to offshore pelagic habitats in the central Gulf of Mexico. Designated EFH includes may overlap with the SFEC construction footprint along a portion of its length.

5.2.7.9 White Shark

The white shark ranges within all temperate and tropical belts of oceans, including the Mediterranean Sea. The white shark occurs in coastal and offshore waters and has a very sporadic presence. Because of the shark's sporadic presence, very little is known about its breeding habits. Sightings of the white shark in the Mid Atlantic Bight occur from April to December. The white shark prefers open ocean habitat. In U.S. waters, white sharks are targeted in a catch-and-release-only recreational fishery, as possession of the species is prohibited. (NOAA 2009b).

Neonate/YOY (≤ 62.6 inches [159 cm] FL): EFH includes inshore waters out to 65.2 linear miles (105 km, 56.7 nm) from Cape Cod, Massachusetts, to an area offshore of Ocean City, New Jersey. Designated EFH includes the SFWF and SFEC footprints.

Juveniles (63–164.6 inches [160–418 cm] FL) and adults (> 164.6 inches [418 cm] FL): Known EFH includes inshore waters to habitats 65.2 linear miles (105 km, 56.7 nm) from shore, in water temperatures ranging from 9 to 28 °C, but more commonly found in water temperatures from 14 to 23 °C from Cape Ann, Massachusetts, including parts of the Gulf of Maine, to Long Island, New York, and from Jacksonville to Cape Canaveral, Florida. Designated EFH includes the SFWF and SFEC footprints.

5.2.7.10 Spiny Dogfish

The spiny dogfish is a circumboreal, coastally oriented shark that occurs along the continental shelf virtually everywhere in the northern and southern temperate zones (McMillan and Morse, 1999). This species is the most abundant shark in the northwest Atlantic. The shark is highly migratory, and migration patterns are reliant on prey species. Spiny dogfish are very common in New England and are found on George's Bank from March to April (Collette and Klein-MacPhee 2002). The dogfish has a depth range of 1,033.5 to 4,842.5 feet (315 to 1,476 meters). Spiny dogfish prefer temperatures ranging from 7 to 15 °C with deeper, open ocean. The dogfish spawn in deeper waters along the continental shelf.

Juveniles (male and female, < 14.2 inches [36 cm]): Designated EFH does not occur in the project area.

Female Sub-Adults (14.2–31.1 inches [36–79 cm]): Pelagic and epibenthic habitats throughout the region. Sub-adult females are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 7 to 15 °C. Sub-adult females are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15 °C. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

Male Sub-Adults (14.2–23.2 inches [36–59 cm]): Pelagic and epibenthic habitats, primarily in the Gulf of Maine and on the OCS from Georges Bank to Cape Hatteras. Sub-adult males are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 7 to 15 °C. Sub-adult males are not as widely distributed over the continental shelf as the females and are generally found in deeper water. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15 °C. Designated EFH includes the SFEC footprint.

Female Adults (≥ 31.5 inches [80 cm]): Pelagic and epibenthic habitats throughout the region. Adult females are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 7 to 15 °C. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15°C. Designated EFH includes the SFWF and SFEC footprints.

Male Adults (≥ 23.6 inches [60 cm]): Pelagic and epibenthic habitats throughout the region. Adult males are found over a wide depth range in full salinity seawater (32–35 ppt) where bottom temperatures range from 7 to 15 °C. They are widely distributed throughout the region in the winter and spring when water temperatures are lower, but very few remain in the Mid-Atlantic area in the summer and fall after water temperatures rise above 15 °C. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

5.2.7.11 Smooth Dogfish

Smooth dogfish is a common coastal shark species found in the Atlantic Ocean from Massachusetts to northern Argentina. They are primarily demersal sharks that inhabit continental shelves and are typically found in inshore waters down to a depth of 656.2 feet (200 meters) (Compagno 1984). Smooth dogfish is a migratory species that responds to changes in water temperature. They primarily congregate between southern North Carolina and the Chesapeake Bay in the winter. In the spring, smooth dogfish move along the coast when bottom water warms up to at least 6 to 7 C. As temperatures get colder, smooth dogfish move offshore to their wintering areas (Compagno 1984). Smooth dogfish can tolerate a range of temperatures from 6 to 27 °C. Smooth dogfish have diets that are dominated by invertebrates (Scharf et al. 2000). They primarily feed on large crustaceans, consisting mostly of crabs (Gelsleichter et al. 1999), but also rely heavily on American lobsters. In the New England waters during the spring, smooth dogfish feed on small bony fish, including menhaden, stickleback, wrasses, porgies, sculpins, and puffers (Compagno 1984). In Delaware Bay, smooth dogfish fed on invertebrates with larger sharks shifting to large crabs and teleosts (McElroy 2009).

Neonate/YOY, Juvenile, and Adult: Smooth dogfish are included in the EFH designation for the smoothhound shark complex. At this time, available information is insufficient for the identification of EFH for this life stage; therefore, all life stages are combined in the EFH designation. The smoothhound shark EFH identified in the Gulf of Mexico is for smooth dogfish, Florida smoothhound, and Gulf smoothhound. EFH in the Gulf of Mexico includes offshore areas from Florida to Texas, roughly following the continental shelf break in habitats ranging from 164 to 656.2 feet (50 to 200 meters) in depth. Designated EFH includes the SFWF, SFEC, and O&M facility footprints.

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6 Effects on Essential Fish Habitat

This section provides an analysis of the effects of the proposed project on designated EFH for managed species and life stages in the project area defined in Section 1.2. As stated, the project area is composed of the maximum impact footprints resulting from the SFWF, SFEC and O&M facility. These footprints are defined by the geographic extent of measurable short-term and long-term effects from project construction and operation, which are quantified by impact mechanism in Section 4. Potential effects on EFH are evaluated in this section by 1) determining if designated EFH occurs in one or more project footprints, and 2) determining if the impact mechanisms described in Section 4 are likely to impair the suitability of the affected habitat for the species and life stage in question. Adverse effects on EFH may include direct or indirect physical, chemical, or biological alterations of waters or substrates used by EFH species during their life cycle, impacts to pelagic and benthic prey organisms and their habitats, and other ecosystem components. Adverse effects may be short-term or long-term, site-specific or habitat-wide, and can result from the individual, cumulative, or synergistic consequences of actions (50 CFR § 600.910). If a project component is likely to result in a short-term or long-term impairment of designated EFH for a managed species and life stage, this would constitute an adverse effect on EFH.

6.1 Short-Term Effects on EFH from Project Construction

Project construction will generate short-term effects on EFH through construction noise; crushing, burial, and entrainment effects; and suspended sediments from bed disturbance. These effects would occur intermittently at varying locations in the project area over the duration of project construction. Depending on the nature, extent, and severity of each effect, this may temporarily reduce the suitability of EFH for managed species. This would constitute a short-term adverse effect on EFH.

6.1.1 Construction Noise Impacts

The construction of the SFWF, SFEC, and O&M facility involves activities that would generate underwater noise exceeding established thresholds for mortality and permanent or temporary injury, TTS, and behavioral effects. Underwater noise would temporarily render the affected habitats unsuitable for EFH species and could temporarily impact prey availability for EFH species. The extent, duration, and severity of noise effects on EFH would vary depending on the noise source and the sensitivity of the affected EFH species and their prey to noise impacts during their life cycle. These effects are detailed by project component in the following sections. The magnitude, extent, timing, and duration of construction noise effects and EFH species exposure is summarized by project component in Appendix A, Table A-1.

The assessment of noise impacts provided in the following sections emphasizes direct noise effects on EFH species based on the sensitivity of different hearing groups and life stages.

However, these results are also applicable to prey resources used by EFH species. Fish eggs and larvae are prey and forage resource for some EFH species during certain life stages. Fish and invertebrates from any hearing group may provide prey for EFH species. Accordingly, short-term noise impacts that temporarily reduce habitat suitability for EFH species may also have localized effects on the availability of their prey resources. Individual prey organisms may be more or less available to EFH species depending on the nature of the noise effect and species-specific sensitivity. In contrast, temporary injury, auditory masking, or behavioral effects may limit the ability of EFH species to detect and locate prey organisms. A full accounting of these complex mechanisms is beyond the scope of this assessment, but in general, short-term noise impacts on prey organisms are considered an adverse effect on EFH.

6.1.1.1 SFWF Construction

Impact pile driving noise impacts would occur over a total of 16 days, with a typical day of pile driving composed of 4,500 pile strikes over 2 hours. One 36-foot (11-meter) monopile may require up to 4,500 pile strikes over 4 hours. Each day’s pile driving activity would be separated by at least 12 to 20 hours of relative quiet, depending on the installation schedule selected. Under the standard installation schedule 16 total days of pile driving would occur, with 1 pile installed every other day. Under the aggressive installation schedule, a total of 6 piles would be installed over 7 days. In total, monopile installation would require 2 to 4 hours of impact pile driving on a total of 16 days distributed over a period lasting from 1 to 4 months as determined by activity restrictions to protect marine mammals and sea turtles. Installation would occur between May and December 2023.

HRG surveys would be conducted concurrent with monopile installation in both the SFWF and the SFEC. The duration of HRG equipment operation would total approximately 60 days distributed over 2 to 4 months from May to December 2023. HRG survey equipment is towed at a typical speed of 4 knots (1.9 kilometers per hour) during operation, meaning that no individual area is continuously exposed to significant underwater noise (i.e., noise exceeding an established effect threshold) for more than approximately 20 minutes.

Construction vessels would generate continuous underwater noise at various locations throughout the project area during SFWF development. For the purpose of this analysis, vessels are assumed to generate continuous underwater noise 24 hours a day for up to 8 months, from May through December 2023.

Noise Effects on Eggs and Larvae

Impact pile driving would produce the most extensive underwater noise effects resulting from the project. Applying the noise impact thresholds defined in Section 4.1.1, the area of water column and benthic EFH for eggs and larvae exposed to potentially lethal instantaneous noise effects would extend up to 475.7 or 377.3 feet (145 or 115 meters) from each 26.2-foot and 36-foot (8-meter and 11-meter) monopile, respectively, depending on the design alternative selected.

The total area of water column and benthic habitat for eggs and larvae exposed to potentially lethal cumulative noise effects would cover up to 558 or 2,839 total acres (226 or 1,149 total hectares) for the 26.2-foot and 36-foot (8-meter and 11-meter) design alternatives, respectively (see Section 4.1.1.1). These effects would apply to both the eggs and larvae of EFH and eggs and larvae that provide prey for EFH species. The cumulative injury exposure area values are conservative, as planktonic eggs and larvae drift with the current and would not necessarily remain within the same exposure area over an entire 2- to-4-hour pile driving period.

Underwater noise produced by HRG survey equipment falls below the instantaneous injury threshold for eggs and larvae. HRG surveys are mobile at a typical speed of 4 knots, meaning that planktonic eggs and larvae would not experience continuous exposure of sufficient duration to accumulate cumulative noise impacts. Continuous underwater noise from construction vessels is unlikely to cause injury or mortality to eggs and larvae of marine fish and invertebrates (Popper et al. 2014).

EFH for eggs and larvae of the following species would be rendered temporarily unsuitable by short-term exposure to underwater noise from SFWF construction sufficient to cause injury or mortality-level effects:

- Atlantic cod
- Haddock (larvae only)
- Pollock
- Red hake
- Silver hake
- White hake
- Atlantic herring (larvae only)
- Atlantic mackerel
- Bluefish
- Butterfish
- Ocean pout (eggs only)
- Monkfish
- Bluefin tuna (larvae only)
- Summer flounder
- Windowpane flounder
- Witch flounder
- Yellowtail flounder
- Atlantic sea scallop

Noise Effects on Fish with Swim Bladder Involved in Hearing (Hearing Specialists)

Construction of the SFWF would result in impulsive and continuous noise sources that exceed the effects thresholds for hearing specialist fish species defined in Section 4.1.1. The affected area includes EFH for juvenile and adult fish belonging to the hearing specialist group. Hearing specialist fish that provide prey for EFH species would also be temporarily affected. Water column and benthic EFH exposed to underwater noise in excess of potential lethal, recoverable injury, TTS, and behavioral effects are described by noise source for impact pile driving, HRG surveys, and vessel noise below.

Potentially lethal effects from the 26.2 foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 262 and 163 total acres (106 and 66 total hectares) (within 475.7 and 377.3 feet [145 and 115 meters of the source)
- Cumulative injury: Up to 1,643 and 7,455 total acres (665 and 3,017 total hectares) (within 1,184.4 and 2,421.3 to 3,960 feet [361 and 738 to 1,207 meters] of the source)

Recoverable injury level effects from the 26.2 foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 262 and 163 total acres (106 and 66 total hectares) (within 475,73 and 377.3 feet [145 and 115 meters] of the source)
- Cumulative injury: Up to 6,365 and 7,455 total acres (2,576 and 3,017 total hectares) (within 2,349 and 4,662 to 6,430.4 feet [716 and 1,421 to 1,960 meters] of the source).

TTS and behavioral level effects from the 26.2 foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous TTS exposure: Up to 83,003 and 11,8895 total acres (33,590 and 48,115 total hectares) (within 22,014.4 and 28,441.6 feet [6,710 and 8,699 meters] of the source)
- Behavioral effects exposure: Up to 201,171 and 204,037 total acres (81,411 and 82,571 total hectares) (within 40,577.4 and 40,948.2 feet [12,368 and 12,481 meters] of the source)

The cumulative exposure area values presented above assume that an individual fish would remain within the same exposure area over an entire 2- to-4-hour pile driving period.

Underwater noise levels produced by HRG surveys and construction vessel activity are unlikely to cause injury but may cause TTS and behavioral effects on hearing specialist fish species. The potential extent of TTS and behavioral level effects on this hearing group are as follows:

- Instantaneous TTS exposure: Within < 16.4 feet (5 meters) of HRG survey equipment (cumulative effects unlikely)
- Cumulative TTS exposure (vessel noise): Up to 17,562 total acres (7,107 total hectares) (within 183.7 feet [56 meters] of operating vessels)
- Behavioral effects exposure:
    - Vessel noise: Up to 18,231 acres (7,378 hectares) (within 443 feet [135 meters] of operative vessels
    - HRG surveys: Up to 1,627,335 acres (658,559 hectares) total for SFWF and SFEC combined (within 2,572.2 feet [784 meters] of operating HRG equipment)

The following EFH species belong to the hearing specialist group and have habitats that are likely to be adversely affected by underwater noise from construction of the SFWF:

- Atlantic cod (juvenile, adult, spawning)
- Pollock (juvenile)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile)
- Black sea bass (juvenile, adult)
- Bluefish (juvenile, adult)
- Monkfish (juvenile, adult, spawning)
- Atlantic herring (juvenile, adult, spawning)

Noise Effects on Fish with Swim Bladder Not Involved in Hearing (Hearing Generalists)

Construction of the SFWF would result in impulsive and continuous noise sources that exceed the effects thresholds for hearing generalist fish species defined in Section 4.1.1. The affected area includes EFH for juvenile and adult fish species belonging to the hearing specialist group. Hearing generalist fish that provide prey for EFH species would also be temporarily affected. Water column and benthic EFH exposed to underwater noise in excess of potential lethal, recoverable injury, TTS, and behavioral effects are described by noise source for impact pile driving, HRG surveys, and vessel noise below.

Potentially lethal effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 262 and 163 total acres (106 and 66 total hectares) (within 475.7 and 377.3 feet [145 and 115 meters] of the source)
- Cumulative injury: Up to 558 and 2,839 total acres (226 and 1,149 total hectares) (within 695.5 and 1,499.3 to 2,378.6 feet [212 and 457 to 725 meters] of the source)

Recoverable injury level effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 262 and 163 total acres (106 and 66 total hectares) (within 145 and 377.3 feet [115 meters] of the source)
- Cumulative injury: Up to 6,365 and 7,455 total acres (2,576 and 3,017 total hectares) (within 2,349.1 and 2,421.3 to 3,9560 feet [716 and 738 to 1,207 meters] of the source).

TTS and behavioral level effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) (normal and difficult installation) monopile alternatives, respectively:

- Instantaneous TTS exposure: Up to 83,003 and 118,895 total acres (33,590 and 48,115 total hectares) (within 22,014.4 and 28,540 feet [6,710 and 8,699 meters] of the source)
- Behavioral effects exposure: Up to 201,171 and 204,037 total acres (81,411 and 82,571 total hectares) (within 40,636.5 and 40,948.1 feet [12,368 and 12,481 meters] of the source)

The cumulative exposure area values presented above assume that an individual fish would remain within the same exposure area over an entire 2- to 4-hour pile driving period.

Underwater noise levels produced by HRG surveys and construction vessel activity are unlikely to cause injury but may cause TTS and behavioral effects on hearing generalist fish species. The potential extent of TTS and behavioral level effects on this hearing group are as follows:

- Instantaneous TTS exposure: Within < 16.4 feet [5 meters] of HRG survey equipment (cumulative effects unlikely)
- Cumulative TTS exposure (vessel noise): Up to 17,562 total acres (7,107 total hectares) (within 183.7 feet [56 meters] of operating vessels)
- Behavioral effects exposure:
    - Vessel noise: Up to 18,231 acres (7,378 hectares) (within 442.9 feet [135 meters] of operative vessels
    - HRG surveys: Up to 1,627,335 acres (658,559 hectares) total for SFWF and SFEC combined (within 2,572.2 feet [784 meters] of operating HRG equipment)

The following EFH species belong to the hearing generalist group and have habitats that are likely to be adversely affected by underwater noise from construction of the SFWF.

- Ocean pout (juvenile, adult, spawning)
- Butterfish (juvenile, adult)
- Scup (juvenile, adult)
- Albacore (juvenile, adult)
- Bluefin tuna (juvenile, adult)
- Skipjack tuna (juvenile, adult)
- Yellowfin tuna (juvenile, adult)

Noise Effects on Fish with no Swim Bladder

Impulsive and continuous noise sources from SFWF construction would exceed the effects thresholds for fish with no swim bladder defined in Section 4.1.1. The affected area includes EFH for the juvenile and adult bony fishes and elasmobranch species belonging to this hearing group. Fish in this hearing group that provide prey for EFH species would experience similar effects. Water column and benthic EFH exposed to underwater noise in excess of potential lethal, recoverable injury, TTS, and behavioral effects are described by noise source for impact pile driving, HRG surveys, and vessel noise below.

Potentially lethal effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 42 and 12 total acres (17 and 5 total hectares) (within 190.3 and 98.4 feet [58 and 30 meters] of the source)
- Cumulative injury: Up to 0 and 183 total acres (0 and 74 total hectares) (within 0 and 393.7 to 472.4 feet [0 and 120 to 144 meters] of the source)

Recoverable injury level effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous injury: Up to 42 and 326 total acres (17 and 132 total hectares) (within 190.3 and 531.5 feet [58 and 162 meters] of the source)
- Cumulative injury: Up to 124 and 346 total acres (50 and 140 total hectares) (within 190.3 and 531.5 to 748 feet [58 and 162 to 228 meters] of the source).

TTS and behavioral level effects from the 26.2-foot (8-meter) (normal installation) and 36-foot (11-meter) monopile (normal and difficult installation) alternatives, respectively:

- Instantaneous TTS exposure: Up to 83,003 and 118,895 total acres (33,590 and 48,115 total hectares) (within 22,014.4 and 28,540 feet [6,710 and 8,699 meters] of the source)
- Behavioral effects exposure: Up to 201,171 and 204,037 total acres (81,411 and 82,571 total hectares) (within 40,577.4 and 40,948.2 feet [12,368 and 12,481 meters] of the source)

The cumulative exposure area values presented above assume that an individual fish would remain within the same exposure area over an entire 2- to-4-hour pile driving period.

Underwater noise levels produced by HRG surveys and construction vessel activity are unlikely to cause injury but may cause TTS and behavioral effects on this hearing group. The potential extent of TTS and behavioral level effects on this hearing group are as follows:

- Instantaneous TTS exposure: Within < 16.4 feet (5 meters) of HRG survey equipment (cumulative effects unlikely)
- Cumulative TTS exposure (vessel noise): Up to 17,562 total acres (7,107 total hectares) (within 183.7 feet [56 meters] of operating vessels)
- Behavioral effects exposure:
  - Vessel noise: Up to 18,231 acres (7,378 hectares) (within 443 feet [135 meters] of operative vessels
  - HRG surveys: Up to 1,627,335 acres (658,559 hectares) total for SFWF and SFEC combined (within 2,572.2 feet [784 meters] of operating HRG equipment)

The following EFH species belong to the hearing group of fishes that lack a swim bladder and have habitats that are likely to be adversely affected by underwater noise from construction of the SFWF:

- Summer flounder (adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Basking shark (neonate/YOY, juvenile, adult)
- Blue shark (neonate/YOY, juvenile, adult)
- Dusky shark (neonate/YOY, juvenile, adult)
- Common thresher shark (neonate/YOY, juvenile)
- Shortfin mako shark (neonate/YOY, juvenile)

- Witch flounder (adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (juvenile, adult)
- Tiger shark (juvenile, adult)
- White shark (neonate/YOY, juvenile)
- Smooth dogfish (neonate/YOY, juvenile, adult)
- Spiny dogfish (subadult, adult)

Noise Effects on Invertebrates

As discussed in Section 4.1.1, invertebrates like squid, bivalves, worms, and crustaceans lack specialized hearing organs and gas-filled body cavities and sense sound in the form of particle motion rather than sound pressure. These organisms are therefore relatively insensitive to intense underwater noise. Popper et al. (2014) were unable to identify useful particle motion thresholds for injury or behavioral-level effects. However, the extent of potential behavioral effects on EFH invertebrate species and invertebrates that provide prey for EFH species can be inferred by comparing noise levels for impulsive noise sources to those evaluated in recent studies (Carroll et al. 2016; Edmonds et al. 2016; Jones et al. 2020, 2021; Hawkins and Popper 2014; Payne et al. 2007). Continuous noise sources like vessel engines are unlikely to produce behavioral effects in invertebrates.

The consensus of the cited studies suggests that impact pile driving could produce behavioral effects on squid in proximity to the seabed (i.e., within 3.3 feet [1 meter]) extending up to 1,640.4 feet [500 meters] from the source, for a total effect area of 776 acres (314 hectares) from SFWF construction. Squid within 6.5 feet [2 meters] of HRG survey equipment may exhibit behavioral responses to particle motion effects, which equates to a total exposure area of 4,151 acres (1,680 hectares) for the combined surveys of the SFWF and alternative SFEC corridors. Bivalves, crustaceans, and other benthic invertebrates are far less sensitive to particle motion effects, becoming unresponsive to intense noise sources like impact pile driving within 16.4 feet (5 meters) of the source. This equates to a total behavioral effect area for EFH invertebrates and invertebrate prey organisms of approximately 0.99 acre (0.40 hectare) around all 16 monopiles. Bivalve EFH species and other benthic invertebrate prey organisms are unlikely to be close enough to HRG survey equipment to detect particle motion effects.

The following EFH invertebrate species are likely to be exposed to impulsive noise sources from SFWF construction sufficient to temporarily alter their behavior:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)
- Longfin squid (eggs, juvenile, adult)

6.1.1.2 SFEC Construction

Underwater noise sources from SFEC construction include the potential use of vibratory pile driving to install the temporary cofferdam at the sea-to-shore transition site, HRG surveys of the alternative SFEC corridors, and noise from construction vessels associated with each of these activities.

The SFEC sea-to-shore transition would be constructed between October 1, 2022, and May 31, 2023. Two alternatives are being considered for the temporary cofferdam used to construct this project feature: a gravity cell or a sheetpile structure installed using a vibratory hammer. The former would not produce any significant noise effects and is therefore not considered further. Vibratory installation of the sheetpile cofferdam would require approximately 18 hours, during which continuous underwater noise would occur intermittently as each sheetpile is placed. The sheetpiles would be removed when the sea-to-shore transition is completed, requiring a similar 18 hours of vibratory hammer operation.

HRG surveys may also be conducted to assist with micrositing of the SFEC corridor. The COP reports the total HRG survey effort for the SFWF and SFEC combined without differentiating the effort for each component. Underwater noise effects for the combined SFWF and SFEC HRG survey effort are described by hearing group in Section 6.1.1.1.

The cable-laying vessel used to install the SFEC and the various construction vessels used to complete the sea-to-shore transition would generate effectively continuous underwater noise 24 hours/day during their respective construction periods. Cable laying would require a total of 74 days and would occur between May and December 2023. The sea-to-shore transition would be constructed over 12 weeks during the same period.

Noise Effects on Eggs and Larvae

Continuous noise sources like vibratory pile driving and vessel engines are unlikely to cause adverse effects on eggs and larvae. Popper et al. (2014) was unable to identify useful thresholds for evaluating potential injury or mortality effects from this type of noise source. On this basis, underwater noise effects from SFEC construction on habitats used by eggs and larvae of EFH species and their prey are expected to be insignificant. The following EFH species are likely to be exposed to underwater noise from SFEC construction during the egg and larval life stages:

- Atlantic cod
- Haddock (larvae only)
- Red hake
- Silver hake
- Black sea bass
- Atlantic herring (larvae only)
- Atlantic mackerel
- Bluefish
- Butterfish
- Ocean pout
- Atlantic herring
- Monkfish
- Scup (eggs only)
- Summer flounder
- Windowpane flounder
- Winter flounder
- Witch Flounder
- Yellowtail flounder
- Atlantic sea scallop
- Longfin squid

Noise Effects on Fish with Swim Bladder Involved in Hearing

Underwater noise from SFEC construction is unlikely to exceed lethal injury thresholds for the hearing specialist group of fishes. Vibratory pile driving noise is likely to exceed thresholds sufficient to cause recoverable injury, TTS, and behavioral level effects on EFH species and prey organisms in the hearing specialist fish group. Water column and benthic EFH exposed to underwater noise in excess of potential recoverable injury, TTS, and behavioral effects are described by noise source for vibratory pile driving and vessel noise as follows.

Vibratory pile driving noise:

- Recoverable cumulative injury: 2.5 total acres (1 total hectare) (within 206.7 feet [63 meters] of source)
- TTS: 45 total acres (18 total hectares) (within 780.8 feet [238 meters] of source)
- Behavioral effects: 420 total acres (170 total hectares) (within 2,555.8 feet [779 meters] of source)

Cable-laying vessel noise

- Recoverable cumulative injury: Unlikely to occur (requires continuous exposure < 3.3 feet [1 meter] from mobile source)
- TTS: Unlikely to occur (requires continuous exposure within 39.4 feet (12 meters) of mobile source)
- Behavioral: 6,637 and 5,357 total acres (2,686 and 2,168 total hectares) for the Beach Lane and Hither Hills alternatives, respectively (area within 443 feet [135 meters] of mobile source)

The following EFH species belong to the hearing specialist group and have habitats that are likely to be adversely affected by underwater noise from construction of the SFEC:

- Atlantic cod (juvenile, adult, spawning)
- Haddock (juvenile, adult)
- White hake (juvenile)
- Black sea bass (juvenile, adult)

- Pollock (juvenile)
- Red hake (juvenile, adult)
- Silver hake (juvenile, adult)
- Bluefish (juvenile, adult)
- Monkfish (juvenile, adult)
- Atlantic herring (juvenile, adult)

Noise Effects on Fish with Swim Bladder not Involved in Hearing and Fish Without a Swim Bladder

Underwater noise from SFEC construction is unlikely to exceed lethal injury thresholds for the hearing generalist group of fishes and fishes lacking a swim bladder. Vibratory pile driving noise is likely to exceed thresholds sufficient to cause recoverable injury, TTS, and behavioral level effects on hearing specialist fish species and prey organisms for EFH species belonging to this hearing group. Water column and benthic EFH exposed to underwater noise in excess of potential recoverable injury, TTS, and behavioral effects are described by noise source for vibratory pile driving and vessel noise as follows.

Vibratory pile driving noise:

- Recoverable cumulative injury: Unlikely to occur (noise source below threshold)
- TTS: Unlikely to occur (noise source below threshold)
- Behavioral effects: 420 total acres (170 total hectares) (within 2,555.8 feet [779 meters] of source)

Cable-laying vessel noise

- Recoverable cumulative injury: Unlikely to occur (requires continuous exposure < 3.3 feet [1 meter] from mobile source)
- TTS: Unlikely to occur (requires continuous exposure within 16.4 feet [5 meters] of mobile source)
- Behavioral: 6,637 and 5,357 total acres (2,686 and 2,168 total hectares) for the Beach Lane and Hither Hills alternatives, respectively (area within 443 feet [135 meters] of mobile source)

The following EFH species belong to the hearing generalist group and have habitats that are likely to be adversely affected by underwater noise from construction of the SFEC:

- Ocean pout (juvenile, adult, spawning)
- Scup (juvenile, adult)
- Butterfish (juvenile, adult)
- Atlantic mackerel (juvenile, adult, spawning)
- Atlantic bluefin (juvenile, adult)
- Atlantic yellowfin (juvenile, adult)
- Albacore (juvenile)
- Atlantic skipjack (adult)

The following EFH species belong to the group of fishes that lack a swim bladder and have habitats that are likely to be adversely affected by underwater noise from construction of the SFEC:

- Summer flounder (juvenile, adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)
- Basking shark (neonate/YOY, juvenile)
- Blue shark (neonate/YOY, juvenile)
- Dusky shark (neonate/YOY, juvenile)
- Common thresher shark (neonate/YOY, juvenile)
- Shortfin mako shark (neonate/YOY, juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- White shark (neonate/YOY, juvenile)
- Smooth dogfish (neonate, juvenile, adult)
- Spiny dogfish (subadult, adult)

Noise Effects on Invertebrates

The consensus of the cited studies suggests that bivalves, and other benthic organisms within 6.6 feet (2 meters) and squid within 16.4 feet (5 meters) of vibratory pile driving may exhibit behavioral responses to particle motion effects, which equates to total exposure areas of 0.15 and 0.37 acre (0.06 and 0.15 hectare), respectively. Construction vessel noise is unlikely to cause behavioral effects on invertebrates.

EFH for the following invertebrate species are likely to be exposed to vibratory pile driving noise from SFEC construction sufficient to temporarily alter their behavior in designated habitat:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)
- Longfin squid (juvenile, adult)

6.1.1.3 O&M Facility Construction

Construction of the SFWF O&M facility would require dredging of the 0.034-acre (0.014-hectare) berthing area for the CTV to achieve a maintained depth of -12.1 feet (-3.7 meters) and will involve vibratory and possibly impact pile driving to replace existing overwater structures. The planned construction window for the O&M facility extends from late 2021 through mid to late 2022. Approximately 18 to 24 hours of vibratory pile driving would be required to complete installation of 6 24-inch steel mooring piles, which could occur at any point during the 9- to-12-month construction window. Dredging and associated vessel use would occur intermittently and could last up to 5 months, with the total duration of dredging activities lasting up to 60 days. The timing and duration of specific construction activities in Montauk Harbor would be determined by federal and state permit requirements.

Noise Effects on Eggs and Larvae

Continuous noise sources like vibratory pile driving, dredging, and vessel engines are unlikely to cause adverse effects on eggs and larvae. Popper et al. (2014) was unable to identify useful thresholds for evaluating potential injury or mortality effects from this type of noise source. On this basis, underwater noise effects from continuous noise sources used during O&M facility construction on habitats used by eggs and larvae are expected to be insignificant. As stated in Sections 2.1.1 and 4.1.1.3 however, impact pile driving may be required to complete installation of some of the 6 24-inch steel piles. Should this occur, fish eggs and larvae in an approximately 0.034-acre (0.014-hectare) area within the O&M facility footprint could be exposed to lethal injury from cumulative sound exposure. This would constitute a short-term effect on habitat suitability for designated egg and larval EFH in Lake Montauk and may also temporarily reduce food availability for EFH species that prey on fish eggs and larvae.

The following EFH species are likely to be exposed to underwater noise from O&M facility construction during the egg and larval life stages:

- Atlantic cod (eggs)
- Red hake (eggs and larvae)
- Black sea bass (eggs and larvae)
- Butterfish (eggs)
- Scup (eggs and larvae)
- Atlantic mackerel (eggs and larvae)
- Summer flounder (eggs and larvae)
- Windowpane flounder (eggs and larvae)
- Winter flounder (eggs and larvae)
- Longfin squid (eggs)

Noise Effects on Fish with Swim Bladder Involved in Hearing

No hearing specialist EFH species occur in Montauk Harbor during their juvenile or adult life stages. Noise effects on other fish species that provide prey for species in this hearing group would be limited in extent and duration and would therefore have insignificant effect on the prey availability component of EFH for fish in this hearing group.

Noise Effects on Fish with Swim Bladder Not Involved in Hearing

Scup is the only EFH species belonging to the hearing generalist group that is likely to occur in Montauk Harbor during the juvenile and adult life stages. Other hearing generalist fish species that are preyed upon by EFH may also be affected by pile driving noise. Underwater noise from vibratory pile driving and dredging activities are unlikely to cause lethal effects on scup and other EFH prey species in this hearing group. Vibratory pile driving could cause recoverable injury on individuals within 206.7 feet (63 meters) of the source, which equates to an estimated total exposure area of 1.7 acres (0.7 hectare) when geographic constraints on noise propagation are considered. Pile driving could cause TTS and behavioral effects up to 780.8 feet and 2,555.8 feet (238 meters and 779 meters) from the source, respectively, which equates to estimated TTS and behavioral effects exposure areas of 22 and 237 acres (9 and 96 hectares), respectively.

If required to complete pile installation, impact pile driving could produce potentially injurious or lethal cumulative noise effects for species in this hearing group over an approximately 0.02-acre (0.008-hectare) area within the O&M facility construction footprint. Instantaneous noise impacts sufficient to cause TTS and behavioral alteration could extend over a larger area, covering approximately 15.8 and 621 acres (6.4 and 252 hectares) of inshore habitats within Lake Mountauk, respectively, constrained by surrounding shorelines. This would constitute a short-term adverse effect on habitat suitability for scup. TTS and behavioral effects could conceivably increase or decrease foraging opportunities for scup, depending on how fish prey respond to noise exposure. These effects would be short-term in duration, lasting for minutes to hours after this construction element is completed.

Dredging and associated vessel noise could cause TTS and behavioral level effects on juvenile and adult scup within 183.7 and 443 feet (56 meters and 135 meters) from the source, respectively, which equates to estimated TTS and behavioral effects exposure areas of 956 and 2,315 acres (387 and 937 hectares), respectively.

Noise Effects on Fish with no Swim Bladder

Several EFH species in the hearing group of fishes lacking swim bladders are known or likely to occur in Lake Montauk and have EFH in the proposed O&M facility construction footprint. EFH prey species in this hearing group also occur in Lake Montauk and may be adversely affected by underwater noise impacts. Vibratory pile driving could cause recoverable injury on individuals in this hearing group within 206.7 feet (63 meters) of the source, which equates to an estimated total exposure area of 1.7 acres (0.7 hectare) when geographic constraints on noise propagation are considered. Pile driving could cause TTS and behavioral effects up to 781 feet and 2,555.8 feet (238 meters and 779 meters) from the source, respectively, which equates to estimated TTS and behavioral effects exposure areas of 22 and 237 acres (9 and 96 hectares), respectively.

The estimated noise levels likely to result from impact pile driving are below the thresholds associated with potential lethal effects on fish species that lack a swim bladder. Impact pile driving could generate sufficient noise to cause recoverable injuries on fish in this hearing group that occur in a 0.1-acre (0.04-hectare) area within the O&M facility construction footprint. However, injury-level exposure is unlikely to occur as this would require fish to remain within this exposure area for an entire construction day. Instantaneous noise impacts sufficient to cause TTS and behavioral alteration could extend over a larger area, covering approximately 15.8 and 621 acres (6.4 and 252 hectares) of inshore habitats within Lake Mountauk, respectively, constrained by surrounding shorelines. This would constitute a short-term adverse effect on habitat suitability for EFH species in this hearing group. TTS and behavioral effects could conceivably increase or decrease foraging opportunities for these species, depending on how fish prey respond to noise exposure. These effects would be short-term in duration, lasting for minutes to hours after this construction element is completed.

Dredging and associated vessel noise could cause TTS and behavioral level effects on juvenile and adults in this hearing group within 183.7 feet and 443 feet (56 meters and 135 meters) from the source, respectively, which equates to estimated TTS and behavioral effects exposure areas of 956 and 2,315 acres (387 and 937 hectares), respectively.

The following EFH species belong to the group of fishes that lack a swim bladder and have habitats that are likely to be adversely affected by underwater noise from O&M facility construction:

- Summer flounder (juvenile, adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Little skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- Spiny dogfish (subadult, adult males)

Noise Effects on Invertebrates

Longfin squid are the only EFH invertebrate species likely to occur in Lake Montauk, and may be present during egg, juvenile, and adult life stages. Impact and vibratory pile driving are the only underwater noise sources likely to elicit a behavioral response in this species. Individuals within 6.6 feet (2 meters) of vibratory pile driving may experience behavioral effects. This equates to a behavioral effect exposure area of approximately 0.20 acre (0.08 hectare). Recent research (Jones et al. 2020, 2021) suggests that squid can detect particle motion effects from impact pile driving transmitted through sediments at distances theoretically extending up to 1,640.4 feet (500 meters) from the source (see Section 4.1.1). This equates to approximately 40 acres (16.2 hectares) of EFH potentially exposed to underwater noise sufficient to cause short-term behavioral effects. Noise exposure could increase or decrease prey availability for longfin squid depending on the nature of prey species response to noise exposure. Noise effects on this component of EFH would similarly be short-term in duration based on the rationale presented in previous sections.

6.1.2 Crushing, Burial, and Entrainment Impacts

The effects of crushing, burial, and entrainment impacts on EFH resulting from project construction will vary depending on how benthic and near-bottom habitats exposed to these impacts are used by EFH species. EFH is divided into the following components for the purpose of this assessment:

- Bottom habitats used by EFH fish and invertebrate species having benthic or epibenthic eggs and larvae

- Bottom habitats used by EFH fish species having benthic or epibenthic juvenile life stages
- Bottom habitats used by EFH fish species that are benthic or epibenthic as adults
- Bottom habitats used by EFH shellfish species

As described in Section 4.1.2, the potential for crushing, burial, and entrainment impacts are limited to the permanent footprint of the project and associated temporary disturbance areas. Within these areas, benthic or epibenthic EFH species and/or life stages will be the primary groups affected, with secondary effects on EFH species and/or life stages that prey on benthic and epibenthic organisms. Pelagic species and/or life stages would not be at risk for lethal crushing or burial impacts but could be subject to entrainment effects. Only those life stages likely to be directly exposed to crushing, burial, or entrainment effects or associated effects on benthic prey species are addressed in this section. Crushing, burial, and entrainment exposure and associated effects on benthic prey organisms represent a temporary reduction in habitat suitability for EFH species. The magnitude, extent, timing and duration of crushing, burial, or entrainment effects from SFWF, SFEC, and O&M facility construction on EFH species are detailed in Appendix A, Table A-2.

6.1.2.1 SFWF Construction

SFWF construction would have the potential to crush, bury, or entrain EFH species utilizing benthic or epibenthic habitats within the permanent footprint of project infrastructure and the temporary construction disturbance area. Construction is expected to occur between May and December 2023, but the frequency of impacts would be intermittent during this range. Each monopile is expected to require 2 to 4 days for installation and the inter-array cable would be installed in approximately 60 days. Thus, crushing, burial, and entrainment effects would be limited in duration but could occur throughout the anticipated construction window.

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic, Epibenthic, and Pelagic Eggs and Larvae

Benthic or epibenthic eggs that occur within the SFWF work area could be exposed to lethal crushing, burial, or entrainment effects. This includes eggs and larvae of selected EFH species, and eggs and larvae that provide prey for EFH species. The total spatial extent of these potential impacts is 820 acres (332 hectares), including monopile and scour protection installation, inter-array cable installation and protection, and vessel anchoring. Refer to Section 4.1.2.1 for details on the extent of impacts associated with each SFWF construction activity.

Crushing and burial impacts result from the placement of material on the substrate and would be lethal for benthic and epibenthic eggs and larvae that do not have the ability to avoid the area. Entrainment impacts could result from use of the hydroplow for the inter-array cable installation. It is assumed that all entrained eggs and larvae would be killed. The jet plow will move at a rate of approximately 5,249.3 to 10,498.7 feet (1,600 to 3,200 meters) per day along the inter-array cable alignment and would withdraw 1,400 m^3 of sea water per hour, or approximately 16,800 m^3 per day (assuming a 12-hour workday). Given the surface-oriented water intake, the volume withdrawn represents the amount of pelagic habitat rendered temporarily unsuitable. Although the jet plow intake will be screened to avoid and minimize entrainment of small fish, planktonic eggs and larvae of some EFH species, and their planktonic prey may be entrained. Inspire Environmental (2018) estimated that up to 382 million eggs of EFH species within the mean density percentile could be killed through entrainment during construction of the inter-array cable. The following EFH species with benthic, epibenthic, or pelagic eggs or larvae that may be exposed to crushing, burial, or entrainment effects during SFWF construction:

- Atlantic cod (eggs, larvae)
- Haddock (eggs, larvae)
- Red hake (eggs, larvae)
- Silver hake (eggs, larvae)
- White hake (larvae)
- Monkfish (eggs, larvae)
- Bluefish (eggs, larvae)
- Black sea bass (eggs, larvae)
- Butterfish (eggs, larvae)
- Ocean pout (eggs, larvae)
- Scup (larvae)
- Atlantic herring (eggs, larvae)
- Longfin squid (eggs)
- Atlantic mackerel (larvae)
- Atlantic sea scallop (eggs)
- Summer flounder (eggs, larvae)
- Winter flounder (larvae)
- Windowpane flounder (eggs, larvae)
- Witch flounder (eggs, larvae)
- Yellowtail flounder (eggs, larvae)
- Atlantic sea scallop (larvae)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Juveniles

EFH species with benthic or epibenthic juveniles that occur within the SFWF work area could be exposed to lethal or behavioral crushing, burial, or entrainment effects. Behavioral avoidance responses would be expected in juveniles with the ability to swim out of the active construction area. Post-larval juveniles that lack a strong swimming ability would be unable to avoid the construction area and would be subject to lethal effects.

As stated in the preceding section, a temporary decrease in habitat suitability due to the placement of material on the substrate could result in lethal crushing and burial impacts. Lethal entrainment impacts could occur during use of the jet plow for the inter-array cable installation. The entrainment analysis completed by Inspire Environmental (2018) estimated that up to 3.82 million ichthyoplankton could be subject to lethal entrainment impacts. This includes direct mortality of EFH ichthyoplankton, and ichthyoplankton prey resources for selected EFH species life stages. Modeling results were based on sampling with 0.02-inch (0.505-mm) mesh nets. This estimate likely includes juveniles of EFH species that may or may not be able to avoid the active construction area. EFH species with benthic or epibenthic juveniles that may be exposed to crushing, burial, or entrainment effects during SFWF construction include:

- Butterfish (juvenile)
- Windowpane flounder (juvenile)
- Winter flounder (juvenile)
- Witch Flounder (juvenile)
- Yellowtail flounder (juvenile)
- Atlantic cod (juvenile)
- Black sea bass (juvenile)
- Haddock (juvenile)
- Monkfish (juvenile)
- Ocean pout (juvenile)
- Pollock (juvenile)
- Red hake (juvenile)
- Scup (juvenile)
- Silver hake (juvenile)
- White hake (juvenile)
- Barndoor skate (juvenile)
- Little Skate (juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile)
- Winter skate (juvenile)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Adult Fish

EFH species with benthic or epibenthic adults that occur within the SFWF work area could be exposed to lethal or behavioral crushing, burial, or entrainment effects. Adults of EFH species in the area are likely to exhibit behavioral avoidance responses and would not be subject to lethal crushing, burial, or entrainment effects. However, during placement of material on the substrate, there is potential for adult fish utilizing benthic or epibenthic habitats to be crushed or buried. Benthic invertebrates and other prey organisms targeted by these species would be killed or otherwise rendered inaccessible by burial and entrainment effects. While unlikely, use of the jet plow during the inter-array cable installation could result in lethal entrainment of adult fish within the temporary disturbance area. EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the spatial extent of crushing, burial, and entrainment effects from SFWF construction include:

- Summer flounder (adult)
- Windowpane flounder (adult, spawning)
- Winter flounder (adult, spawning)
- Witch Flounder (adult, spawning)
- Yellowtail flounder (adult, spawning)
- Atlantic cod (adult, spawning)
- Black sea bass (adult)
- Butterfish (adult)
- Haddock (adult, spawning)
- Monkfish (adult, spawning)
- Ocean pout (adult, spawning)
- Pollock (adult, spawning)
- Red hake (adult, spawning)
- Scup (adult)
- Silver hake (adult, spawning)
- White hake (adult, spawning)
- Atlantic herring (spawning)
- Barndoor skate (adult)
- Little skate (adult)
- Sandbar skate (adult)
- Spiny dogfish (adult, male)
- Winter skate (adult)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic Invertebrates

Benthic invertebrates present within the SFWF work area could be subject to lethal crushing, burial, or entrainment effects. Individuals within the footprint of the monopiles or scour protection would be crushed or buried during installation. This includes EFH bivalve species, and benthic invertebrates prey resources for certain EFH fish species. Additionally, individuals along the alignment of the inter-array cable or in areas where vessels anchor would also experience lethal crushing or burial effects. Juveniles in the construction area could also become entrained within the jet plow intake during the inter-array cable installation. EFH shellfish species and life stages potentially exposed to crushing, burial, or entrainment effects from SFWF construction include:

- Atlantic sea scallop (juvenile, adult, spawning)
- Ocean quahog (juvenile, adult)
- Atlantic surf clam (juvenile, adult)

6.1.2.2 SFEC Construction

Crushing and burial impacts could occur along the length of the SFEC alignment and within the temporary disturbance areas associated with cable installation and boulder relocation. Entrainment effects could occur during use of the jet plow for installation of the SFEC. Additionally, dredging and installation of the temporary cofferdam at the sea-to-shore transition location could result in crushing, burial, or entrainment effects on EFH species and their prey. Construction at the sea-to-shore transition is expected to occur between September 2021 and May 2022 and would take 6-9 months. Installation of the offshore SFEC would occur in 2023 and take a total of approximately 74 days. Potential impacts during that time would be continuous but limited to the area of active construction.

Crushing, Burial and Entrainment Effects on Habitats Used by Benthic, Epibenthic, and Pelagic Eggs and Larvae

EFH species with benthic or epibenthic eggs or larvae that occur within the SFEC work area could be exposed to lethal crushing or burial effects. EFH species with pelagic eggs or larvae may be subject to lethal entrainment effects. Along the SFEC route, cable laying, boulder relocation, and placement of cable protection would temporarily decrease the suitability of benthic and epibenthic habitat and could crush or bury eggs and larvae utilizing this habitat. Entrainment effects from use of the jet plow during cable installation would be limited to pelagic habitat. Based on sampling between April and August, it was estimated that up to 884 million eggs of various fish species along the Hither Hills route and up to 70.7 million eggs along the Beach Lane route may be exposed to lethal entrainment effects (Inspire Environmental 2018). This would include direct effects on the eggs and larvae of select EFH species as well as ichthyoplankton prey. Entrainment effects could also occur during dredging of the temporary cofferdam installed at the sea-to-shore transition. EFH species with benthic, epibenthic, or pelagic eggs or larvae that may be exposed to crushing, burial, or entrainment effects during SFEC construction include:

- Atlantic cod (eggs, larvae)
- Atlantic herring (eggs, larvae)
- Haddock (eggs, larvae)
- Longfin squid (eggs)

- Red hake (eggs, larvae)
- Silver hake (eggs, larvae)
- White hake (larvae)
- Monkfish (eggs, larvae)
- Bluefish (eggs, larvae)
- Black sea bass (eggs, larvae)
- Butterfish (eggs, larvae)
- Ocean pout (eggs, larvae)
- Scup (larvae)
- Atlantic mackerel (eggs, larvae)
- Atlantic sea scallop (eggs)
- Summer flounder (eggs, larvae)
- Winter flounder (eggs, larvae)
- Windowpane flounder (eggs, larvae)
- Witch flounder (eggs, larvae)
- Yellowtail flounder (eggs, larvae)
- Atlantic sea scallop (larvae)

Crushing, Burial and Entrainment Effects on Habitats Used by Benthic and Epibenthic Juveniles

EFH species with benthic or epibenthic juveniles that occur within the SFEC work area could be exposed to lethal or behavioral crushing, burial, or entrainment effects. As described in Section 5.1.3.1, larger juveniles would likely exhibit a behavioral avoidance response and swim out of the temporarily affected habitat. Juveniles unable to avoid the area would be subject to lethal crushing or burial effects.

Modeling of potential entrainment effects along the SFEC route suggests that up to 11 million and 8.8 million eggs and larvae could be entrained along the Beach Lane and Hither Hills route alternatives, respectively, and could be subject to lethal effects (Inspire Environmental 2018). Eggs, larvae and juvenile fish may also be entrained by dredging at the sea-to-shore transition. Overall mortality of fish entrained during dredging is considered to be low (Wenger et al. 2016). EFH species with benthic or epibenthic juveniles that may be exposed to crushing, burial, or entrainment effects during SFEC construction include:

- Butterfish (juvenile)
- Windowpane flounder (juvenile)
- Winter flounder (juvenile)
- Witch Flounder (juvenile)
- Yellowtail flounder (juvenile)
- Atlantic cod (juvenile)
- Black sea bass (juvenile)
- Haddock (juvenile)
- Monkfish (juvenile)
- Ocean pout (juvenile)
- Pollock (juvenile)
- Red hake (juvenile)
- Scup (juvenile)
- Silver hake (juvenile)
- White hake (juvenile)
- Barndoor skate (juvenile)
- Little Skate (juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile)
- Winter skate (juvenile)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Adult Fish

EFH species with benthic or epibenthic adult life stages present along the SFEC route may be subject to lethal or behavioral crushing, burial, or entrainment effects. Adult fish would be likely to exhibit avoidance responses to exit the active construction area but there is potential for lethal effects. Placement of cable protection and installation of the cofferdam could crush or bury adult fish unable to avoid the area. Use of the jet plow for cable installation and dredging for excavation of the cofferdam at the sea-to-shore transition could also entrain adult fish within the disturbed area. However, evidence of dredging entrainment effects suggests that the mortality rate would be low (Wenger et al. 2016). Mortality rate of estuarine fish entrained during a hopper dredging event was found to be 38% (Armstrong et al. 1982). Potential avoidance and the less than 100 percent mortality rate indicate that the dredging effects to EFH would likely have a minor effect on EFH species. EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the spatial extent of crushing, burial, and entrainment effects from SFEC construction include:

- Summer flounder (adult)
- Windowpane flounder (adult, spawning)
- Winter flounder (adult, spawning)
- Witch Flounder (adult, spawning)
- Yellowtail flounder (adult, spawning)
- Atlantic cod (adult, spawning)
- Black sea bass (adult)
- Butterfish (adult)
- Haddock (adult, spawning)
- Monkfish (adult, spawning)
- Ocean pout (adult, spawning)
- Pollock (adult, spawning)
- Red hake (adult, spawning)
- Scup (adult)
- Silver hake (adult, spawning)
- White hake (adult, spawning)
- Atlantic herring (spawning)
- Barndoor skate (adult)
- Little skate (adult)
- Sandbar skate (adult)
- Spiny dogfish (adult, male)
- Winter skate (adult)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic Invertebrates

Benthic invertebrates utilizing EFH within the SFEC work area could be subject to lethal crushing, burial, or entrainment effects. Crushing or burial due to cable laying or boulder location would likely be lethal to individuals within the footprint of the material placement. The surface-oriented jet plow intake could also render a portion of the pelagic habitat temporarily unsuitable and result in mortality for juveniles utilizing the habitat. EFH shellfish species and life stages potentially exposed to crushing, burial, or entrainment effects from SFWF construction include:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.1.2.3 O&M Facility Construction

Improvements at the O&M facility will include dredging to allow for vessel berthing and reinforcement of an existing bulkhead with sheetpile. Crushing or burial effects may occur due to driving of the sheetpile or dredging. Dredging may also result in entrainment effects. The sheetpile placement is expected to occur in 2021 or 2022 within a 9-to-12-month construction window. However, construction activities will likely only require 18 to 24 hours within that window. Initial dredging will occur between October 1, 2021 and January 15, 2022 and then annually for maintenance.

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Eggs or Larvae

EFH species with benthic or epibenthic eggs or larvae that occur within the O&M facility work area could be exposed to lethal crushing, burial, or entrainment effects. Eggs or larvae utilizing EFH within the footprint of the 6 new 24-inch steel piles could be crushed or buried. Those within the dredge prism would be subject to lethal crushing or burial impacts, in addition to potential entrainment impacts. Although the mortality rate for entrained eggs and larvae is likely 100 percent, the number of eggs and larvae entrained by dredges is considered to be a small portion of the total production (Reine and Clarke 1998; Reine et al. 1998). EFH species with benthic, epibenthic, or pelagic eggs or larvae that may be exposed to crushing, burial, or entrainment effects during the O&M facility construction include:

- Winter flounder (eggs, larvae)
- Longfin squid (eggs)
- Windowpane flounder (eggs, larvae)
- Black sea bass (larvae)
- Summer flounder (eggs, larvae)
- Scup (eggs, larvae)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Juveniles

Juvenile life stages of EFH species utilizing benthic or epibenthic habitats in the O&M facility work area may be exposed to lethal or behavioral crushing, burial, or entrainment effects. As described in Section 5.1.3.1, larger juveniles would likely exhibit a behavioral avoidance response and could swim out of the active construction area. Juveniles unable to avoid the area would be subject to lethal crushing, burial, or entrainment effects. Crushing or burial effects would be limited to the footprint of the bulkhead and dredge area. Entrainment effects may occur within the dredge area. EFH species with benthic or epibenthic juveniles that may be exposed to crushing, burial, or entrainment effects during the O&M facility construction include:

- Summer flounder (juvenile)
- Windowpane flounder (juvenile)
- Winter flounder (juvenile)
- Scup (juvenile)
- Little Skate (juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile)

Crushing, Burial, and Entrainment Effects on Habitats Used by Benthic or Epibenthic Adults

Adult life stages of EFH species utilizing benthic or epibenthic habitats in the O&M facility work area may be exposed to lethal or behavioral crushing, burial, or entrainment effects. Given the relatively small area of potential effects (.872 acre [0.353 hectare]), adult fish in the vicinity of the O&M facility construction would likely be able to avoid lethal impacts. However, there is potential for lethal crushing or burial effects if individuals are unable to exit the area. EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the spatial extent of crushing, burial, and entrainment effects from SFEC construction include:

- Summer flounder (adult)
- Windowpane flounder (adult, spawning)
- Winter flounder (adult, spawning)
- Scup (adult)
- Little Skate (adult)
- Sandbar shark (adult, male)
- Spiny dogfish (adult)

6.1.3 Water Quality

The effects of projected TSS and suspended sediment impacts on EFH resulting from project construction will vary depending on how benthic and near-bottom habitats exposed to these impacts are used by EFH species. EFH is divided into the following components for the purpose of this assessment:

- Bottom habitats used by EFH fish and invertebrate species having benthic or epibenthic eggs and larvae, and/or benthic or epibenthic eggs and larvae that provide prey for EFH species
- Bottom habitats used by EFH fish species having benthic or epibenthic juvenile life stages, and/or benthic or epibenthic juvenile fish that provide prey for EFH species
- Bottom habitats used by EFH fish species that are benthic or epibenthic as adults, and/or adult fish that provide prey for EFH species
- Bottom habitats used by EFH shellfish species, and/or shellfish that provide prey for EFH species

As described in Section 4.1.3, anticipated suspended sediment effects resulting from project construction are expected to be limited to within 9.9 feet (3 meters) of the seabed. As a result, EFH species having surface oriented or mid-water pelagic life stages would not be exposed to these effects and would therefore not experience adverse effects during these life stages. Therefore, only those life stages likely to be exposed to suspended sediment effects are addressed in this section. The magnitude, extent, timing, and duration of suspended sediment effects from SFWF, SFEC, and O&M facility construction on EFH species are detailed in Appendix A, Table A-3.

6.1.3.1 SFWF Construction

Inter-array cable construction would generate localized plumes of suspended sediments with maximum TSS concentrations ranging from 82 to 100 mg/L in the immediate proximity of trench excavation and reburial. Vinhateiro et al. (2018) estimated that sediment plumes would resettle and TSS concentrations would return to background levels within 0.3 to 0.4 hours of disturbance. Inter-array cable construction would occur in 2023 and is expected to require approximately 60 days to complete. Sediment-producing activities would occur intermittently during this period as new cable segments constructed as each WTG foundation installation is completed.

Sediment Effects on Habitats Used by Benthic and Epibenthic Eggs and Larvae

Benthic and epibenthic eggs and larvae that occur within the SFWF construction footprint could be exposed to elevated water column TSS concentrations and burial by deposition of suspended sediments from inter-array cable construction. As detailed in Section 4.1.3.1, an estimated 464 acres (188 hectares) of benthic habitat could be exposed to fine sediment deposition depths between 0.4 and 1.2 inches (10 and 30 mm), and an estimated 2,268 acres (918 hectares) could be exposed to deposition depths less than 0.4 inch (10 mm). Various researchers have reviewed suspended sediment effects on the benthic life stages of various fish species (Kjelland et al. 2015; Michel et al. 2013; Wilber and Clarke 2001). While sensitivity varies widely, egg and larval life stages are particularly sensitive and can experience sublethal or lethal effects from as little as 0.4 inch (10 mm) of sediment deposition. Certain species, like winter flounder, are highly sensitive to sediment deposition and can experience mortality at burial depths less than 0.1 inch (3 mm) (Michel et al. 2013). On this basis, benthic habitats exposed to measurable burial depths from inter-array cable construction described above would be rendered temporarily unsuitable for the following EFH species having benthic or epibenthic eggs and larvae and are likely to occur in this component of the project area:

- Atlantic herring (eggs)
- Atlantic sea scallop (eggs and larvae)
- Longfin squid (eggs)
- Ocean pout (eggs and larvae)

Sediment Effects on Habitats Used by Epibenthic Juvenile Fish

Benthic and epibenthic juvenile fish life stages that occur within the SFWF construction footprint could be exposed to elevated water column TSS concentrations and deposition of suspended sediments from inter-array cable construction. Juvenile fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column. As described above, maximum TSS concentrations are expected to range from 82 to 100 mg/L within 5 feet (1.5 meters) of the seabed and would dissipate to background in less than 1 hour. Concentrations of this magnitude and duration are typically associated with behavioral avoidance and sublethal physiological effects on juvenile marine and estuarine fishes (Michel et al. 2013; Wilber and Clarke 2001). Juvenile fishes exposed to elevated TSS may temporarily cease feeding, abandon cover, and experience short-term physiological stress. The affected individuals may be more vulnerable to predation. EFH species with benthic or epibenthic juvenile life stages that are known or likely to occur within the range of potential TSS effects from SFWF construction include the following:

- Atlantic cod (juvenile)
- Windowpane flounder (juvenile)

- Pollock (juvenile)
- Red hake (juvenile)
- Silver hake (juvenile)
- White hake (juvenile)
- Black sea bass (juvenile)
- Monkfish (juvenile)
- Ocean pout (juvenile)
- Scup (juvenile)
- Winter flounder (juvenile)
- Witch Flounder (juvenile)
- Yellowtail flounder (juvenile)
- Barndoor skate (juvenile)
- Little skate (juvenile)
- Winter skate (juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile)

Sediment Effects on Habitats Used by Epibenthic Adult Fish

Benthic or epibenthic adult fish that occur within the SFWF construction footprint could be exposed to elevated water column TSS concentrations and deposition of suspended sediments from inter-array cable construction. Adult fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column through behavioral avoidance. Short-term exposure to minor elevations in TSS (82 to 100 mg/L lasting less than 1 hour) is typically associated with behavioral avoidance in adult fishes and are below levels associated with sublethal physiological effects on adult marine and estuarine fishes (Michel et al. 2013; Wilber and Clarke 2001). EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the range of potential TSS effects from SFWF construction include the following:

- Atlantic cod (adult, spawning)
- Red hake (adult, spawning)
- Silver hake (adult, spawning)
- Black sea bass (adult)
- Monkfish (adult, spawning)
- Ocean pout (adult, spawning)
- Scup (adult)
- Atlantic herring (spawning)
- Summer flounder (adult)
- Windowpane flounder (adult, spawning)
- Winter flounder (adult, spawning)
- Witch flounder (adult, spawning)
- Yellowtail flounder (adult, spawning)
- Barndoor skate (adult)
- Little skate (adult)
- Winter skate (adult)
- Sandbar shark (adult)
- Spiny dogfish (adult, male and female)

Sediment Effects on Benthic Invertebrates

Juvenile and adult Atlantic sea scallop, Atlantic surf clam, and ocean quahog could be exposed to elevated water column TSS and sediment deposition effects during SFWF construction. Benthic invertebrate prey resources for EFH species may be similarly affected. In general, short-term exposure to TSS concentrations like those anticipated from inter-array cable installation (up to 100 mg/L for less than 1 hour) are not associated with adverse effects on filter-feeding bivalves (USACE 2000; Wilber and Clarke 2001; Yang et al. 2017). In contrast, burial depths between 0.4 and 1.2 inches (10 and 30 mm) could result in sublethal to lethal effects on smaller juveniles or adults. Potential sublethal to lethal effects could occur on up to 464 acres (188 hectares) where burial depths could exceed 0.4 inch (10 mm), and on up to 2,268 acres (918 hectares) where burial depths could exceed 0.1 inch (3 mm). The resulting effects on EFH suitability would be short-term in duration, effectively ending immediately after suspended sediments have completely settled. EFH shellfish life stages potentially exposed to elevated TSS and sedimentation from SFWF construction are as follows:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.1.3.2 SFEC Construction

SFEC construction would generate localized plumes of suspended sediments with maximum TSS concentrations ranging as high as 500 to 1,347 mg/L at selected locations over approximately 12.4 linear miles (20 km, 10.8 nm) of the SFEC corridor common to each route alternative. These effects would be limited to within 8.2 feet (2.5 meters) of the seabed and would dissipate to background in less than 1.4 hours. Over the remainder of the SFEC corridor, including the divergent segments of the Beach Lane and Hither Hills routes, TSS concentrations would be lower, ranging from 10 to 200 mg/L along the majority of route length, with peaks in selected areas ranging from 200 to 500 mg/L (Vinhateiro et al. 2018). Vinhateiro et al. (2018) estimated that sediment plumes would resettle and TSS concentrations would return to background levels within 1.3 to 1.4 hours of disturbance. SFEC construction would occur in 2023 and is expected to require approximately 74 days to complete. Sediment-generating activities would occur continuously throughout these periods but would be limited to the area immediately around the hydroplow as it transits along the SFEC corridor.

Dredging and sidecast during construction of the SFEC sea-to-shore transition would generate TSS concentrations reaching up to 562 mg/L in the immediate proximity of excavation (Vinhateiro et al. 2018). Dredging activities would take place between September 2021 and May of 2022 and would require 3 to 4 days to complete. Vinhateiro et al. (2018) estimated that TSS concentrations would dissipate to background levels within 1.1 hours after the disturbance ceases.

Sediment Effects on Habitats Used by Benthic and Epibenthic Eggs and Larvae

EFH species with benthic and epibenthic eggs and larvae that occur within the SFWF construction footprint could be exposed to elevated water column TSS concentrations and burial by deposition of suspended sediments from inter-array cable construction. The eggs and larvae of these other species that provide prey resources for EFH species could be similarly exposed. As detailed in Section 4.1.3.2, an estimated 4.2 acres (1.7 hectares) of benthic habitat could be exposed to fine sediment deposition depths between 0.4 and 1.2 inches (10 and 30 mm), and an estimated 804.6 acres (325.6 hectares) could be exposed to deposition depths less than 0.4 inch (10 mm) if the Hither Hills route alternative is selected. An estimated 4.2 acres (1.7 hectares) of benthic habitat could be exposed to fine sediment deposition depths between 0.4 and 1.2 inches (10 and 30 mm), and an estimated 1,032.2 acres (417.7 hectares) could be exposed to deposition depths less than 0.4 inch (10 mm) if the Beach Lane route alternative is selected.

As discussed in Section 6.1.3.1, the sensitivity of egg and larval life stages to sediment deposition effects varies widely between species, but the available research indicates that sublethal or lethal effects can result from as little as 0.4 inch (10 mm) of sediment deposition. Certain species, like winter flounder, are highly sensitive to sediment deposition and can experience mortality at burial depths less than 0.1 inch (3 mm) (Michel et al. 2013). On this basis, benthic habitats exposed to measurable burial depths from each of the SFEC route alternatives described above would be rendered temporarily unsuitable for the following EFH species having benthic or epibenthic eggs and larvae and are likely to occur in this component of the project area:

- Atlantic herring (eggs)
- Atlantic sea scallop (eggs and larvae)
- Longfin squid (eggs)
- Ocean pout (eggs and larvae)

Sediment Effects on Habitats Used by Epibenthic Juvenile Fish

Juvenile fish that use benthic and epibenthic habitats within the SFEC construction footprint could be exposed to elevated water column TSS concentrations and deposition of suspended sediments from inter-array cable construction. This includes juveniles of EFH species and juvenile fish that provide prey for other EFH species. Juvenile fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column. As described above, maximum TSS concentrations are expected to range as high as 500 to 1,347 mg/L at selected locations. The highest concentration TSS plumes would remain 8.2 feet (2.5 meters) of the seabed and would dissipate to background in less than 1.4 hours. Over the remainder of the SFEC corridor, including the divergent segments of the Beach Lane and Hither Hills routes, TSS concentrations would be lower, within the majority of plume concentrations ranging from 10 to 200 mg/L along most of the route length, with concentrations ranging has high as 200 to 500 mg/L at selected locations. TSS plumes would remain within 6.6 feet (2 meters) of the seabed and would disperse to background conditions within 1.3 to 1.4 hours (Vinhateiro et al. 2018).

TSS concentrations at the lower end of the modeled range are typically associated with behavioral avoidance, while the higher-end concentrations overlap with levels associated with sublethal physiological effects on juvenile marine and estuarine fishes, albeit over longer exposure periods (Michel et al. 2013; Wilber and Clarke 2001). Juvenile fishes exposed to elevated TSS may temporarily cease feeding and abandon cover, and experience short-term physiological stress. EFH species with benthic or epibenthic juvenile life stages that are known or likely to occur within the range of potential TSS effects from SFWF construction include the following:

- Atlantic cod (juvenile)
- Pollock (juvenile)
- Red hake (juvenile)
- Silver hake (juvenile)
- White hake (juvenile)
- Black sea bass (juvenile)
- Monkfish (juvenile)
- Ocean pout (juvenile)
- Scup (juvenile)
- Windowpane flounder (juvenile)
- Winter flounder (juvenile)
- Witch flounder (juvenile)
- Yellowtail flounder (juvenile)
- Barndoor skate (juvenile)
- Little skate (juvenile)
- Winter skate (juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile)

Sediment Effects on Habitats Used by Epibenthic Adult Fish

EFH species that are benthic or epibenthic as adults and are likely occur within the SFEC construction footprint could be exposed to elevated water column TSS concentrations and deposition of suspended sediments from cable installation and sea-to-shore transition construction. EFH species that prey on adult benthic and epibenthic species may also be exposed to short-term effects on prey resources. Adult fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column through behavioral avoidance. Short-term exposure to TSS concentrations exceeding 1,000 mg/L has been associated with sublethal and behavioral avoidance effects on adult marine and estuarine fishes, while concentrations of less than 500 mg/L are more commonly associated with behavioral avoidance (Michel et al. 2013; Wilber and Clarke 2001). EFH species having benthic or epibenthic adult life stages that are known or likely to occur within the range of potential TSS effects from SFWF construction include the following:

- Atlantic cod (adult, spawning)
- Red hake (adult, spawning)
- Silver hake (adult, spawning)
- Black sea bass (adult)
- Monkfish (adult, spawning)
- Ocean pout (adult, spawning)
- Scup (adult)
- Atlantic herring (spawning)
- Summer flounder (adult)
- Windowpane flounder (adult, spawning)
- Winter flounder (adult, spawning)
- Witch flounder (adult, spawning)
- Yellowtail flounder (adult, spawning)
- Barndoor skate (adult)
- Little skate (adult)
- Winter skate (adult)
- Sandbar shark (adult)
- Spiny dogfish (adult, male and female)

Sediment Effects on Habitats Used by Benthic Invertebrates

Juvenile and adult Atlantic sea scallop, Atlantic surf clam, and ocean quahog could be exposed to elevated water column TSS and sediment deposition effects during SFEC construction. Other benthic invertebrates that provide prey for EFH species may also be exposed to TSS and sediment deposition effects. Short-term exposure to the maximum TSS concentrations anticipated from SFEC installation (up to 1,347 mg/L) are at the lower end of exposures associated with observed sublethal effects on filter-feeding bivalves, although those effects resulted over exposure periods lasting 24 hours or more (USACE 2000; Wilber and Clarke 2001; Yang et al. 2017). In contrast, burial depths between 0.4 and 1.2 inches (10 and 30 mm) could result in sublethal to lethal effects on smaller juveniles or adults. For the SFEC Beach Lane route alternative, sublethal to lethal effects could occur on up to 4.2 acres (1.7 hectares) where burial depths could exceed 0.4 inch (10 mm), and on up to 2,268 acres (918 hectares) where burial depths could exceed 1.2 inches (30 mm). The resulting effects on EFH suitability would be short-term in duration, effectively ending immediately after suspended sediments have completely settled. EFH shellfish life stages potentially exposed to elevated TSS and sedimentation from SFWF construction are as follows:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.1.3.3 O&M Facility Construction and Maintenance

Dredging associated with O&M facility construction and maintenance would be expected to generate typical maximum TSS concentrations on the order of 282 mg/L, limited to within 5.5 feet (2 meters) of the bottom and dissipating to background within 1,148.3 feet (350 meters) of dredging activity. Given uncertainty about the potential type of dredging equipment used, potential TSS plumes from O&M facility construction are estimated to extend between 984.3 to 3,937 feet (300 to 1,200 meters) from the source for the purpose of this EFH assessment.

Sediment Effects on Habitats Used by Benthic and Epibenthic Eggs and Larvae

Benthic and epibenthic eggs and larvae that occur within proximity to the O&M facility could be exposed to periodically elevated water column TSS concentrations and burial by deposition of suspended sediments associated with construction and maintenance dredging. Maximum TSS concentrations on the order of 282 mg/L are anticipated for each annual dredging event. These impacts could directly affect the eggs and larvae of certain EFH species, and eggs and larvae of EFH and other species that provide prey for EFH species.

As discussed in Section 6.1.3.1, the sensitivity of egg and larval life stages to sediment deposition effects varies widely between species, but the available research indicates that sublethal or lethal effects can result from as little as 0.4 inch (10 mm) of sediment deposition. Certain fish species, like winter flounder, are highly sensitive to sediment deposition during egg and larval life stages and can experience mortality at burial depths less than 0.1 inch (3 mm)

(Michel et al. 2013). While sediment deposition depths have not been estimated for O&M facility dredging, short-term deposition of up to 0.4 inch (10 mm) could occur in close proximity to the dredging footprint. These effects would constitute a potential adverse effect on the following egg and larval life stages of EFH species likely to occur in Lake Montauk:

- Winter flounder (eggs and larvae)
- Longfin squid (eggs)

Sediment Effects on Habitats Used by Habitats Used by Epibenthic Fish

EFH species with benthic and epibenthic life stages that occur within Lake Montauk to elevated water column TSS concentrations and deposition of suspended sediments from O&M facility construction and maintenance. In general, juvenile and adult fish are expected to be able to avoid burial effects from sediment deposition and would primarily respond to elevated TSS concentrations in the water column. As described above, maximum TSS concentrations are expected to range as high as 282 mg/L at selected locations, remaining within 6.6 feet (2 meters) of the seabed and dissipating to background within approximately 2 hours of disturbance.

TSS concentrations on the order of 300 mg/L are typically associated with behavioral avoidance in juvenile and adult marine fishes and are below levels commonly associated with sublethal effects. Fishes exposed to elevated TSS may be temporarily displaced from favorable habitats, ceasing feeding and abandoning cover (Michel et al. 2013; Wilber and Clarke 2001). The following EFH species are known or likely to occur in Lake Montauk during their juvenile life stages and could be exposed to short-term elevation in TSS concentrations from O&M facility construction and maintenance dredging:

- Scup (juvenile and adult)
- Summer flounder (juvenile and adult)
- Windowpane flounder (juvenile, adult, spawning)
- Spiny dogfish (adult males)
- Sand tiger shark (neonate/YOY, juvenile)
- Winter flounder (juvenile, adult, spawning)
- Little skate (juvenile, adult)
- Sandbar shark (neonate/YOY, juvenile, adult)

Sediment Effects on Habitats Used by Benthic Invertebrates

No EFH bivalve species occur in Lake Montauk. Therefore O&M facility construction and maintenance dredging would have no effect on EFH for Atlantic scallop, Atlantic surf clam, or ocean quahog. Dredging and beach nourishment could affect benthic invertebrates that are preyed upon by EFH species. These effects would be similar to those described for benthic invertebrates in Sections 6.1.3.1 and 6.1.3.2.

6.2 Intermediate to Long-Term Effects on EFH from Project Operation

The operation and maintenance of the SFWF, SFEC and O&M facility would result in long-term alteration of water column and benthic habitats within the construction footprint. Long-term effects are those effects that would last over the approximate 30-year lifespan of the project from the completion of construction through decommissioning. Some project effects may be effectively permanent. For example, boulder scour protection may develop into complex fisheries habitat over time, the benefits of which may outweigh the removal of these features to return the habitat to its original condition. Those decisions and any associated effects on EFH would be addressed through separate consultation for project decommissioning.

The long-term impacts of project operations and maintenance that could alter the suitability of EFH for managed species are as follows:

- Alteration of water column and benthic habitat composition by monopile foundations, scour protection, cable protection, and O&M facility maintenance and improvements
- Operational noise effects on habitat suitability in the vicinity of the WTGs
- EMF effects on benthic and demersal habitat suitability in the vicinity of the inter-array cable and SFEC
- Hydrodynamic effects on pelagic habitat suitability in the vicinity of the monopile foundations
- Food web effects resulting from long-term habitat alteration, including the colonization of new hard substrates introduced to the offshore environment

The physical extent of these impacts is quantified, to the extent practicable, in Section 4.2. The magnitude, extent, and duration of these impacts on EFH are described below.

6.2.1 Habitat Alteration

The SFWF, SFEC, and O&M facility each include features that would result in long-term alteration of habitats known or likely to be used by EFH species. EFH is divided into the following components for the purpose of assessing habitat impacts by EFH species and life stage:

- Complex benthic habitat: Benthic habitats where ledge, megaclasts, boulders, cobbles, and pebbles dominate the sea floor, and may also include finer material (e.g., pebbles in a sand matrix).
- Potentially complex benthic habitat: Benthic habitats that may contain a substantial portion of boulders, cobbles, and pebbles.
- Non-complex benthic habitat: Benthic habitats that do not include a substantial portion of coarse-grained sediment.

The magnitude, extent, timing, and duration of habitat alteration effects resulting from the development and long-term operation of the SFWF, SFEC, and O&M facility on EFH species are detailed in Appendix A, Table A-4.

6.2.1.1 SFWF

The installation of the SFWF would have long-term effects on pelagic and benthic habitats on the mid-Atlantic OCS, resulting from the presence of the monopile foundations, boulder scour protection, and concrete mattresses used to protect the inter-array cable. In addition, boulder relocation during site preparation for construction would redistribute and temporarily impair complex benthic habitat.

Long-Term Effects on Near-Surface and Pelagic Habitats

The installation of 16 26.2-foot (8-meter) or 36-foot (11-meter) diameter monopile foundations would introduce approximately 12,000 to 16,000 m^2 of new hard surfaces to the water column, respectively, extending from the seabed to the water surface. These vertical structures would alter the character of pelagic habitats used by many EFH species and their prey and foraging resources. Over time these new hard surfaces will become colonized by sessile organisms, creating complex habitats that effectively serve as artificial reef.

The artificial reef effect created by offshore structures like WTGs is well documented and can have an attractive effect on many marine species (Langhamer 2012; Peterson and Malm 2006; Ruebens et al 2013; Wilhelmsson et al. 2006). This can lead to localized increases in fish abundance and changes in community structure. In a meta-analysis of studies on windfarm reef effects, Methratta and Dardick (2019) observed an almost universal increase in the abundance of epibenthic and demersal fish species. Effects on pelagic fish species are less clear, however (Floeter et al. 2017; Methratta and Dardick 2019). On balance, the reef effect of offshore windfarms is likely to produce a neutral to beneficial effect on EFH. However, these beneficial effects could be offset if the colonizable habitats provided by offshore wind energy structures aggregate predators and prey, increasing predation risk, or provide steppingstones for non-native species invasions (De Mesel et al. 2015; Gill, 2005; Roux et al. 2017). The net effect of WTGs on pelagic EFH is likely to be neutral to beneficial depending on species-specific responses, with the recognition that beneficial effects could be negated should these structures inadvertently promote the establishment of invasive species on the mid-Atlantic OCS.

In addition to reef effects, the WTGs are likely to create localized hydrodynamic effects that could have localized effects on food web productivity and pelagic eggs and larvae. Hydrodynamic effects on EFH are described further in Section 6.2.4. Over time, the attractive effects of the structures and complex habitats formed by the maturing reef effect are also expected to alter food web dynamics in ways that may be difficult to predict. Colonization of the new hard surface habitat typically begins with suspension feeders and progresses through intermediate and climax stages (6+ years) characterized by the codominance of plumose anemones and blue mussels (Degraer et al. 2020, Kerckhof et al. 2019). Suspension feeders can act as biofilters, transferring pelagic nutrient resources to the benthic community and decreasing pelagic primary productivity (Slavik et al. 2019). The trophic resources used by suspension feeders could include pelagic eggs or larvae of EFH species, as well as ichthyoplankton prey resources. This could result in a local decrease of eggs and larvae but is unlikely to impact the reproductive success of the affected species as a whole, or have more than a localized effect on prey availability for EFH species. As noted above, the colonization of the WTGs could also attract fish due to the increase in resource availability and shelter. This aggregation and change in resource availability could lead to shifts in food web dynamics. While localized effects are possible, ecosystem modeling studies of a European windfarm showed little difference in key food web indicators before and after construction (Raoux et al. 2017). Even though the biomass of certain taxa increased in proximity to the wind farm, trophic group structure was functionally similar between the before and after scenarios. Thus, largescale food web shifts are not expected due to the installation of WTGs and conversion of pelagic habitat to hard surface.

The following species and life stages have designated EFH in areas likely to experience insignificant to beneficial effects from the long-term alteration of pelagic habitats by the monopile foundations:

- Atlantic cod (eggs, larvae)
- Haddock (eggs, larvae)
- Red hake (eggs, larvae)
- Silver hake (eggs, larvae)
- Black sea bass (eggs)
- Bluefish (eggs, larvae, juvenile, adult)
- Butterfish (juvenile, adult)
- Scup (eggs, larvae)
- Atlantic herring (larvae, juvenile, adult)
- Atlantic mackerel (eggs)
- Albacore tuna (juvenile)
- Atlantic bluefin (juvenile, adult)
- Monkfish (eggs, larvae)
- Windowpane flounder (eggs, larvae)
- Winter flounder (eggs, larvae)
- Witch flounder (eggs, larvae)
- Yellowtail flounder (eggs, larvae)
- Basking shark (neonate/YOY, juvenile)
- Blue shark (neonate/YOY, juvenile)
- Dusky shark (neonate/YOY, juvenile)
- Common thresher shark (neonate/YOY, juvenile)
- Shortfin mako shark (neonate/YOY, juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- White shark (neonate/YOY, juvenile)
- Smooth dogfish (neonate, juvenile, adult)
- Spiny dogfish (subadult, adult)
- Smooth dogfish (neonate, juvenile, adult)
- Spiny dogfish (subadult [m/f], adult [m/f])
- Longfin squid (juvenile, adult)
- Shortfin squid (juvenile, adult)

Long-Term Effects on Complex and Potentially Complex Benthic Habitat

As detailed in Section 4.2.1.1, some of the monopile foundations would be placed in complex or potentially complex benthic habitat. The 26.2-foot (8-meter) piles would displace 0.10 acre (0.04 hectare) of complex and 0.02 acre (0.01 hectare) of potentially complex habitat within the pile footprints. The 36-foot (11-meter) monopiles would displace 0.20 acre (0.08 hectare) of complex habitat and 0.05 acre (0.02 hectare) of potentially complex habitat. These habitats would no longer be available to EFH species for the entire 30-year life of the project through decommissioning when the foundations are removed.

An estimated 3.47 to 6.85 acres (1.4 to 2.8 hectares) of complex and 0.87 to 1.75 acres (0.4 to 0.7 hectare) of potentially complex benthic habitat, and 2.61 to 5.38 acres (1.06 to 2.18 hectares) of non-complex benthic habitat would be modified by placement of rock blankets for scour protection around the foundations and the inter-array cable approaches for the 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively. Approximately 47.2 acres (19.1 hectares) of complex and 11.25 acres (4.6 hectares) of potentially complex benthic habitat would be modified by placement of concrete mattresses to protect exposed segments of inter-array cable. Approximately 54.03 acres (21.9 hectares) of non-complex habitat would be converted to hard surfaces by cable protection. Quantity estimates are identical for both the standard and standard +20 percent contingency estimates. Over time, these natural rock surfaces would become colonized by sessile organisms and would gradually evolve into functional habitat for EFH species.

Approximately 240.23 to 236.76 acres (97.2 to 95.8 hectares) of complex and 44.49 to 43.59 acres (17.6 to 18.0 hectares) of potentially complex habitat would be temporarily impacted by boulder relocation during seabed preparation for installation of the 26.2-foot and 49.2-foot (8-meter and 15-meter) monopiles, respectively. Some boulders may be relocated to non-complex benthic habitat, resulting in the conversion of approximately 204.96 to 202.13 acres (82.9 to 81.8 hectares) to complex benthic habitat, respectively. Approximately 91.39 to 109.66 acres (37.0 to 44.4 hectares) of complex and 21.8 to 26.16 acres (8.8 to 10.6 hectares) of potentially complex habitat would be affected by boulder location for inter-array cable construction. These values for are the standard estimate and standard +20 percent contingency estimates, respectively.

The relocation process is likely to injure or kill encrusting organisms and damage biogenic structures that contribute to habitat. Over time, the relocated boulders would be recolonized, contributing to the habitat function provided by existing complex benthic habitat and the artificial reef effect provided by the SFWF.

The projected increase in abundance of epibenthic and demersal fish species resulting from the reef effect (Methratta and Dardick 2019) suggests a beneficial expansion of available EFH for species associated with complex benthic habitat like Atlantic cod, black sea bass, and scup. However, it could take a decade or more for the reef effect to develop before fully functional habitat status is achieved (Auster and Langton 1999; Collie et al. 2005; Tamsett et al. 2010). The concrete mattresses may take 3 to 12 months to fully cure after placement. Curing concrete can have surface pH levels as high as 11 or 12, rendering the surfaces of these structures toxic to sessile eggs, larvae, and invertebrates (Lukens and Selberg 2004). As such, the installation of these project features would result in a diminishing intermediate-term adverse effect on EFH lasting up to 10 years. At this point the additional 202.1 to 204.8 acres (81.8 to 82.9 hectares) of functional complex benthic habitat would constitute a beneficial increase in available EFH lasting for at least the remaining 20 years of project life. These features may or may not be removed when the project is decommissioned, depending on the habitat value they provide.

Potential effects to the food web from the loss or modification of complex or potentially complex habitat would be limited to increases in biomass and slight shifts in community composition. Stable isotope analysis of colonizing organisms on wind turbines in the Belgian North Sea suggests that the trophic structure is differentiated by depth, likely associated with different food sources (Mavraki 2020; Mavraki et al. 2020). Around the base of the monopiles, colonizing organisms on the surface of the pile would likely enhance food availability and food web complexity through an accumulation of organic matter (Degraer et al. 2020; Mavraki et al. 2020). This accumulation could lead to an increased importance of the detritus-based food web but is unlikely to result in significant broad scale changes to the local trophic structure (Raoux et al. 2017). Modification of complex or potentially complex benthic habitat is not expected to significantly impact the food web for EFH species.

EFH for the following fish species and life stages would be adversely affected in the intermediate-term and beneficially affected in the long-term by the expansion of functional complex benthic habitat:

- Atlantic cod (juvenile, adult, spawning)
- Pollock (juvenile)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- Atlantic herring (eggs, spawning)
- Black sea bass (larvae, juvenile, adult)
- Ocean pout (eggs, larvae, spawning)
- Scup (juvenile, adult)
- Monkfish (juvenile, adult, spawning)
- Summer flounder (adult)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Longfin squid (eggs)
- Atlantic sea scallop (eggs, larvae, juvenile, adult, spawning)

A portion of SFEC Hither Hills route alternative contains the habitat features of HAPC for inshore juvenile Atlantic cod but is outside of the range of currently designated HAPC range. Specifically, the construction footprint for the Hither Hills sea-to-shore transition site contains complex benthic habitat in the nearshore zone at depths less than 66 feet (20 meters). While SFEC construction would not impact inshore juvenile cod HAPC, this alternative could affect potentially valuable habitat features used by this life stage.

Long-Term Effects on Non-Complex Benthic Habitat

As detailed in Section 4.2.1.1, 5 of 16 monopile foundations would be placed in non-complex benthic habitat, displacing between 0.07 to 0.12 acre (0.03 to 0.05 hectare) of habitat within the pile footprints, depending on the monopile design alternative selected. These habitats would no longer be available to EFH species for the entire 30-year life of the project through decommissioning when the foundations are removed.

Approximately 2.7 to 5.4 acres (1.1 to 2.2 hectares) of non-complex benthic habitat would be permanently modified by placement of rock blankets for scour protection around the monopiles and the inter-array cable approaches, for the standard estimate and standard +20 percent contingency, respectively. Approximately 105.5 to 126.5 acres (42.7 to 51.2 hectares) of non-complex habitat would be modified by concrete mattress cable protection, respectively. As discussed in the previous section, these introduced hard surfaces would become colonized by sessile organisms and would evolve into functional complex benthic habitat over the course of approximately 10 years. The affected areas would be rendered unsuitable for species that use non-complex benthic habitats during one or more life stages.

The SFWF is located in an area where large mobile sand waves are not present. However, non-complex benthic habitat may include small sand waves, and depressions in the seabed may be present. These habitat features are part of juvenile and adult EFH used by red and silver hake. Hydroplow installation of the inter-array cable would flatten depressions and small sand waves, temporarily reducing benthic habitat suitability within the cable plow footprint. In contrast, trenching and vessel anchoring may leave behind temporary depressions that provide similar habitat function. The extent of these natural features is difficult to quantify, as they are continually reshaped by natural sediment transport processes. Butman and Moody (1983) observed significant mobility of mud and fine sand on the mid-Atlantic OCS during winter storms, indicating that natural recovery from anthropogenic disturbance could occur rapidly or over the course of several months depending on timing relative to winter storm events.

Conversion or loss of non-complex benthic habitat could influence the local food web by introducing habitat for colonizing organisms. Conversion of soft sediment habitat to complex, rocky habitat would support a different suite of species and could even aid in dispersal pathways through the “stepping stone effect” (Adams et al. 2014). While the local food web may shift with the conversion of habitat, largescale effects to ecosystem trophic structure are not expected (Raoux et al. 2014). Impacts to the suitability of EFH for managed species due to food web effects is not anticipated.

SFWF construction would result in short-term term to effectively permanent adverse effects on EFH for the following species and life stages:

- Ocean pout (juvenile, adult)
- Scup (juvenile, adult)
- Summer flounder (adult)
- Red hake (juvenile, adult)
- Silver hake (juvenile, adult)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)

- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Sand tiger shark (neonate/YOY, juvenile)
- Atlantic surf clam (adult)
- Ocean quahog (juvenile, adult)

6.2.1.2 SFEC

The SFEC would have long-term effects on complex, potentially complex, and non-complex benthic habitats resulting from placement of concrete mattresses for cable protection. Some intermediate-term effects (6 months to 1 year) on non-complex benthic habitats may also result from hydroplow installation of the SFEC.

Long-Term Effects on Complex and Potentially Complex Benthic Habitat

As detailed in Section 4.2.1.1, the placement of concrete mattresses as protection for exposed segments of the SFEC would result in the intermediate- to long-term modification of complex, potentially complex, and non-complex benthic habitats. Cable protection area and distribution by habitat type would vary by SFEC route alternative as follows:

- Hither Hills route:
    - Complex benthic habitat: 58.8 to 63.2 acres (23.8 to 25.6 hectares), standard estimate and standard +20 percent contingency, respectively
    - Potentially complex habitat: 1.2 to 1.5 acres (0.5 to 0.6 hectare), standard estimate and standard +20 percent contingency, respectively
- Beach Lane route:
    - Complex benthic habitat: 62.8 to 75.4 acres (25.4 to 30.5 hectares), standard estimate and standard +20 percent contingency, respectively
    - Potentially complex habitat: 5.7 to 6.7 acres (2.3 to 2.7 hectares), standard estimate and standard +20 percent contingency, respectively

Concrete mattress placement in complex and potentially complex habitat would reduce the suitability of the affected habitat of for an intermediate-term period lasting up to 10 years as artificial reef features mature (see Section 6.2.1.1). Mattress placement in non-complex habitat would convert non-complex fisheries habitat to complex fisheries habitat, with a similar lag period of up to 10 years before functional habitat status is achieved.

SFEC installation would therefore result in a diminishing, intermediate-term adverse effect on EFH for species associated with complex benthic habitat lasting up to 10 years. At this point the additional 60 to 68.4 acres (24.3 to 27.7 hectares) of functional complex benthic habitat would constitute a beneficial increase in available EFH lasting for at least the remaining 20 years of project life. The concrete mattresses would likely be removed during SFEC decommissioning. The effects of project decommissioning would be addressed under future EFH consultation.

The nearshore terminus of the SFEC Hither Hills route alternative overlaps areas of complex habitat that may be within designated HAPC for summer flounder if they support macroalgae or seagrasses. While such areas would be avoided to the extent practicable during construction, any impacts on macroalgae or aquatic vegetation would constitute an intermediate-term adverse effect on HAPC for this species.

EFH for the following fish species and life stages would be adversely affected in the intermediate-term and beneficially affected in the long-term by the expansion of functional complex benthic habitat resulting from the SFEC:

- Atlantic cod (juvenile, adult, spawning)
- Pollock (juvenile, adult, spawning)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- White hake (juvenile)
- Atlantic herring (eggs, spawning)
- Black sea bass (larvae, juvenile, adult)
- Ocean pout (eggs, larvae, spawning)
- Scup (juvenile, adult)
- Monkfish (juvenile, adult, spawning)
- Summer flounder (juvenile, adult)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Longfin squid (eggs)
- Atlantic sea scallop (eggs, larvae, juvenile, adult, spawning)

Long-Term Effects on Non-Complex Benthic Habitat

The placement of concrete mattresses as protection for exposed segments of the SFEC would result in the long-term conversion of non-complex benthic habitats to complex benthic habitats. The extents of habitat conversion for the Beach Lane and Hither Hills route alternatives total approximately 87.5 to 105 acres (35.4 to 42.5 hectares) each (standard and standard +20 percent contingency).

The affected areas would be rendered unsuitable for EFH species associated with non-complex benthic habitats during one or more life stages. SFEC installation would therefore result in a long-term adverse effect on EFH lasting for at least the 30-year lifetime of the project. The concrete mattresses would likely be removed during SFEC decommissioning, restoring the affected area to non-complex benthic habitat (the effects of mattress removal would be addressed under a separate future EFH consultation for project decommissioning).

The SFEC route alternatives were selected to avoid large mobile sand waves on the seabed, as these features can unbury transmission cables. Hydroplow installation of the SFEC may flatten depressions and small sand waves, temporarily reducing benthic habitat suitability of EFH for juvenile and adult red and silver hake within the cable plow footprint. Prey organisms that use these habitats would also be displaced, potentially affecting habitat suitability for EFH species. In contrast, trenching may leave behind temporary depressions that provide similar habitat function. As discussed in Section 5.2.1.1, the extent of these natural features is difficult to quantify, as they are continually reshaped by natural sediment transport processes. Natural recovery from anthropogenic disturbance is likely to occur within several months of the disturbance, depending on timing relative to winter storm events.

On this basis, construction of the SFEC and associated cable protection would result in short-term to effectively permanent adverse effects on EFH for the following species and life stages:

- Ocean pout (juvenile, adult)
- Butterfish (juvenile, adult)
- Scup (juvenile, adult)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- Summer flounder (adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Atlantic surf clam (adult)
- Ocean quahog (juvenile, adult)

6.2.1.3 O&M Facility

As discussed in Section 4.2.1.3, construction and ongoing maintenance of the O&M facility would permanently displace 19 square feet (1.8 m^2) within the footprint of 6 24-inch steel piles and permanently modify 0.86 acre (0.35 hectare) of non-complex benthic habitat within the maintenance dredging footprint.

The 0.35-acre (0.14-hectare) berthing area would be dredged during construction from -5 feet (-1.5 meters) MLLW to a desired target depth of -12.1 feet (-3.7 meters) MLLW. The berthing area would be dredged annually to maintain the desired depths, routinely disturbing the substrate, killing benthic invertebrates and entraining benthic and pelagic eggs and larvae. This constitutes a long-term alteration of non-complex benthic habitat in the project footprint, and a long-term intermittent negative impact on habitat suitability for the following EFH species that rely on non-complex estuarine and nearshore benthic habitats, and their prey:

- Winter flounder (eggs and larvae)
- Longfin squid (eggs)
- Scup (juvenile and adult)
- Summer flounder (juvenile and adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Little skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- Spiny dogfish (adult males)

6.2.2 Operational Noise Effects

The operation of the SFWF would produce underwater noise from the following sources:

- Effectively continuous, non-impulsive, low-frequency underwater noise and particle motion effects from WTG operations
- O&M vessel operations
- Annual maintenance dredging of the O&M facility

The effects of these underwater noise sources on habitat suitability for EFH species are described by project component in the following sections. The operation of the SFEC would not generate underwater noise or particle motion effects and would not require planned maintenance. Therefore, there are no operational noise effects on EFH associated with this project feature.

The magnitude, extent, timing, and duration of operational noise effects from the SFWF, and O&M facility on EFH species are detailed in Appendix A, Table A-5.

6.2.2.1 SFWF

The SFWF would be expected to generate operational noise on the order of 110 to 125 dB_{RMS} within the 10-Hz to 8-kHz frequency range and particle acceleration effects on the order of 10 to 30 dB re 1 $\mu m/s^2$ at a reference distance of 50 meters. These noise effects are below injury and behavioral effects thresholds for all species, indicating that potentially significant underwater noise effects from SFWF on habitat suitability would be restricted to a very small area around each monopile.

For example, applying the practical spreading loss model to source noise level of 125 dB_{RMS} at 10 meters, noise levels exceeding the behavioral effects threshold for fish would be limited to within 5 feet (1.5 meters) of the monopile surface. An individual fish belonging to the hearing specialist group would have to remain within 1 foot (0.32 meter) of the pile surface for 24 hours to experience TTS. Cod and other hearing specialist species are also potentially sensitive to particle motion effects. Elliot et al. (2019) compared available research on particle motion sensitivity in fish to observed detectable particle motion effects 164 feet (50 meters) from the foundations of the Block Island Windfarm during turbine operation. Their findings suggest that particle motion effects in the 1- to 6-kHz range could occasionally exceed the lower limit of observed behavioral responses in Atlantic cod and flatfish within these limits.

Some degree of habituation to these operational noise and particle motion effects is to be anticipated. Bedjer et al. (2009) argue that habituation of organisms to ongoing low-level disturbance is not necessarily a neutral or benign process. For example, habituation to particle motion effects could make individual fish or invertebrates less aware of approaching predators, or could cause masking effects that interfere with communication, mating or other important behaviors.

Collectively, these findings suggest that the SFWF operations could have limited adverse effects on habitat suitability for EFH species within a certain distance of each monopile foundation. The extent of these effects is difficult to quantify as they are likely to vary depending on wind speed, water temperature, ambient noise conditions, and other factors. Applying the sensitivity thresholds detailed in Section 4.1.1 and the impact assessment rationale presented in Section 6.2.1.1, potential adverse effects on habitat suitability for squid and fish belonging to the hearing specialist group are estimated to extend up to 164 feet (50 meters) from each foundation. This equates to adverse effects on habitat suitability over 41.5 to 46 acres (16.8 to 18.6 hectares) for the 26.2-foot and 36-foot (8-meter and 11-meter) monopile alternatives, respectively, for the following EFH species and life stages:

- Atlantic cod (juvenile, adult, spawning)
- Haddock (juvenile, adult, spawning)
- Pollock (juvenile, adult, spawning)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- Black sea bass (juvenile, adult)
- Bluefish (juvenile, adult)
- Monkfish (juvenile, adult, spawning)
- Atlantic herring (juvenile, adult, spawning)
- Summer flounder (juvenile, adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Longfin squid (juvenile, adult)
- Shortfin squid (juvenile, adult)

6.2.2.2 SFEC

The SFEC would produce no operational noise effects and would therefore have no associated effects on EFH through this impact mechanism.

6.2.2.3 O&M Facility

Underwater noise sources from O&M facility operations include the CTV and annual maintenance dredging. Noise effects on EFH from CTV operations are expected to be insignificant relative to the existing baseline based on the rationale presented in Section 4.2.2.2. Underwater noise effects on EFH resulting from maintenance dredging and species and life stages and prey organisms exposed would be the same as those described for initial construction dredging in 6.1.1.3. These effects would recur on an annual frequency and would therefore periodically reduce habitat suitability for the affected species over the lifetime of the project. EFH species and life stages exposed to these effects are as follows.

- Summer flounder (juvenile, adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Little skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- Spiny dogfish (subadult, adult males)

6.2.3 EMF and Heat Effects

The SFWF inter-array cable and SFEC would generate intermittent induced magnetic and electrical field effects and substrate heating effects whenever they are under power throughout the life of the project. Essentially, EMF and heat effects would occur whenever wind speeds are sufficient to turn the WTGs. As such, these effects are anticipated to be effectively continuous with brief interruptions during periods with no wind.

EFH is divided into the following components for the purpose of this assessment:

- Benthic habitats used by EFH fish and invertebrate species having benthic or epibenthic eggs and larvae. Minimum physiological effect thresholds are defined as follows (Brouard et al. 1996):
  - Magnetic field: 1,000 mG (observed developmental delay)
  - Electrical field: > 500 millivolts per meter (mV/m)
- Bottom habitats used by benthic or epibenthic life stages of EFH finfish species. Minimum physiological effect thresholds are defined as follows (Armstrong et al. 2015; Basov 1999; Bevelhimer et al. 2013; Orpwood et al. 2015):
  - Magnetic field: > 1,000 mG
  - Electrical field: 20 mV/m
- Demersal habitats (from 3.3 to 26.2 feet [1 to 8 meters] off the seabed) used by pelagic life stages of EFH finfish and invertebrates:
  - Finfish: Same thresholds as above.
  - Squid: > 800 mG (Love et al. 2015)
- Bottom habitats used by benthic and epibenthic life stages of EFH shark and skate species. Minimum effect thresholds are defined as follows (Bedore and Kajiura 2013; Hutchinson et al. 2020; Kempster et al. 2013):
  - Magnetic field: Detection, unknown; behavioral, 250-1,000 mG (species-specific)
  - Electrical field: Detection, 20-50 µV/cm (2-5 mV/m) for fields < 20 Hz, no response to electrical fields above 20 Hz
- Benthic and infaunal habitats used by EFH shellfish species, and benthic invertebrate prey organisms for EFH species

Induced electrical field effects in aquatic species are a function of body size, with smaller-bodied organisms experiencing a smaller induced field effect than larger organisms. Exponent Engineering (2018) calculated the maximum induced electrical field from the inter-array cable and SFEC likely to be experienced by three fish species based on representative body length. These results are summarized in Table 6.1. These model values are used here to characterize induced field strength experienced by EFH fish species based on typical body size, relative to the effect criteria detailed above.

Table 6.1. Induced Electrical Field Effects from the Inter-Array Cable and SFEC Based on Cable Location and Body Size and Position of the Receptor (Exponent Engineering 2018)

Modeled Species	Representative Body Length	Inter-Array, Buried (mV/m)		Inter-Array, Bed Surface (mV/m)		SFEC, Buried (mV/m)		SFEC, Bed Surface (mV/m)	
		Surface	1 meter	Surface	1 meter	Surface	1 meter	Surface	1 meter
Smooth dogfish	3.3 feet (1 meter)	0.13	0.06	0.40	0.19	0.19	0.08	0.59	0.25
Atlantic sturgeon	5.9 feet (1.8 meters)	0.24	0.10	0.74	0.31	0.34	0.15	1.05	0.47
Sand tiger shark	8.2 feet (2.5 meters)	0.33	0.14	1.02	0.43	0.48	0.20	1.49	0.62

Notes:
Buried = cable segments buried to target depth of 4 to 6 feet (1.2 to 1.8 meters); Bed Surface = cable segments on bed surface
Surface = induced field strength in model fish at the bed surface; 1 meter = induced field strength in model fish at 1 meter above the bed surface

The magnitude, extent, timing and duration of EMF effects from SFWF and SFEC operations on EFH species are detailed in Appendix A, Table A-6.

6.2.3.1 SFWF

The EMF and substrate heating effects of the inter-array cable on EFH will vary depending on the respective cable voltage, the position of the cable on the seabed (i.e., buried to target depth or laid on bed surface), and how EFH is used by different life stages of EFH species. Specifically, EFH species with life stages that are surface-oriented or use pelagic habitats more than 26.2 feet (8 meters) of a cable path would not be exposed to EMF effects and would experience no effects on this habitat component. In contrast, EFH species that use bottom or near-bottom habitats along the potential cable paths during one or more life stages may be exposed to EMF effects. The significance of these potential effects is dependent on habitat use (i.e., likelihood of exposure), and species-specific sensitivity to magnetic and electrical fields and heating effects.

The inter-array cable would generate intermittent induced magnetic and electrical field effects throughout the life of the project, with the timing and duration of occurrence determined by wind speeds exceeding the operational kick-in threshold. The resulting effects on EFH would vary in intensity depending on the following factors:

- Position of the cable segment (i.e., buried to target depth or laid on the bed surface)
- Proximity of the affected habitat to the cable (i.e., benthic or epibenthic habitat within 3.3 feet (1 meter) of the seabed or surficial or mid-water pelagic habitats)
- Species-specific sensitivity to EMF effects

EMF Effects on Habitats Used by Benthic or Epibenthic Eggs and Larvae

Several EFH species and fish and invertebrates that provide prey for EFH species have benthic eggs and larvae could settle in areas along the inter-array cable path, including both buried and exposed cable segments. The maximum induced magnetic field and electrical field generated by the inter-array cable are 65.1 mG and 4.3 mV/m at the bed surface immediately adjacent to exposed cable segments, respectively. Induced electrical field effects on eggs and larvae would be insignificant based on their small body size.

Species-specific data on egg and larval sensitivity to EMF effects is lacking. However, general research on fish sensitivity to magnetic and electrical fields suggests that the effects of EMF from the inter-array cable on benthic egg and larval EFH would be insignificant. For example, Cameron et al. (1985) determined that magnetic fields on the order of 1,000 mG are required to produce observable developmental delay on the eggs of euryhaline Japanese rice fish. Brouard et al. (1996) exposed rainbow trout embryos to electrical fields ranging as high as 5,000 mV/m and observed no evident effects on development or subsequent survival. These test exposures are orders of magnitude higher than the largest potential EMF effect on benthic habitats likely to result from inter-array cable operation. These findings indicate that the EMF effects of this project component on benthic EFH for the eggs and larvae would be insignificant.

The following EFH species have benthic, epibenthic, or near-bottom pelagic egg and larval life stages and are likely to be exposed to insignificant EMF effects from the inter-array cable:

- Atlantic cod (larvae)
- Black sea bass (larvae)
- Bluefish (eggs and larvae)
- Butterfish (eggs and larvae)
- Monkfish (larvae)
- Ocean pout (eggs and larvae)
- Atlantic herring (larvae)
- Atlantic mackerel (larvae)
- Summer flounder (eggs and larvae)
- Windowpane flounder (larvae)
- Atlantic sea scallop (eggs and larvae)

EMF Effects on Habitats Used by Epibenthic Finfish and Flatfish Species

Several EFH species and their fish prey species use benthic or epibenthic habitats within 3.3 feet (1 meter) of the seabed during their life cycle that overlap with the inter-array cable path, including both buried and exposed cable segments. This indicates that EFH species and their prey could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
- Electrical field: 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
- Induced electrical fields:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m

As with eggs and larvae, species-specific research on the magnetic and electrical field sensitivity is generally lacking. However, the preponderance of available research on a variety of fish species (e.g., Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015) indicates that the minimum magnetic field exposure threshold for observable effects on behavior exceeds 1,000 mG for most fish species. The minimum threshold for observable detection of electrical fields in electrosensitive fish species is on the order of 20 mV/m (Basov 1999). Each of these thresholds is an order of magnitude or more greater than the maximum potential EMF effect likely to result from inter-array cable operation. In a review of EMF effects produced by offshore wind energy, Copping et al. (2016) concluded that induced electrical fields on the order of those generated in fish in close proximity to the inter-array cable would have no observable effects on physiology or behavior.

On this basis, the EMF effects of inter-array cable operation on benthic and epibenthic habitats used by EFH finfish species and finfish prey organisms would be insignificant. The following EFH species use the affected habitat during juvenile, adult, and/or spawning life stages:

- Atlantic cod (juvenile, adult, spawning)
- Pollock (juvenile)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- White hake (juvenile)
- Black sea bass (juvenile, adult)
- Butterfish (juvenile, adult)
- Ocean pout (juvenile, adult, spawning)
- Scup (juvenile, adult)
- Atlantic herring (spawning)
- Monkfish (juvenile, adult, spawning)
- Summer flounder (adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)

EMF Effects on Demersal Habitats Used by Pelagic Finfish Species

Several pelagic EFH species may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. Prey organisms for pelagic fish species may also occur within this EMF exposure zone. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
    - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.43 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of inter-array cable operation on near-bottom pelagic habitats used by EFH finfish species would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

- Albacore tuna (juvenile, adult)
- Atlantic bluefin (juvenile, adult)
- Atlantic skipjack (juvenile, adult)
- Atlantic yellowfin (juvenile, adult)
- Atlantic mackerel (juvenile, adult, spawning)
- Atlantic herring (juvenile, adult)
- Bluefish (juvenile, adult)

EMF Effects on Demersal Habitats Used by Pelagic Invertebrates

Two pelagic EFH invertebrate species, longfin squid and shortfin squid, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. Prey organisms within this zone would also experience EMF exposure. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields (body size dependent): Juveniles and adults less than 3.3 feet (1 meter) in length: < 0.25 mV/m

While directed studies are lacking, there is little evidence that cephalopods like squid are electromagnetically sensitive (Normandeau 2011; Williamson 1995). Anecdotal observations suggest that EMF from submarine power cables has no effect on cephalopod behavior. Love et al. (2015) observed no differences in octopus predation on caged crabs placed immediately adjacent to a powered HVAC electrical cable producing induced magnetic fields ranging from 450 to 800 mG, and at a control site adjacent to an unpowered cable. The lack of effects on predation behavior suggests that cephalopods are insensitive to EMF effects of this magnitude. Given that the largest projected magnetic field effects from the inter-array cable are 1 to 2 orders of magnitude lower than these values, it is reasonable to conclude that the EMF effects of this project feature on EFH used by longfin squid would be insignificant.

EMF Effects on Demersal and Epibenthic Habitats Used by Skates and Sharks

Several EFH skate and shark species use demersal and epibenthic habitats overlapping the potential inter-array cable corridor during one or more life history stages. This indicates that these species may be exposed to the following EMF effects depending on their proximity to the seabed:

- Induced magnetic field:
  - 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
  - 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field:
  - 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
  - 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at seabed:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 1.02 mV/m
- Induced electrical fields at 1 meter above seabed
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.43 mV/m

Elasmobranchs are sensitive to EMFs, using specialized electrosensory organs to detect faint bioelectric signals emitted by prey. Sharks and rays demonstrate sensitivity to bioelectrical fields less than 1 mV/m (Adair et al. 1998; Ball et al. 2016; Bedore and Kajiura 2013; Kempster et al. 2013). However, it is important to recognize that most bioelectrical fields operate at frequencies on the order of 0.001 to 5 Hz, and fields with frequencies greater than 20 Hz are beyond the detection range of most electrosensitive organisms (Bedore and Kajiura 2013). For example, Kempster et al. (2013) observed behavioral responses in bamboo shark (*Chiloscyllium plagiosum*) embryos exposed to electrical fields of 0.004 to 0.02 mV/m at 0.1 to 1.0 Hz, emulating the bioelectric fields generated by predators, but no response to the same field strength at 20 Hz. These findings indicate that the 60-Hz electrical fields generated by the inter-array cable would not be detectable by elasmobranchs.

The evidence for magnetic field sensitivity in sharks and rays is more variable. Orr (2016) exposed the benthic draughtsboard shark (*Cephaloscyllium isabellum*) to a 50-Hz magnetic field operating at 14,300 mG and found no observable effects on foraging behavior. In contrast, Hutchinson et al. (2018; 2020) observed behavioral responses in little skate to induced magnetic fields on the order of 650 mG. The available research indicates that while the minimum magnetosensitivity of elasmobranchs is unknown, some species have exhibited observable behavioral responses to anthropogenic EMF at field strengths ranging between 250 and 1,000 mG (Hutchinson et al. 2018, 2020; Normandeau 2011). The induced electrical fields generated in even the largest individuals potentially exposed to these effects are less than those generated by muscular and nervous activity in living animals (~10 mV/m) and are therefore likely indetectable (Adair et al. 1998).

Based on the above findings, it is reasonable to conclude that the EMF effects of the inter-array cable on EFH used by epibenthic and demersal pelagic skates and sharks would be insignificant. The 60-Hz electrical fields generated by the cable are above the known detection frequency limit of 20 Hz, while the maximum induced magnetic field and induced electrical field effects are orders of magnitude below the known or probable detection limits of these species. EFH for the following epibenthic and demersal pelagic shark and ray species would be exposed to insignificant EMF effects from the inter-array cable:

- Blue shark (neonate/YOY, juvenile)
- Dusky shark (neonate/YOY, juvenile)
- Common thresher shark (neonate/YOY, juvenile)
- Shortfin mako shark (neonate/YOY, juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- White shark (neonate/YOY, juvenile)
- Smooth dogfish (neonate, juvenile, adult)
- Spiny dogfish (subadult and adult, male and female)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)

EMF and Heat Effects on Benthic Invertebrates

The inter-array cable corridor overlaps with EFH used by Atlantic sea scallop, Atlantic surf clam, and ocean quahog and these species are likely to be exposed to EMF and heat effects from inter-array cable operation. Benthic infauna that provide prey resources for EFH species would also be exposed to these effects. The potential for EMF effects on shellfish EFH and benthic infauna in general is of concern as these species are generally immobile and any exposures to measurable effects would be prolonged. The available information on invertebrate sensitivity to EMF effects is equivocal (Albert et al. 2020). For example, Ottoviani et al. (2002) and Malagoli et al. (2003, 2004) observed apparent disruption of cellular processes in mussels exposed to induced 50-Hz magnetic fields ranging from 3 to 10 mG for as little as 15 minutes, and Stankevičiūtė et al. (2019) observed apparent genotoxic and cytotoxic effects in infaunal clams and worms after 12 days of exposure to a 10-mG field at 50 Hz. In contrast, Bochert and Zettler (2006) observed no apparent effects on physiological condition or gonad development in mussels exposed to a 37-mG DC magnetic field for over 90 days. Cada et al. (2011) observed no effects on the behavior of clams exposed to 360 mG for 48 hours.

The preponderance of evidence suggests that the inter-array cable could produce sufficient EMF to have potentially adverse effects on bivalve physiology, but the specific sensitivity of EFH shellfish species likely to occur in the cable path remains unclear. The maximum induced magnetic field generated of 65.1 mG would attenuate to 1 mG within 32.8 feet (10 meters) of the cable. Applying this value as a conservative physiological effect threshold over the entire corridor length, this would equate to 85 acres (34.4 hectares) of bivalve EFH exposed to potentially significant EMF effects on habitat suitability. This conservative estimate is likely representative of the maximum potential extent of EMF effects on foraging habitat for EFH species that prey on benthic infauna.

In addition to EMF effects, buried segments of the inter-array cable would generate sufficient heat to raise the temperature of the surrounding sediments by as much as 10 to 20 °C above ambient within 1.3 to 2 feet (0.4 to 0.6 meter) of buried cable segments (Section 4.2.3). Substrate temperature changes of this magnitude could adversely affect habitat suitability for juvenile and adult life stages of Atlantic surf clam and ocean quahog (Acquafredda et al. 2019; Harding et al. 2008), as well as other benthic infauna species. However, because the inter-array cable would be buried to a minimum depth of 4 to 6 feet (1.2 to 1.8 meters) along the majority of its length, heat effects from buried cable segments on benthic infauna would likely be insignificant. Cable segments at the transitions between fully buried and exposed cable segments would be buried at shallower depths, potentially exposing quahog and surf clam habitat and infaunal prey species to adverse thermal effects. Based on conceptual designs for the exposed cable segments (COP Appendix G2), these shallow buried segments would account for approximately 10 percent of the 5.8 linear miles (9.3 km, 5 nm) of exposed cable length. This equates to approximately 1.5 acres (0.6 hectare) of benthic EFH exposed to potentially adverse thermal effects. Note however that suitability of these habitats for surf clam and quahog and benthic infauna in general would also be negatively affected by the overlying concrete mattresses so the areal extents of these two impacts are not additive.

The following bivalve species and life stages may be exposed to potentially adverse effects on EFH resulting from EMF and heat effects from inter-array cable operation:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.2.3.2 SFEC

The EMF and substrate heating effects of the SFEC on EFH will vary depending on the respective cable voltage, the position of the cable on the seabed (i.e., buried to target depth or laid on bed surface), and how EFH is used by different life stages of EFH species. The nature of these effects and the potential exposure of EFH used by fish and invertebrates occurring along the SFEC corridor, and the rationale used to analyze these effects, are similar to those described for the inter-array cable in Section 6.2.3.1.

EMF Effects on Habitats Used by Benthic or Epibenthic Eggs and Larvae

Several EFH species have benthic eggs and larvae could settle in areas along the SFEC path, including both buried and exposed cable segments. The maximum induced magnetic field and electrical field generated by the inter-array cable are 76.6 mG and 5.4 mV/m at the bed surface immediately adjacent to exposed cable segments, respectively. Induced electrical field effects on eggs and larvae would be insignificant based on their small body size.

Applying the effect thresholds and rationale described for these life stages in Section 6.2.3.1, the maximum EMF exposure generated by the SFEC is orders of magnitude smaller than the lowest observed biological effect threshold in fish and shellfish eggs and larvae. On this basis, the EMF effects of the SFEC on EFH used by benthic and epibenthic eggs and larvae are likely to be insignificant. EFH species with habitats exposed to insignificant EMF effects from the SFEC are as follows:

- Atlantic cod (larvae)
- Atlantic herring (larvae)
- Atlantic mackerel (larvae)
- Black sea bass (larvae)
- Butterfish (eggs and larvae)
- Ocean pout (eggs and larvae)
- Monkfish (larvae)
- Summer flounder (eggs and larvae)
- Windowpane flounder (larvae)
- Atlantic sea scallop (eggs and larvae)
- Longfin squid (eggs)

EMF Effects on Habitats Used by Epibenthic Finfish and Flatfish Species

Several EFH species use benthic or epibenthic habitats within 3.3 feet (1 meter) of the seabed during their life cycle that overlap with the SFEC corridor, including both buried and exposed cable segments. Epibenthic fish species that provide prey for EFH species also use these habitats. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 30 to 76.6 mG at seabed above buried and exposed cable segments, respectively
- Electrical field: 2.1 to 5.4 mV/m at seabed above buried and exposed cable segments, respectively
- Induced electrical fields:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.59 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 1.05 mV/m

Applying the same thresholds described in Section 6.2.3.1, the largest potential EMF effects from the SFEC are orders of magnitude smaller than the lowest observed physiological and behavioral effects thresholds for EFH species and prey that use benthic and epibenthic habitats. On this basis, the EMF effects of inter-array cable operation on benthic and epibenthic habitats used by EFH finfish species would be insignificant. The following EFH species use the affected habitat during juvenile, adult, and/or spawning life stages:

- Atlantic cod (juvenile, adult, spawning)
- Pollock (juvenile)
- Red hake (juvenile, adult, spawning)
- Scup (juvenile, adult)
- Atlantic herring (spawning)
- Monkfish (juvenile, adult, spawning)

- Silver hake (juvenile, adult, spawning)
- White hake (juvenile)
- Black sea bass (juvenile, adult)
- Butterfish (juvenile, adult)
- Ocean pout (juvenile, adult, spawning)
- Summer flounder (adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)

EMF Effects on Demersal Habitats Used by Pelagic Finfish Species

Several pelagic fish species, including EFH species and their prey, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during their respective life cycles. This may include habitats that overlap buried and exposed segments of the inter-array cable. This indicates that these species could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 53.6 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field: 1.4 to 3.6 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed:
    - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.25 mV/m
    - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.47 mV/m
    - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 0.62 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of SFEC operation on near-bottom pelagic habitats used by EFH finfish species and their prey organisms would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

- Albacore tuna (juvenile, adult)
- Atlantic bluefin (juvenile, adult)
- Atlantic skipjack (juvenile, adult)
- Atlantic yellowfin (juvenile, adult)
- Atlantic mackerel (juvenile, adult, spawning)
- Atlantic herring (juvenile, adult)
- Bluefish (juvenile, adult)

EMF Effects on Demersal Habitats Used by Pelagic Invertebrates

One pelagic EFH invertebrate species, longfin squid, may periodically use demersal habitats at or near 3.3 feet (1 meter) of the seabed during its life cycle. This may include habitats overlapping buried and exposed segments of the inter-array cable. This indicates that this species could be exposed to the following EMF effects:

- Induced magnetic field: 21 to 53.6 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively

- Electrical field: 1.4 to 3.6 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at 3.3 feet (1 meter) above seabed: Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.25 mV/m

Longfin squid prey on fish and other invertebrates within this same effect area, indicating that effects described for fish and invertebrates in previous and following sections would apply to prey species. Applying the effect thresholds and rationale presented in the previous section, the EMF effects of SFEC operation on near-bottom pelagic habitats used by squid and their prey would be insignificant. Longfin squid may periodically use the affected habitat during the designated juvenile and adult life stages.

EMF Effects on Demersal and Epibenthic Habitats Used by Skates and Sharks

Several EFH skate and shark species use demersal and epibenthic habitats overlapping the potential SFEC corridor alternatives during one or more life history stages. This indicates that these species may be exposed to the following EMF effects depending on their proximity to the seabed:

- Induced magnetic field:
  - 21 to 65.1 mG at seabed above buried and exposed cable segments, respectively
  - 9 to 27.9 mG at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Electrical field:
  - 1.4 to 4.3 mV/m at seabed above buried and exposed cable segments, respectively
  - 0.9 to 2.8 mV/m at 3.3 feet (1 meter) above the seabed over buried and exposed cable segments, respectively
- Induced electrical fields at seabed:
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.4 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.74 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5 meters) length: < 1.02 mV/m
- Induced electrical fields at 3.3 feet (1 meter) above seabed
  - Juveniles and subadults less than 3.3 feet (1 meter) in length: < 0.19 mV/m
  - Adults between 3.3 and 6 feet (1 and 1.8 meters) length: < 0.31 mV/m
  - Adults between 6 and 8.2 feet (1.8 and 2.5) meters length: < 0.43 mV/m

Applying the effect thresholds and rationale presented in the previous section, the EMF effects of SFEC operation on demersal and epibenthic habitats used by EFH shark and skate species and their prey organisms would be insignificant. The following EFH species may periodically use the affected habitat during juvenile, adult, and/or spawning life stages:

- Blue shark (neonate/YOY, juvenile)
- Dusky shark (neonate/YOY, juvenile)
- White shark (neonate/YOY, juvenile)

- Common thresher shark (neonate/YOY, juvenile)
- Shortfin mako shark (neonate/YOY, juvenile)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- Smooth dogfish (neonate, juvenile, adult)
- Spiny dogfish (subadult and adult, male and female)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Winter skate (juvenile, adult)

EMF and Heat Effects on Benthic Invertebrates

The SFEC route alternatives overlap with EFH used by Atlantic sea scallop, Atlantic surf clam, and ocean quahog, and these species are likely to be exposed to EMF and heat effects from SFEC operation. As described in Section 6.2.3.1, the preponderance of evidence suggests that the SFEC could produce sufficient EMF to have potentially adverse effects on invertebrate physiology, but the specific sensitivity of EFH shellfish species and benthic infaunal prey organisms that are likely to occur in the cable path remains unclear. The maximum induced magnetic field generated of 76.6 mG would attenuate to 1 mG within 32.8 feet (10 meters) of the cable. Applying this value as a conservative physiological effect threshold over the entire corridor length, this would equate to approximately 244.1 and 198.7 acres (98.8 and 80.4 hectares) of bivalve and infaunal prey habitat exposed to potentially significant EMF effects for the Beach Lane and Hither Hills route alternatives, respectively.

As discussed in Section 4.2.3, buried segments of the SFEC would generate sufficient heat to raise the temperature of the surrounding sediments by as much as 10 to 20 °C above ambient within 1.3 to 2 feet (0.4 to 0.6 meter) of buried cable segments. Temperature changes of this magnitude could adversely affect habitat suitability for juvenile and adult life stages of Atlantic surf clam and ocean quahog, and benthic infaunal prey species (see Section 6.2.3.1). However, because the SFEC would be buried to a minimum depth of 4 to 6 feet (1.2 to 1.8 meters) along the majority of its length, heat effects on juvenile and adult clams and other benthic infauna over buried cable segments would likely be insignificant. Cable segments at the transitions between fully buried and exposed cable segments would be buried at shallower depths, potentially exposing quahog and surf clam habitat and other benthic infauna to adverse thermal effects. Based on conceptual designs for the exposed cable segments (COP Appendix G2), these shallow buried segments would account for approximately 10 percent of exposed cable length. This equates to approximately 0.7 and 0.5 acre (0.3 and 0.2 hectare) of benthic EFH exposed to potentially adverse thermal effects on EFH for the Beach Lane and Hither Hills route alternatives, respectively. As stated however, these areas would be covered by concrete mattresses and rendered unsuitable habitat for benthic infauna so the two effect areas are not additive.

The following bivalve species and life stages may be exposed to potentially adverse effects on EFH resulting from EMF and heat effects from inter-array cable operation:

- Atlantic sea scallop (juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.2.4 Hydrodynamic Effects

Hydrodynamic effects on EFH resulting from project operations vary depending on how pelagic and benthic habitats exposed to these impacts are used by EFH species. EFH is divided into the following components for the purpose of this assessment:

- Water column habitats used by pelagic eggs and larvae
- Water column habitats used by pelagic juveniles and adults
- Bottom habitats used by benthic-oriented juveniles and adults
- Bottom habitats used by EFH shellfish species

As described in Section 4.2.4, it is assumed that hydrodynamic effects are limited to 656.2 to 1,312.3 feet (200 to 400 meters) downcurrent of each monopile within the SFWF. Given the 0.9-nautical-mile (1.6-km, 1-nm) separation between monopiles, these effects are expected to be localized around each monopile and would not produce additive effects across the entire array. These localized hydrodynamic effects would persist through the life of the Project until the monopile foundations are decommissioned and removed. This assessment focuses on life stages of EFH species and their prey organisms that would likely be exposed to hydrodynamic effects.

The magnitude, extent, and duration of hydrodynamic effects the SFWF on EFH species and habitats are detailed in Appendix A, Table A-7.

6.2.4.1 SFWF

Operation of the SFWF has the potential to affect local hydrodynamics through placement of the monopiles and WTGs in the water column.

Hydrodynamic Effects to Surface and Water Column Habitats used by Pelagic Eggs and Larvae

The presence of SFWF monopiles has the potential to locally reduce current speeds and introduce turbulence. Given their planktonic nature, altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, leading to reduced survival. These effects would apply to EFH species that have or prey upon pelagic eggs and larvae. Any such effects on egg and larval survival theoretically could be offset by increased primary productivity in the wake of the monopiles. Turbulence downcurrent of the monopiles could introduce nutrients to the surface mixed layer that promote primary production, increasing the forage base for pelagic larvae (Floeter et al. 2017). As stated, these offsetting effects would be highly localized and likely insignificant relative to the natural mortality rate of ichthyoplankton in general. On balance, hydrodynamic effects on EFH species that have or prey upon pelagic eggs and larvae are expected to be neutral to beneficial. EFH species with pelagic eggs or larvae that are known or likely to occur within the SFWF area include:

- Atlantic cod (eggs, larvae)
- Atlantic herring (larvae)
- Atlantic mackerel (larvae)
- Black sea bass (eggs)
- Bluefish (eggs, larvae)
- Butterfish (eggs, larvae)
- Haddock (eggs, larvae)
- Monkfish (eggs, larvae)
- Red hake (eggs, larvae)
- Scup (eggs, larvae)
- Silver hake (eggs, larvae)
- Smooth dogfish (neonate)
- Summer flounder (eggs, larvae)
- White hake (larvae)
- Windowpane flounder (eggs, larvae)
- Witch flounder (eggs, larvae)
- Yellowtail flounder (eggs, larvae)

Hydrodynamic Effects to Water Column Habitats used by Pelagic Juveniles and Adults

Pelagic juveniles and adults of EFH species utilizing water column habitats may experience localized hydrodynamic effects downcurrent of each SFWF monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Pelagic juveniles and adults would likely exhibit a behavioral avoidance response away from any habitat with decreased suitability. This behavioral effect applies to EFH species and pelagic prey organisms. Hydrodynamic effects are expected to vary depending on seasonal and tidal hydrodynamic cycles. Regardless of variability, these effects would be localized to within 656.2 to 1,312.3 feet (200 to 400 meters) downcurrent from each monopile and would persist through the life of the Project. EFH species with pelagic juvenile or adult life stages that are known or likely to occur within the SFWF area include:

- Albacore tuna (juvenile, adult)
- Atlantic bluefin (juvenile, adult)
- Atlantic herring (juvenile, adult)
- Atlantic mackerel (juvenile, adult, spawning)
- Atlantic skipjack (juvenile, adult)
- Atlantic yellowfin (juvenile, adult)
- Bluefish (juvenile, adult)
- Longfin squid (juvenile, adult)
- Smooth dogfish (juvenile, adult)
- Spiny dogfish (subadult (f), subadult (m), adult (f), adult (m))

Hydrodynamic Effects to Bottom Habitats used by Benthic-oriented Juveniles and Adults

Benthic-oriented juveniles and adults of EFH species and their prey organisms may experience hydrodynamic effects of the SFWF influencing local habitat suitability down-current of each monopile. Benthic-oriented juveniles and adults would likely exhibit a behavioral avoidance response away from any habitat with decreased suitability. These localized intermittent hydrodynamic effects would persist throughout the life of the Project. EFH species with benthic-oriented juvenile or adult life stages that are known or likely to occur within the SFWF area include:

- Atlantic cod (juvenile, adult, spawning)
- Haddock (juvenile, adult, spawning)
- Pollock (juvenile, adult, spawning)
- Red hake (juvenile, adult, spawning)
- Silver hake (juvenile, adult, spawning)
- White hake (juvenile, adult, spawning)
- Atlantic herring (eggs, spawning)
- Summer flounder (adult)
- Windowpane flounder (juvenile, adult, spawning)
- Winter flounder (juvenile, adult, spawning)
- Witch flounder (juvenile, adult, spawning)
- Yellowtail flounder (juvenile, adult, spawning)
- Black sea bass (larvae, juvenile, adult)
- Butterfish (juvenile, adult)
- Monkfish (juvenile, adult, spawning)
- Ocean pout (eggs, larvae, juvenile, adult, spawning)
- Scup (juvenile, adult)
- Longfin squid (eggs)
- Barndoor skate (juvenile, adult)
- Little skate (juvenile, adult)
- Sand tiger shark (neonate/YOY, juvenile)
- Sandbar shark (neonate/YOY, juvenile, adult)
- Winter skate (juvenile, adult)

Hydrodynamic Effects to Bottom Habitats used by EFH Shellfish

Hydrodynamic effects of SFWF operations would be localized and largely insignificant for bottom habitat utilized by EFH shellfish. As noted in the section above on pelagic eggs and larvae, there is potential for hydrodynamic effects to influence dispersal of planktonic life stages. However, given the spawning strategy of these species, these minor effects are not expected to influence reproductivity of the species. EFH shellfish species and life stages that utilize habitats that may be exposed to hydrodynamic effects include:

- Atlantic sea scallop (eggs, larvae, juvenile, adult, spawning)
- Atlantic surf clam (juvenile, adult)
- Ocean quahog (juvenile, adult)

6.2.4.2 SFEC

No measurable hydrodynamic effects on EFH are expected to result from SFEC operations.

6.2.4.3 O&M Facility

No measurable hydrodynamic effects on EFH are expected to result from O&M facility operation.

6.3 Planned Environmental Protection Measures, Anticipated Mitigation Requirements, and Proposed Environmental Monitoring

This section outlines relevant environmental protection measures (EPMs) proposed by DWSF and anticipated additional mitigation and monitoring measures that are intended to avoid and/or minimize potential impacts to aquatic species and habitats. Relevant EPMs and mitigation measures, contribution to avoiding and/or minimizing adverse effects on EFH, and supporting rationale are summarized by project component in Table 6.2. Lessee-proposed EPMs and anticipated mitigation measures that could be required by BOEM are presented separately.

Table 6.2. Relevant EPMs and Potential Additional Mitigation Measures for Construction and O&M of the SFWF, SFEC, and O&M Facility

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
EPMs Proposed by Deepwater Wind South Fork, LLC				
The SFWF and SFEC project components would be sited to avoid and minimize impacts to complex and potentially complex bottom habitats to the extent practicable.	x	x	--	Minimizes impacts to sensitive and slow to recover habitats utilized by EFH species.
The SFWF inter-array cable and SFEC would be installed using low-impact equipment such as a mechanical cutter, mechanical plow, and/or jet plow to minimize cable installation disturbance footprints and suspended sediment impacts.	x	x	--	Limits impacts to EFH and EFH species by minimizing the extent and duration of direct habitat impacts and reducing suspended sediment effects on EFH species.
Monopile foundations with associated scour protection would minimize impacts to benthic habitat compared to other foundation types.	x	--	--	Smaller long-term project footprint limits impacts to EFH and EFH species by minimizing the extent of direct habitat impacts.
All project vessels would comply with regulatory requirements related to the prevention and control of discharges and accidental spills.	x	x	x	Avoids adverse effects on EFH from impacts to water quality.
Accidental spill or release of oils or other hazardous materials would be managed through the Oil Spill Response Plan (OSRP) (COP Appendix D).	x	x	x	Avoids and minimizes adverse effects on EFH from impacts to water quality.
An HDD inadvertent release plan would minimize the potential risks associated with release of drilling fluids or a frac-out.	--	x	--	Avoids and minimizes adverse effects on EFH from impacts to water quality.
DWSF has designed the Project to account for site-specific oceanographic and meteorological conditions within the Lease Area; therefore, no additional measures are necessary.	x	x	--	Consideration of site-specific conditions minimizes potential impacts to EFH and EFH species from changes to hydrodynamics.
A plan for vessels would be developed prior to construction and used to identify no-anchor areas inside the MWA to protect sensitive habitat or other areas to be avoided.	x	x	x	This measure would minimize the impact of vessel anchorage to EFH and EFH species.
The SFWF and SFEC would use HRG surveys and other site characterization methods to identify, avoid, and minimize impacts to complex bottom habitats to the extent practicable.	x	x	--	Consideration of benthic habitat would reduce impacts to sensitive habitats utilized by EFH species.
The SFWF inter-array cable and SFEC offshore would be buried to a target depth of 4 to 6 feet (1.2 to 1.8 meters) to minimize potential impacts from EMFs.	x	x	--	This measure would minimize impacts to EFH and EFH species from EMF.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
Use of dynamic positioning vessels for cable installation for the SFWF inter-array cable and SFEC would minimize anchoring impacts to EFH and EFH species.	x	x	--	This measure would minimize the impact of vessel anchorage to EFH and EFH species.
The SFEC sea-to-shore transition would be installed via HDD to avoid impacts to EFH and EFH species in the intertidal and nearshore zones.	--	x	--	This measure limits impacts to EFH and EFH species by minimizing the extent of direct habitat impacts.
Site-specific benthic habitat assessments will inform siting of the SFWF and SFEC offshore.	x	x	--	Consideration of benthic habitat would reduce impacts to sensitive habitats utilized by EFH species.
Mitigation measures would be implemented for pile-driving and HRG survey activities for ESA species, which would also have a protective effect on EFH species. These measures would include soft-start procedures and noise attenuation systems such as bubble curtains, as appropriate.	x	x	x	The reduction in sound pressure levels (SPLs) will reduce the area of effects to EFH species and the prey they feed upon.
Impact pile-driving activities would not occur at the SFWF from January 1 to April 30 to minimize potential impacts to the North Atlantic right whale. Timing restrictions for marine mammal protection may alter the timing and duration of underwater noise exposure for some sensitive EFH species and life stages.	x	x	--	Time of year restrictions for pile-driving activities may minimize and avoid potentially adverse effects to EFH species that are more likely to occur in the area during that time period.
Impacts to waters of the U.S. would be avoided and minimized by reducing the size of the dredge/excavation footprints to the extent practicable, eliminating the need for bulkhead improvements at the Montauk O&M facility by locating the berthing area away from the bulkhead, and beneficial reuse of dredged materials for beach nourishment at an active beach nourishment site. These avoidance and minimization measures would have a protective effect on EFH species and EFH.	--	--	x	Construction and operational measures are designed to minimize effects on EFH. Beneficial use of dredge materials for beach nourishment efforts would enhance nearshore habitats used by EFH species and their prey organisms.
Potential Additional Mitigation and Monitoring Measures				
Data-sharing: Orsted has signed a Memorandum of Agreement with NOAA to share all physical and biological data collected in Ørsted-leased waters subject to U.S. jurisdiction, including data on water quality, biological communities, coastal and ocean currents, circulation and waves, and physical oceanography. This agreement applies to all physical, biological, and mitigation effectiveness monitoring, including all measures described below.	x	x	x	Physical and biological habitat data collected by Ørsted will increase understanding of EFH on the mid-Atlantic OCS. This information will inform future management and conservation of EFH resources.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
Time-of-year restrictions would occur during January through May to avoid dredging activities within Lake Montauk during spawning activities of winter flounder.	--	--	x	Time of year restrictions for dredging would minimize and avoid potentially adverse effects to EFH species (esp. winter flounder) that occur in the area during that time period.
Fisheries and benthic monitoring plan. Orsted has developed a fisheries and benthic habitat monitoring plan (draft dated 9/30/20) that has been reviewed and approved by NMFS and the Rhode Island and New York state environmental agencies. The beam trawl survey commenced in the fall of 2020 and the benthic habitat acoustic telemetry study is ongoing. Gillnet, fish pot, and ventless lobster trap surveys are anticipated for Spring 2021.	x	x	--	The fisheries and benthic habitat monitoring plan will provide valuable baseline information about the condition and use of habitats within the SFWF and SFEC project footprints. This information will support assessment of ecological impacts from project construction and operations, and inform future management of EFH on the mid-Atlantic OCS.
DWSF would provide an anchoring plan for all areas where anchoring is being used to avoid construction impacts on sensitive habitats, including hard bottom and structurally complex habitats. Require that DWSF consider any new data on benthic habitats to avoid/minimize impacts on benthic habitat. The anchoring plan would include the planned location of anchoring activities, sensitive habitats and locations, seabed features, potential hazards, and any related facility installation activities such as cables, WTGs, and OSSs, as appropriate. All vessels deploying anchors would use, whenever feasible and safe, mid-line anchor buoys to reduce the amount of anchor chain or line that touches the seafloor. The anchoring plan would be provided to BOEM and NOAA for review and approval before construction begins.	x	x	--	This measure would minimize the impact of vessel anchorage to EFH and EFH species.
The locations of any boulder (which would protrude >6.6 feet [2 meters] or more on the sea floor) relocated during cable installation activities must be reported to BOEM, USCG, NOAA, and the local harbormaster within 30 days of relocation. These locations must be reported in latitude and longitude degrees to the nearest 10 thousandth of a decimal degree (roughly the nearest meter), or as precise as practicable.	x	x	--	Precise quantification of impacts and location information will increase the value and effectiveness of ecological response monitoring.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
Marine debris is defined by the Bureau of Safety and Environmental Enforcement as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper, or any other manmade item or material that is lost or discarded in the marine environment. DWSF must ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the COP are briefed on marine debris prevention. BOEM must ensure that DWSF employees and contractors receive training to understand and implement best practices to ensure that debris is not intentionally or accidentally discharged into coastal or marine environments. Training must occur for all employees and contract personnel on the proper storage and disposal practices at-sea to reduce the likelihood of accidental discharge of marine debris at all at-sea and dockside operations that can impact protected species through entanglement or incidental ingestion. Training must include the environmental and socioeconomic impacts associated with marine trash and debris, as well as their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into coastal and marine environments. In the event that any materials unexpectedly enter the water, personnel would follow best practices to recover it if conditions are safe to do so, or notify the appropriate officials if conditions are unsafe.	x	x	x	Crew and personnel training will effectively limit releases of marine debris, which could decrease the potential for entanglement or ingestion of debris by EFH species.
Derelict fishing gear and debris removal. During routine inspections of the SFWF and SFEC, DWSF will identify and collect derelict fishing gear and other marine debris for disposal.	x	x	--	Removal of derelict fishing gear and other debris will remove synthetic materials from the environment, reducing mortality of EFH species from ingestion, entanglement, and ghost fishing.
DWSF would routinely inspect the condition of the inter-array cable and SFEC post-installation and provide regular reports to BOEM on an agreed upon schedule. Cable monitoring will include assessment of cable location, burial depths, state of the cable, and site conditions. Inspection methods are expected to include HRG surveys, such as a multi-beam bathymetric survey equipment, and identify seabed features, natural and man-made hazards, and site conditions along federal sections of the cable routing. In federal waters, the initial inter-array and export cable inspection would be carried out within 6 months of commissioning and subsequent inspections would be carried out at years 1, 2, and every 3 years thereafter and after a major storm event. Major storm events are defined as when metocean conditions at the facility meet or exceed the 1 in 50-year return period calculated in the metocean design basis, to be submitted to BOEM with the Facility Design Report. If conditions warrant adjustment to the frequency of inspections following the Year 2 survey, a revised monitoring plan may be provided to BOEM for review. DWSF will provide cable monitoring reports to BOEM within 45 calendar days following each inter-array and export cable inspection.	x	x	--	This measure would minimize impacts to EFH and EFH species from the presence of cable.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
The SFEC would be continuously monitored using the as-built Distributed Temperature Sensing System (DTSS). This system will immediately indicate if cable burial conditions have deteriorated or changed significantly and remedial actions are warranted. Should such actions be required, a report including all DTSS data, a seabed stability analysis, and report of remedial actions taken or scheduled would be provided to BOEM within 45 calendar days of initial observation. DTSS and annual cable inspection data, and an annual cable conditions assessment would be provided to BOEM consistent with annual compliance reporting requirements as specified in 30 CFR § 585.633(b).	--	x	--	This measure would minimize impacts to EFH and EFH species from the presence of cable.
DWSF would conduct post-construction monitoring to document habitat disturbance and recovery and inspection of scour protection and monitoring of performance at 20% of locations every 3 years starting year 3 (see fisheries and benthic habitat monitoring plan above). DWSF would consult with NMFS and BOEM prior to conducting monitoring and address any agency comments prior to implementation. As appropriate, based on Project design and engineering, DWSF would apply foundation scour protection to only the minimum area needed for sufficient protection.	x	x	x	This measure ensures proper monitoring of project effects on EFH. The data gathered could be used to evaluate impacts.
To ensure that the required 10 dB (decibel) re:1micropascal (μPa) noise attenuation is met, field verification during pile driving would be conducted. A Sound Source Verification Plan would be submitted to BOEM. Sound source verification would be carried out for the first two monopiles to be installed. Should larger diameter piles be installed, or greater hammer size or energy used, additional field measurements would be conducted.	x	x	x	This monitoring measure would not reduce effects but would ensure that the deployed noise reduction technologies are effective.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
Before driving any additional piles following underwater noise measurements, DWSF would review the initial field measurement results and make any necessary adjustments to the sound attenuation system and/or the exclusion or monitoring zones as detailed below. If the initial field measurements indicate that the isopleths of concern are larger than those considered, in coordination with BOEM, NMFS, and USACE, DWSF would ensure that additional sound attenuation measures are put in place before additional piles are installed. Additionally, the exclusion and monitoring zones would be expanded to match the actual distances to the isopleths of concern. If the exclusion zones (EZs) are expanded beyond 4,921.3 feet (1,500 meters), additional observers must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180 degrees and an area with a radius no greater than 0.93 mile (1.5 km, 0.81 nm). The EZs established in the Proposed Action must be considered minimum EZs and may not be reduced based on sound source verification results. DWSF must provide the initial results of the field measurements to NMFS, USACE, and BOEM as soon as they are available; NMFS, USACE, and BOEM would discuss these as soon as feasible with a target for that discussion within two business days of receiving the results. BOEM and NMFS would provide direction to DWSF on whether any additional modifications to the sound attenuation system or changes to the exclusion or monitoring zones are required. BOEM would also discuss with NMFS the potential need for re-initiation of consultation if appropriate.	x	--	--	Mitigation effectiveness monitoring would ensure that the deployed sound attenuation systems are achieving desired noise impact reduction targets. This would minimize the extent of EFH exposed to short-term adverse effects on habitat suitability.
Unanticipated impacts on EFH species would be reduced through near-term refinement of exclusion zones by refining pile-driving monitoring protocols based on monthly and/or annual monitoring results, in coordination with BOEM and NMFS. The sizes of exclusion zones and any modifications may increase zones based on required reporting.	x	x	--	This mitigation measure would ensure that exclusion zones are the appropriate size during pile driving.

Proposed EPMs and Mitigation Measures to Avoid and Minimize Impacts	Relevant Project Component			Expected Effects
	SFWF	SFEC	O&M Facility	
Passive acoustic monitoring (PAM) buoys or autonomous PAM devices would be used to record ambient noise and marine mammal species vocalizations in the Lease Area before, during, and immediately after construction (at least 2 years of operation) to monitor Project noise including vessel noise, pile driving, and WTG operation, and large whale detections in the WDA. Monitoring would also occur during the decommissioning phase. The total number of PAM stations and array configuration will depend on the size of the zone to be monitored, the amount of noise expected in the area, and the characteristics of the signals being monitored to accomplish both monitoring during constructions, and also meet post-construction monitoring needs. Results must be provided within 90 days of construction completion and again within 90 days of the 1-year and 2-year anniversary of collection. The underwater acoustic monitoring must follow standardized measurement and processing methods and visualization metrics developed by the Atlantic Deepwater Ecosystem Observatory Network (ADEON) for the U.S. Mid- and South Atlantic OCS (see https://adeon.unh.edu/). At least two buoys must be independently deployed within or bordering the Lease Area or one or more buoys must be deployed in coordination with other acoustic monitoring efforts in the RI and MA Lease Areas.	x	--	--	This monitoring measure would not reduce the expected adverse effects on EFH or EFH species, but the data gathered could be used to evaluate impacts and potentially lead to additional mitigation measures, if required (30 CFR 585.633(b)).
DWSF would monitor impacts associated with charter and recreational gear lost from expected increases in fishing around WTG foundations. Surveys by remotely operated vehicles, divers, or other means would inform frequency and locations of debris removal to decrease ingestion by and entanglement of EFH species.	x	--	--	The removal of fishing gear would reduce the expected adverse effects on EFH species by reducing the potential for habitat modification as well as hooking, entrapment, injury, and death from lost fishing gear, and decrease the potential for ingestion by EFH species.
NMSs, such as the Noise Mitigation System , Hydro-Sound Damper, Noise Abatement System, bubble curtain, or similar, would be used during impact pile driving activities to reduce the SPLs that are transmitted through the water by at least 10 dB below predicted levels. A primary NMS is required, and a secondary NMS is required as a backup or may be deployed in addition to the primary NMS as needed to achieve a noise reduction target of -10 dB.	x	--	x	The reduction in SPLs will reduce the area of effects to EFH species and the prey they feed upon.
DWSF would implement soft-start techniques for impact pile driving. The soft start must include an initial set of three strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period. This process must be repeated a total of three times prior to initiation of pile driving. Soft start is required for any impact driving, including at the beginning of the day, and at any time following a cessation of impact pile driving of 30 minutes or longer.	x	--	x	The establishment of soft-start protocols would minimize the potential for adverse effects and warn animals of the pending pile driving activity in the area and allow them to leave before full hammer power is reached.

7 EFH Effect Determinations

EFH effect determinations are summarized by species and life stage in Table 7.1. This table details designated EFH in the project area, short-term and long-term impacts on habitat suitability by impact mechanism detailed in Section 6, and EFH effect determinations by managed species and life stage. The project **will adversely affect** EFH for a managed species and life stage if one or more impact mechanisms in Section 6 to be adversely affected by one or more of the short-term or long-term impact mechanisms listed. The project **will not adversely affect** EFH if 1) EFH for the designated species or life stage does not occur in the project area, or 2) the effects of each impact mechanism on habitat suitability for the affected life stage is insignificant. The project will also affect habitats for NOAA trust resources known or likely to occur in the project area. These effects and effect determinations are described in Appendix B.

Table 7.1. Summary of Project Effects on EFH by Impact Mechanism and EFH Effect Determinations for Managed Species by Managed Species and Life Stages

EFH Species Group	EFH Species	Life Stage	Habitat Association§	Short-Term Adverse Effect on EFH‡			Long-Term or Permanent Adverse Effects on EFH‡				EFH Effect Determination (will adversely affect EFH?)
				Construction Noise (Section 6.1.1)	Crush., Burial, Entr. (Section 6.1.2)	Water Quality (Section 6.1.3)	Habitat Conversion (Section 6.2.1)	Operational Noise (Section 6.2.2)	EMF & Heat (Section 6.2.3)	Hydrodynamic (Section 6.2.4)	
Gadids	Atlantic cod	Eggs	Surface	Yes	Yes	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	Yes	Yes	--	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic complex/ non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Haddock	Eggs	Surface	--	--	--	--	--	--	--	No
		Larvae	Surface	Yes	Yes	--	--	No	--	No	Yes
		Juvenile	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Pollock	Juvenile	Benthic complex/ non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex	--	--	--	--	--	--	--	No
		Spawning	Benthic complex	--	--	--	--	--	--	--	No
	Red hake	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Silver hake	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	No	--	No	Yes
		Juvenile	Benthic complex/ benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex/ benthic non-complex	--	--	--	--	--	--	--	No
		Spawning	Benthic complex/ benthic non-complex	--	--	--	--	--	--	--	No
	White hake	Larvae	Surface	Yes	--	--	--	No	--	No	Yes
		Juvenile	Pelagic/ Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	--	--	--	--	--	--	--	No
		Spawning	Benthic non-complex	--	--	--	--	--	--	--	No

EFH Species Group	EFH Species	Life Stage	Habitat Association[§]	Short-Term Adverse Effect on EFH[‡]			Long-Term or Permanent Adverse Effects on EFH[‡]				EFH Effect Determination (will adversely affect EFH?)
				Construction Noise (Section 6.1.1)	Crush., Burial, Entr. (Section 6.1.2)	Water Quality (Section 6.1.3)	Habitat Conversion (Section 6.2.1)	Operational Noise (Section 6.2.2)	EMF & Heat (Section 6.2.3)	Hydrodynamic (Section 6.2.4)	
Other finfish	Monkfish	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	--	Yes	--	No	No	No	Yes
		Juvenile	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Bluefish	Eggs	Pelagic	Yes	--	--	--	No	No	No	Yes
		Larvae	Pelagic	Yes	--	--	--	No	No	No	Yes
		Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Black sea bass	Eggs	Surface	--	--	--	--	--	--	--	No
		Larvae	Benthic complex	--	--	--	--	--	--	--	No
		Juvenile	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Butterfish	Eggs	Pelagic	Yes	--	--	--	No	Yes	No	Yes
		Larvae	Pelagic	Yes	--	--	--	No	Yes	No	Yes
		Juvenile	Pelagic/ benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Pelagic/ benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Scup	Eggs	Pelagic	Yes	--	--	--	No	No	No	Yes
		Larvae	Pelagic	Yes	--	Yes	--	No	No	No	Yes
		Juvenile	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Ocean pout	Eggs	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Atlantic herring	Eggs	Benthic complex	--	Yes	Yes	Yes	No	Yes	No	Yes
		Larvae	Pelagic	Yes	--	--	--	No	No	No	Yes
		Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Spawning	Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

EFH Species Group	EFH Species	Life Stage	Habitat Association§	Short-Term Adverse Effect on EFH‡			Long-Term or Permanent Adverse Effects on EFH‡				EFH Effect Determination (will adversely affect EFH?)
				Construction Noise (Section 6.1.1)	Crush., Burial, Entr. (Section 6.1.2)	Water Quality (Section 6.1.3)	Habitat Conversion (Section 6.2.1)	Operational Noise (Section 6.2.2)	EMF & Heat (Section 6.2.3)	Hydrodynamic (Section 6.2.4)	
Flatfish	Windowpane flounder	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Pelagic	Yes	--	Yes	--	No	Yes	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Winter flounder	Eggs	Benthic non-complex	Yes	Yes	Yes	Yes	--	--	--	Yes
		Larvae	Pelagic/ benthic non-complex	Yes	Yes	Yes	Yes	--	--	--	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Witch flounder	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	--	--	--	--	--	--	--	No
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Yellowtail flounder	Eggs	Surface	Yes	--	--	--	No	--	No	Yes
		Larvae	Surface	Yes	--	--	--	No	--	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Spawning	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Summer flounder	Eggs	Pelagic	Yes	--	--	--	No	Yes	No	Yes
		Larvae	Pelagic	Yes	--	Yes	--	No	Yes	No	Yes
		Juvenile	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Highly Migratory Species	Atlantic mackerel	Eggs	Pelagic	Yes	--	--	--	No	--	--	Yes
		Larvae	Pelagic	Yes	--	--	--	No	--	--	Yes
		Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Atlantic mackerel (cont.)	Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Spawning	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Albacore tuna	Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Atlantic bluefin	Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Atlantic skipjack	Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes
	Atlantic yellowfin	Juvenile	Pelagic	Yes	--	--	--	Yes	No	No	Yes
		Adult	Pelagic	Yes	--	--	--	Yes	No	No	Yes

EFH Species Group	EFH Species	Life Stage	Habitat Association§	Short-Term Adverse Effect on EFH‡			Long-Term or Permanent Adverse Effects on EFH‡				EFH Effect Determination (will adversely affect EFH?)
				Construction Noise (Section 6.1.1)	Crush., Burial, Entr. (Section 6.1.2)	Water Quality (Section 6.1.3)	Habitat Conversion (Section 6.2.1)	Operational Noise (Section 6.2.2)	EMF & Heat (Section 6.2.3)	Hydrodynamic (Section 6.2.4)	
Sharks	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Juvenile	Benthic complex/ non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Sandbar shark	Neonate/YOY	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Smooth dogfish	Neonate	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
		Juvenile	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
		Adult	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
	Spiny dogfish	Sub-Adult (f)	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
		Sub-Adult (m)	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
		Adult (f)	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
		Adult (m)	Pelagic	Yes	--	Yes	--	Yes	Yes	No	Yes
Skates	Barndoor skate	Juvenile	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Little Skate	Juvenile	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Winter skate	Juvenile	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
		Adult	Benthic non-complex/ Benthic complex	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Invertebrates	Atlantic sea scallop	Eggs	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Larvae	Pelagic/ Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Juvenile	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Invertebrates (continued)	Atlantic sea scallop	Adult	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Spawning	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
	Atlantic surf clam	Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
	Ocean quahog	Juvenile	Benthic non-complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Adult	Benthic non-complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
	Shortfin squid	Juvenile	Pelagic	Yes	--	Yes	--	No	Yes	No	Yes
		Adult	Pelagic	Yes	--	Yes	--	No	Yes	No	Yes
	Longfin squid	Eggs	Benthic complex	Yes	Yes	Yes	Yes	No	Yes	No	Yes
		Juvenile	Pelagic	Yes	--	Yes	--	No	No	No	Yes
		Adult	Pelagic	Yes	--	Yes	--	No	No	No	Yes

Notes:
§ Benthic complex habitat includes potentially complex benthic habitat.
‡ 'Yes' = adverse effect on habitat suitability; 'No' = insignificant effect on habitat suitability; '—' = no life stage EFH exposure to this impact mechanism.

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8 Conclusion

Over 40 species of finfish and invertebrates with designated EFH and HAPC occur within the SFWF, SFEC, and O&M facility project area. The proposed action, described in Section 2, includes construction, O&M, and decommissioning of the project components. Project decommissioning would occur at the end of the 30-year planned lifetime of the project and would be subject to separate EFH consultation at that time. Effects of project activities on EFH are analyzed in Section 6. Project effects on EFH are then summarized by impact mechanism, species and life stage in Table 7.1, which details designated EFH in the project area, short-term and long-term impacts on habitat suitability by impact mechanism, and EFH effect determinations by managed species and life stage.

Impacts associated with construction activities, such as pile driving and jet-plowing, are likely to be greater than those associated with O&M, such as sound produced by operational turbines. EFH species with one or more demersal life stage are more likely to be subjected to long-term or permanent adverse impacts than species with only pelagic life stages, primarily due to the installation of the turbine foundations and scour and cable protection measures, and the concomitant alteration and conversion of benthic habitat.

Project construction would result in short-term adverse effects on the environment that could affect habitat suitability for managed species (Section 6.1). Short-term adverse effects include construction-related underwater noise impacts; crushing, burial, and entrainment effects; and disturbance of bottom substrates resulting in increased turbidity and sedimentation. These effects would occur intermittently at varying locations in the project area over the duration of project construction but are not expected to cause permanent effects on EFH quality. Depending on the nature, extent, and severity of each effect, this may temporarily reduce the suitability of EFH for managed species, which would result in short-term adverse effects on EFH for those species. For example, underwater noise from pile-driving could temporarily render the affected habitats unsuitable as EFH for multiple life stages of Atlantic cod and longfin squid (see Section 6.1.1.1). However, EPMs such as sound attenuation and soft start procedures could minimize such acoustic impacts. Additional project EPMs are described in Table 6.2.

The operation and maintenance of the SFWF, SFEC, and O&M facility would result in intermediate to long-term adverse effects on EFH for some life stages of EFH species (Section 6.2). Long-term adverse effects are those that would last over the approximately 30-year lifespan of project, so would be effectively permanent. These impacts include alteration of water column and benthic habitats, operational noise, EMF and heat effects, hydrodynamic effects, and food web effects. Monopile foundations, scour protection, cable protection, and O&M facility maintenance and improvements would alter habitat. Benthic habitat within the entire lease area includes 7,503 acres (3,036 hectares) of complex, 1,092 acres (442 hectares) of potentially complex, and 4,615 acres (1,866 hectares) of non-complex benthic habitat (Table 3.2).

Foundation piles would displace 0.1–0.2 acres (0.04–0.08 hectare) of complex and 0.02–0.05 acres (0.01–0.02 hectare) of potentially complex benthic habitat within the pile footprints, depending on the size of the pile selected. An additional estimated 3.47 to 6.85 acres (1.40 to 2.77 hectares) of complex, 0.87 to 1.75 acres (0.35 to 0.71 hectare) of potentially complex, and 2.61–5.38 acres (1.06–2.18 hectares) of non-complex benthic habitat would be modified by placement of scour protection around the foundations and inter-array cable approaches. Approximately 47.2 acres (19.10 hectares) of complex, 11.25 acres (4.55 hectares) of potentially complex, and 54.03 acres (21.86 hectares) of non-complex habitat would be modified by placement of concrete mattresses to protect exposed segments of inter-array cables. The potential increase in abundance of epibenthic and demersal fishes resulting from the reef effect may offset some impacts to EFH of those species over the life of the wind farm, although it may take a decade or more for the reef effect to fully develop. Analyses of habitat impacts are found in Section 6.2.1 and Appendix A, Table A-4. The implementation of EPMs (Table 6.2) would likely result in the avoidance and minimization of some of the intermediate to long-term (permanent) project impacts to EFH described above.

The project will also affect habitats for NOAA trust resources known or likely to occur in the analysis area. These effects and effect determinations are described in Appendix B.

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Appendix A – Quantification of Effects on EFH by Project Component and Impact Mechanism

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Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Eggs and larvae Impulsive noise sources - Peak injury, lethal (L_{pk}), 210 dB - Cumulative injury, lethal ($L_{E, 24hr}$), 207 dB - Peak injury, recoverable (L_{pk}), n/a - Cumulative injury, recoverable ($L_{E, 24hr}$), n/a - Behavioral response (L_{pk}), n/a Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury, n/a - TTS, n/a	Atlantic cod	Eggs	Surface													Yes	Yes	Yes	**Impact Pile Driving** 26-foot (8-meter) monopile alternative Lethal injury - Lpk 475 ft/262 total acres (145 m/106 total hectares) - LE, 24hr 695 ft/558 total acres (212 m/226 total hectares) 36-foot (11-meter) monopile alternative Lethal injury - Lpk 377 ft/163 total acres (115 m/66 total hectares) - LE, 24hr normal, 1,499ft (457m) - LE, 24hr difficult, 2,378ft (725m) - LE, 24hr 2,839 total acres (1,149 total hectares) Recoverable injury/TTS - Not applicable/no threshold Behavioral - Not applicable **HRG Surveys** Lethal injury - Unlikely	**Temporary Cofferdam** Sheetpile alternative (vibratory pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Not applicable Gravity cell alternative (no pile driving) - No significant noise impacts **HRG Surveys** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Not applicable **Vessel Noise** Lethal injury - Unlikely	**Mooring Improvements (vibratory pile driving)** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Not applicable **Mooring Improvements (impact pile driving)** Lethal injury -0.02 acres (0.01 hectares) Recoverable injury/TTS -Unlikely Behavioral -Not applicable **Vessel/Dredging Noise** Lethal injury - Unlikely Recoverable injury - Unlikely Behavioral - Not applicable	**Impact Pile Driving** Timing window - May 1 to December 31, 2023 Total activity duration - 16 days total - Distributed over 1 to 4 months Anticipated activity schedule - Standard, 1 pile every other day (30 days total) - Aggressive, 6 piles every 7 days (20 days total) Anticipated daily duration - Normal 2 hours/day - Difficult 4 hours/day **HRG Surveys** Timing window - May to December 2023	**Temporary Cofferdam, sheetpile alternative** Timing window - October 1 to May 31, 2023 Total activity duration - 18 hours (installation) - 18 hours (removal) **HRG Surveys** Timing Window - May to December 2023 Total activity duration - Approximately 60 days total (SFWF and SFEC) - Distributed over 6 to 9 months **Vessel Noise** Cable installation Timing window - May to December 2023	**Mooring Improvements** Construction start - 2022 Total activity duration - 30 days - May occur anytime in 9 to 12 month construction window **Vessel/Dredging Noise** Timing window - 2021 to 2022 Total activity duration - 60 days Frequency - Intermittent (nighttime noise restrictions)
	Atlantic cod	Larvae	Pelagic													Yes	Yes	--						
	Atlantic herring	Larvae	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Eggs	Pelagic													--	Yes	Yes						
	Atlantic mackerel	Larvae	Pelagic													Yes	Yes	--						
	Atlantic sea scallop	Eggs	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Larvae	Pelagic/ Benthic complex													Yes	Yes	--						
	Bluefish	Eggs	Pelagic													Yes	Yes	--						
	Bluefish	Larvae	Pelagic													Yes	Yes	--						
	Butterfish	Eggs	Pelagic													Yes	Yes	Yes						
	Butterfish	Larvae	Pelagic													Yes	Yes	--						
	Haddock	Larvae	Surface													Yes	Yes	--						
	Monkfish	Eggs	Surface													Yes	Yes	--						
	Monkfish	Larvae	Pelagic													Yes	Yes	--						
	Ocean pout	Eggs	Benthic complex													Yes	Yes	--						
	Pollock	Eggs	Pelagic													Yes	Yes	--						
	Pollock	Larvae	Pelagic													Yes	Yes	--						
	Red hake	Eggs	Surface													Yes	Yes	Yes						
	Red hake	Larvae	Surface													Yes	Yes	Yes						
	Scup	Eggs	Pelagic													Yes	Yes	Yes						
	Scup	Larvae	Pelagic													Yes	Yes	Yes						
	Silver hake	Eggs	Surface													Yes	Yes	--						
	Silver hake	Larvae	Surface													Yes	Yes	--						
	Summer flounder	Eggs	Pelagic													Yes	Yes	--						
	Summer flounder	Larvae	Pelagic													Yes	Yes	--						
	White hake	Eggs	Pelagic													Yes	Yes	--						
	White hake	Larvae	Surface													Yes	Yes	Yes						
	Windowpane flounder	Eggs	Surface													Yes	Yes	Yes						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Eggs and larvae	Windowpane flounder	Larvae	Pelagic													Yes	Yes	Yes	Recoverable injury/TTS - Unlikely Behavioral - Not applicable Vessel Noise Lethal injury - Unlikely Recoverable injury - Unlikely Behavioral - Not applicable	Recoverable injury - Unlikely Behavioral - Not applicable	**Same as above**	Total activity duration - Approximately 60 days total (SFWF and SFEC) Frequency - Intermittent - Distributed over 2 to 4 months Vessel Noise Timing window - May to December 2023 Total activity duration - Approximately 8 months total Frequency - Continuous, 24 hours/day	Total activity duration - Approximately 74 days Frequency - Continuous, 24 hours/day Sea-to-shore Transition Timing window - May to December 2023 Total activity duration - Approximately 12 weeks Frequency - Continuous, 24 hours/day	**Same as above**
	Winter flounder	Eggs	Benthic non-complex													--	Yes	Yes						
	Winter flounder	Larvae	Pelagic/ Benthic non-complex													Yes	Yes	Yes						
	Witch Flounder	Eggs	Surface													Yes	Yes	--						
	Witch Flounder	Larvae	Surface													Yes	Yes	--						
	Yellowtail flounder	Eggs	Surface													Yes	Yes	--						
	Yellowtail flounder	Larvae	Surface													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, involved in hearing Impulsive noise sources - Peak injury, lethal (L_{pk}), 207 dB - Cumulative injury, lethal ($L_{E,\ 24hr}$), 207 dB - Peak injury, recoverable (L_{pk}), 207 dB - Cumulative injury, recoverable ($L_{E,\ 24h}$r), 203 dB - TTS, (LE, 24hr), 186 dB - Behavioral response (L_{pk}), 150 dB Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury (LE, 48hr), 170 dB - TTS, (LE, 12hr), 158 dB - Behavioral response (Lpk), 150 dB	Atlantic cod	Adult	Benthic complex													Yes	Yes	--	**Impact Pile Driving** 26-foot (8-meter) monopile alternative Lethal injury - Lpk 475ft/261 total acres (145 m/106 total hectares) - LE, 24hr 1,184 ft/1,618 total acres (361 m/655 total hectares) Recoverable injury - Lpk 475ft/261 total acres (145 m/106 total hectares) - LE, 24hr 2,349 ft/6,365 total acres (716 m/2,576 total hectares) TTS - Lpk 22,014 ft/83,002 total acres (6,710 m/33,590 total hectares) Behavioral - Lpk 40,577 ft/201,170 total acres (12,368 m/81,411 total hectares) 36-foot (11-meter) monopile alternative Lethal injury - Lpk 377 ft/163 total acres (115 m/66 total hectares) - LE, 24hr normal, 2,421 ft (738 m) - LE, 24hr difficult, 3,959 ft (1,207 m) - LE, 24hr/ 7,455 total acres (3,017 total hectares) Recoverable injury - Lpk 377 ft/163 total acres (115 m/66 total hectares) - LE, 24hr normal, 4,662 ft (1,421 m) - LE, 24hr difficult, 6,430 ft (1,960 m) - LE, 24hr/ 7,455 total acres (3,017 total hectares)	**Temporary Cofferdam** Sheetpile alternative (vibratory pile driving) Lethal injury - Unlikely Recoverable injury - 207 ft/ 3 total acres (63 m/1 total hectares) TTS - 780 ft/44 total acres (238 m/18 total hectares) Behavioral -2,556 ft/420 total acres (779 m/170 total hectares) Gravity cell alternative (no pile driving) - No significant noise impacts **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury - Unlikely TTS - Unlikely (requires 24 hr exposure at <16 feet (5 meters) from source) Behavioral - Lpk 2,572 ft/4,021,232 total acres(784 m/1,627,335 hectares) (SFWF and SFEC) **Vessel Noise** Lethal injury - Unlikely Recoverable injury - 0 ft/0 total acres (0 m/0 total hectares)	**Mooring Improvements** (vibratory pile driving) Lethal injury - Unlikely Recoverable injury - 206 ft/1.7 total acres (63 m/0.7 total hectares) TTS - 780 ft/22 total acres (238 m/9 total hectares) Behavioral - 2,556 ft/237 total acres (779 m/96 total hectares) **Mooring Improvements** (impact pile driving) Lethal injury - 0.02 acres (0.01 hectares) Recoverable injury - 0.07 acres (0.3 hectares) TTS - 241.5 ft/15.8 acres (73.6 m/ 6.4 hectares) Behavioral - 622 acres (252 hectares) **Vessel/Dredging Noise** Lethal injury - Unlikely Recoverable injury - 0 ft/0 total acres (0 m/0 total hectares) TTS - 184 ft/956 total acres (56 m/387 total hectares) Behavioral - 443 ft/2,315 total acres (135 m/937 total hectares)	**Same as above**	**Same as above**	**Same as above**
	Atlantic cod	Juvenile	Benthic complex													Yes	Yes	--						
	Atlantic cod	Spawning	Benthic complex/ non-complex													Yes	Yes	--						
	Atlantic herring	Adult	Pelagic													Yes	Yes	--						
	Atlantic herring	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic herring	Spawning	Benthic complex													Yes	Yes	--						
	Black sea bass	Adult	Benthic complex													Yes	Yes	--						
	Black sea bass	Juvenile	Benthic complex													Yes	Yes	--						
	Bluefish	Adult	Pelagic													Yes	Yes	--						
	Bluefish	Juvenile	Pelagic													Yes	Yes	--						
	Haddock	Adult	Benthic complex													Yes	Yes	--						
	Haddock	Juvenile	Benthic complex													Yes	Yes	--						
	Haddock	Spawning	Benthic complex													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, involved in hearing	Monkfish	Adult	Benthic complex													Yes	Yes	--	TTS - Lpk 28,540 ft/118,895 total acres (8,699 m/48,115 total hectares) Behavioral - Lpk 40,948 ft/ 204,037 total acres (12,481 m/82,571 total hectares) 'HRG Surveys (SFWF and SFEC) Lethal injury - Unlikely Recoverable injury - Unlikely TTS - <16 feet (5 meters) Behavioral - Lpk 2,572 ft/1,627,334 acres (784 m/658,559 hectares) (SFWF and SFEC) Vessel Noise Lethal injury - Unlikely Recoverable injury - 0 ft/0 total acres (0 m/0 total hectares) TTS - 184 ft/17,561 total acres (56 m/7,107 total hectares) Behavioral - 443 ft/18,231 total acres (135 m/7,378 total hectares)	TTS - Unlikely (requires >12 hours exposure within 184 ft (56 meters)) Behavioral - Beach Lane Alternative - 443 ft/ 6,637 total acres (135 m/2,686 total hectares) Behavioral - Hither Hills Alternative - 443 ft/5,357 total acres (135 m/2,168 total hectares)	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Monkfish	Juvenile	Benthic complex													Yes	Yes	--						
	Monkfish	Spawning	Benthic complex													Yes	Yes	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Red hake	Adult	Benthic non-complex													Yes	Yes	--						
	Red hake	Juvenile	Benthic non-complex													Yes	Yes	--						
	Red hake	Spawning	Benthic non-complex													Yes	Yes	--						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	White hake	Juvenile	Pelagic/ Benthic non-complex													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, not involved in hearing Impulsive noise sources - Peak injury, lethal (Lpk), 207 dB - Cumulative injury, lethal (LE, 24hr), 210 dB - Peak injury, recoverable (Lpk), 207 - Cumulative injury, recoverable (LE, 24hr), 203 - TTS, (LE, 24hr), 186 dB - Behavioral response (Lpk), 150 dB Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury, n/a - TTS, n/a - Behavioral response (Lpk), 150 dB	Albacore tuna	Adult	Pelagic													Yes	Yes	--	**Impact Pile Driving** 26-foot (8-meter) monopile alternative Lethal injury - Lpk 475 ft/262 total acres (145 m/106 total hectares) - LE, 24hr 695 ft/558 total acres (212 m/226 total hectares) Recoverable injury - Lpk 475 ft/262 total acres (145 m/106 total hectares) - LE, 24hr 2,349 ft/6,365 total acres (716 m/2,576 total hectares) TTS - Lpk 22,014 ft/83,002 total acres (6,710 m/33,590 total hectares) Behavioral - Lpk 40,577 ft/201,173 total acres (12,368 m/81,412 total hectares) 36-foot (11-meter) monopile alternative Lethal Injury - Lpk 377 ft/163 total acres (115 m/66 total hectares) - LE, 24hr normal, 1,499 ft (457 m) - LE, 24hr difficult, 2,379 ft (725 m) - LE, 24hr/ 2,839 total acres (1,149 total hectares) Recoverable injury - Lpk 377 ft/163 total acres (115 m/66 total hectares) - LE, 24hr normal, 2,421 ft (738 m) - LE, 24hr difficult, 3,960 ft (1,207 m) - LE, 24hr/ 7,455 total acres (3,017 total hectares) TTS - Lpk 28,540 ft/118,895 total acres (8,699 m/48,115 total hectares)	**Temporary Cofferdam** Sheetpile alternative (vibratory pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - 2,556 ft/420 total acres (779 m/170 total hectares) Gravity cell alternative (no pile driving) - No significant noise impacts **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury - Unlikely TTS - Unlikely (requires 24 hr exposure at <16 feet (5 meters) from source) Behavioral - Lpk 2,572 ft/4,021,232 acres (784 m/1,627,335 hectares) (SFWF and SFEC) **Vessel Noise** Lethal injury - Unlikely Recoverable injury, TTS - Unlikely Behavioral - Beach Lane Alternative - 443 ft/6,637 total acres (135 m/2,686 total hectares) Behavioral - Hither Hills Alternative - 443 ft/5,377 total acres (135 m/2,176 total hectares)	**Mooring Improvements** (vibratory pile driving) Lethal injury - Unlikely Recoverable injury - 207 ft/1.7 total acres (63 m/0.7 total hectares) TTS - 781 ft/22 total acres (238 m/9 total hectares) Behavioral - 2,556 ft/237 total acres (779 m/96 total hectares) **Mooring Improvements** (impact pile driving) Lethal injury - 0.02 acres (0.008 hectares) Recoverable injury - 0.1 acres (0.04 hectares) TTS - 241.5 ft/ 15.8 acres (73.6 m/ 6.4 hectares) Behavioral - 623 acres (252 hectares) **Vessel/Dredging Noise** Lethal injury - Unlikely Recoverable injury - 0 ft/0 total acres (0 m/0 total hectares) TTS - 184 ft/956 total acres (56 m/387 total hectares) Behavioral - 443 ft/2,315 total acres (135 m/937 total hectares)	**Same as above**	**Same as above**	**Same as above**
	Albacore tuna	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic bluefin tuna	Adult	Pelagic													Yes	Yes	--						
	Atlantic bluefin tuna	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Adult	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Spawning	Pelagic													Yes	Yes	--						
	Atlantic skipjack tuna	Adult	Pelagic													Yes	Yes	--						
	Atlantic skipjack tuna	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic yellowfin tuna	Adult	Pelagic													Yes	Yes	--						
	Atlantic yellowfin tuna	Juvenile	Pelagic													Yes	Yes	--						
	Butterfish	Adult	Pelagic/ Benthic non-complex													Yes	Yes	--						
	Butterfish	Juvenile	Pelagic/ Benthic non-complex													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, not involved in hearing	Ocean pout	Adult	Be75:79nthic non-complex													Yes	Yes	--	Behavioral - Lpk 40,948 ft/204,037 total acres (12,481 m/82,571 total hectares) **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury - Unlikely TTS - <16 feet (5 meters) Behavioral - Lpk 2,572 ft/1,627,335 acres (784 m/658,559 hectares) Vessel Noise Lethal injury - Insignificant Recoverable injury/TTS - Unlikely Behavioral - 443 ft/18,231 total acres (135 m/7,378 total hectares)	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Ocean pout	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Spawning	Benthic complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bony fishes and Elasmobranchs - no swim bladder Impulsive noise sources - Peak injury, lethal (Lpk), 213 dB - Cumulative injury, lethal (LE, 24hr), 219 dB - Peak injury, recoverable (Lpk), 213 - Cumulative injury, recoverable (LE, 24hr), 216 - TTS, (LE, 24hr), 186 dB - Behavioral response (Lpk), 150 dB Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury, n/a - TTS, n/a - Behavioral response (Lpk), 150 dB	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--	**Impact Pile Driving** 26-foot (8-meter) monopile alternative Lethal injury - Lpk 190 ft/42 total acres (58 m/17 total hectares) - LE, 24hr 0 ft/0 total acres (0 m/0 total hectares) Recoverable injury - Lpk 190 ft/42 total acres (58 m/17 total hectares) - LE, 24hr 328 ft/124 acres (100 m/50 total hectares) TTS - Lpk 22,014 ft/83,003 total acres (6,710 m/33,590 total hectares) Behavioral - Lpk 40,577 ft/201,173 total acres (12,368 m/81,412 total hectares) 36-foot (11-meter) monopile alternative Lethal injury - Lpk 98 ft/12 total acres (30 m/5 total hectares) - LE, 24hr normal, 394 ft (120 m) - LE, 24hr difficult, 472 ft (144 m) - LE, 24hr 183 ft (74 total hectares) Recoverable injury - Lpk 531 ft/326 total acres (162 m/132 total hectares)	**Temporary Cofferdam** Sheetpile alternative (vibratory pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - 2,556 ft/420 total acres (779 m/170 total hectares) Gravity cell alternative (no pile driving) - Insignificant **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury - Unlikely TTS - Unlikely (requires 24 hr exposure at <16 feet (5 meters) from source) Behavioral - Lpk 2,572 ft/4,021,232 acres (784 m/1,627,335 hectares) (SFWF and SFEC) **Vessel Noise** Lethal injury - Unlikely Recoverable injury, TTS - Unlikely (no thresholds defined) Behavioral - Beach	**Mooring Improvements** (vibratory pile driving) Lethal injury - Unlikely Recoverable injury - 207 ft/1.7 total acres (63 m/0.7 total hectares) TTS - 781 ft/22 total acres (238 m/9 total hectares) Behavioral - 2,556 ft/237 total acres (779 m/96 total hectares) **Mooring Improvements** (impact pile driving) Lethal injury - Unlikely Recoverable injury - 0.1 acres (0.04 hectares) TTS - 241.5 ft/15.8 acres (73.6m/ 6.4 hectares) Behavioral - 623 acres (252 hectares) **Vessel/Dredging Noise** Lethal injury - Unlikely Recoverable injury - 0 ft/0 total acres (0 m/0 total hectares) TTS - 184 ft/956 total acres (56 m/387 total hectares) Behavioral - 443 ft/2,315 total acres (135 m/937 total hectares)	**Same as above**	**Same as above**	**Same as above**
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Basking shark	Adult	Pelagic													Yes	Yes	Yes						
	Basking shark	Juvenile	Pelagic													Yes	Yes	Yes						
	Basking shark	Neonate/YOY	Pelagic													Yes	Yes	Yes						
	Blue shark	Adult	Pelagic													Yes	Yes	--						
	Blue shark	Juvenile	Pelagic													Yes	Yes	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Dusky shark	Adult	Pelagic													Yes	Yes	--						
	Dusky shark	Juvenile	Pelagic													Yes	Yes	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Little skate	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Little skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sandbar shark	Adult	Benthic non-complex													Yes	Yes	Yes						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	Yes	Yes						
	Shortfin mako shark	Adult	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Juvenile	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Smooth dogfish	Adult	Pelagic													Yes	Yes	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	Yes	--						
	Smooth dogfish	Neonate	Pelagic													Yes	Yes	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bony fishes and Elasmobranchs - no swim bladder	Spiny dogfish	Adult (m)	Pelagic													Yes	Yes	Yes	- LE, 24hr normal, 531 ft (162 m) - LE, 24hr difficult 748 ft (228 m) - LE, 24hr 459 total acres (140 total hectares) TTS - Lpk 28,540 ft/118,895 total acres (8,699 m/48,115 total hectares) Behavioral - Lpk 40,948 ft/204,037 total acres (12,481 m/82,571 total hectares) **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury - Unlikely TTS - Unlikely (requires 24 hr exposure at <16 feet (5 meters) from source) Behavioral - Lpk 2,572 ft/1,627,335 acres (784 m/658,559 hectares) (SFWF and SFEC) Vessel Noise Lethal injury - Insignificant Recoverable injury, TTS - Unlikely Behavioral - 443 ft/18,231 total acres (135 m/7,378 total hectares)	Lane Alternative - 443 ft/6,637 total acres (135 m/2,686 total hectares) Behavioral - Hither Hills Alternative - 443 ft/5,357 total acres (135 m/2,168 total hectares)	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Spiny dogfish	Sub-Adult (f)	Pelagic													Yes	Yes	Yes						
	Spiny dogfish	Sub-Adult (m)	Pelagic													Yes	Yes	Yes						
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Summer flounder	Juvenile	Benthic non-complex/ complex													--	--	Yes						
	Tiger shark	Adult	Pelagic													--	Yes	--						
	Tiger shark	Juvenile	Pelagic													--	Yes	--						
	White shark	Adult	Pelagic													Yes	Yes	--						
	White shark	Juvenile	Pelagic													Yes	Yes	--						
	White shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Windowpane flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Spawning	Benthic non-complex													Yes	Yes	Yes						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Witch Flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Table A-1. Construction Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Construction Noise Effects by Project Component			Timing and Duration of Construction Noise Effects		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Invertebrates Particle motion effects only Squid behavioral threhsold bed-propagated particle motion at ~1,640 feet (~500 meters) (Jones et al. 2020, 2021)	Atlantic sea scallop	Juvenile	Benthic complex													Yes	Yes	--	**Impact Pile Driving (all pile scenarios)** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Squid, 1,640 ft/776 acres (500 m/314 hectares) - Bivalves, <16 ft/1 acres (<5 m/0.40 hectares) **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Squid, 7 ft/4,151 acres (2 m/1,680 hectares) (SFWF and SFEC) - Bivalves, unlikely **Vessel Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Unlikely	**Temporary Cofferdam** Sheetpile alternative (vibratory pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Squid, 7 ft/0.15 acres (2 m/0.06 hectares) - Bivalves, <16 ft/0.37 acres (5 m/0.15 hectares) Gravity cell alternative (no pile driving) - Insignificant **HRG Surveys (SFWF and SFEC)** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Squid, 7 ft/4,151 acres (2 m/1,680 hectares) (SFWF and SFEC) - Bivalves, unlikely **Vessel Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Unlikely	**Mooring Improvements** (vibratory pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral (squid) - 7 ft/0.20 total acres (2 m/0.08 total hectares) Behavioral (bivalves) - 0.37 acres (0.15 hectares) **Mooring Improvements** (impact pile driving) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral (squid) - 1,640 ft/40 total acres (500 m/16.2 total hectares) Behavioral (bivalves) - 0.37 acres (0.15 hectares) **Vessel/Dredging Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Unlikely	**Same as above**	**Same as above**	**Same as above**
	Atlantic sea scallop	Adult	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	Yes	--						
	Atlantic surfclam	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	Yes	--						
	Longfin squid	Eggs	Benthic complex													Yes	Yes	Yes						
	Longfin squid	Juvenile	Pelagic													Yes	Yes	Yes						
	Longfin squid	Adult	Pelagic													Yes	Yes	Yes						

Notes

Peak occurrence in the Analysis Area

Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M
Eggs and Larvae	Atlantic cod	Eggs	Surface													Yes	Yes	--
	Atlantic cod	Larvae	Pelagic													Yes	Yes	--
	Atlantic herring	Larvae	Pelagic													Yes	Yes	--
	Atlantic mackerel	Eggs	Pelagic													--	Yes	--
	Atlantic mackerel	Larvae	Pelagic													Yes	Yes	--
	Atlantic sea scallop	Eggs	Benthic complex													Yes	Yes	--
	Atlantic sea scallop	Larvae	Pelagix/ benthic													Yes	Yes	--
	Bluefish	Eggs	Pelagic													Yes	Yes	--
	Bluefish	Larvae	Pelagic													Yes	Yes	--
	Butterfish	Eggs	Pelagic													Yes	Yes	--
	Butterfish	Larvae	Pelagic													Yes	Yes	--
	Haddock	Larvae	Surface													Yes	Yes	--
	Longfin squid	Eggs	Benthic complex													Yes	Yes	Yes
	Monkfish	Eggs	Surface													Yes	Yes	--
	Monkfish	Larvae	Pelagic													Yes	Yes	--
	Ocean pout	Eggs	Benthic complex													Yes	Yes	--
	Pollock	Eggs	Benthic complex/ non-													Yes	Yes	--
	Pollock	Larvae	Benthic complex/ non-													Yes	Yes	--
	Red hake	Eggs	Surface													Yes	Yes	--

Habitat Use	Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Eggs and Larvae	**Monopile and Scour Protection** Placement - Lethal: 15 acres (6 hectares) **Inter-array Cable Installation** - Lethal: 363 acres (146.9 hectares) total (trenching and cable protection) **Vessel Anchoring** Lethal: 820 acres (332 hectares)	**Cable Protection Placement** Crushing or burial Hither Hills Alternative - Lethal: 4.4 acres (1.8 hectares) Beach Lane Alternative - Lethal: 7.9 acres (3.2 hectares) **SFEC Installation** Burial and/or entrainment Hither Hills Alternative - Lethal: 462 acres (187 hectares) Beach Lane Alternative - Lethal: 573 acres (232 hectares) **Sea-to-shore Transition** Lethal (crushing or burial) - Lethal: 1.80 acres (0.73 hectares)	**Dredging** Lethal (dredge entrainment) - 0.035 acres (0.014 hectares) **Beach Nourishment** Lethal (crushing) - 0.69 acres (0.28 hectares) **Mooring Improvements** Lethal (crushing or entrapment) - 19.4 sqare feet (1.8 square meters)	**Monopile and Scour protection Placement** Construction Window - May 1 to December 31, 2023 Duration - 1 to 4 months Frequency - Intermittent **Inter-array Cable Installation** Construction Window - May to December 2023 Duration - Approximately 60 days total Frequency - Continuous mobile effect **Vessel Anchoring** Construction Window - May 1 to December 21, 2023 Duration - 7 months Frequency - Intermittent	**Sea-to-shore Transition** Construction Window - September 2021 to May 2022 Duration - 6 to 9 months **SFEC Installation** Construction Window - 2023 Duration - Approximately 74 days total Frequency - Continuous mobile effect	**Mooring Improvements** Construction start - 2022 Total activity duration - 30 days - May occur anytime in 9 to 12 month construction window **Construction and Maintenance Dredging** Timing window - October 1, 2021 to January 15, 2022 (Based on dredging window for adjacent federal navigation channel) Duration - 60 days Frequency - Annual

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Eggs and Larvae	Red hake	Larvae	Surface													Yes	Yes	--	Same as above	Same as above	Same as above	Same as above	Same as above	Same as above
	Scup	Eggs	Pelagic													--	--	Yes						
	Scup	Larvae	Pelagic													Yes	Yes	Yes						
	Silver hake	Eggs	Surface													Yes	Yes	--						
	Silver hake	Larvae	Surface													Yes	Yes	--						
	Summer flounder	Eggs	Pelagic													Yes	Yes	Yes						
	Summer flounder	Larvae	Pelagic													Yes	Yes	Yes						
	White hake	Eggs	Surface													Yes	Yes	--						
	White hake	Larvae	Surface													Yes	Yes	--						
	Windowpane flounder	Eggs	Surface													Yes	Yes	Yes						
	Windowpane flounder	Larvae	Pelagic													Yes	Yes	Yes						
	Winter flounder	Eggs	Benthic non-complex													--	Yes	Yes						
	Winter flounder	Larvae	Pelagic/ benthic non-complex													Yes	Yes	Yes						
	Witch flounder	Eggs	Surface													Yes	Yes	--						
	Witch flounder	Larvae	Surface													Yes	Yes	--						
	Yellowtail flounder	Eggs	Surface													Yes	Yes	--						
	Yellowtail flounder	Larvae	Surface													Yes	Yes	--						

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Juveniles	Atlantic cod	Juvenile	Benthic complex													Yes	Yes	--	**Monopile and Scour Protection** Placement Lethal (crushing or burial) - 15 acres (6 hectares) Behavioral avoidance - 15 acres (6 hectares) **Inter-array Cable Installation** - Lethal: 363 acres (146.9 hectares) total - Behavioral: 363 acres (146.9 hectares) total **Vessel Anchoring** Lethal (crushing or burial) - 820 acres (332 hectares) Behavioral avoidance - 820 (acres) 332 hectares	**Cable Protection Placement** Hither Hills Alternative - Lethal: 4.4 acres (1.8 hectares) - Behavioral: 4.4 acres (1.8 hectares) Beach Lane Alternative - Lethal: 7.9 acres (3.2 hectares) - Behavioral: 7.9 acres (3.2 hectares) **SFEC Installation** Hither Hills Alternative - Lethal: 462 acres (187 hectares) - Behavioral: 462 acres (187 hectares) Beach Lane Alternative - Lethal: 573 acres (232 hectares) - Behavioral: 575 acres (232 hectares) **Sea-to-shore Transition** Entrainment or burial - Lethal: 1.80 acres (0.73 hectares) - Behavioral: 1.80 acres (0.73 hectares)	**Dredging** Lethal (dredge entrainment) - 0.035 acres (0.014 hectares) Behavioral avoidance - 0.035 acres (0.014 hectares) **Beach Nourishment** Lethal (crushing) - 0.69 acres (0.28 hectares) Behavioral (avoidance) - 0.69 acres (0.28 hectares) **Mooring Improvements** Lethal (crushing or entrapment) - 19.4 square feet (1.8 square meters) Behavioral avoidance - 19.4 square feet (1.8 square meters)	**Same as above**	**Same as above**	**Same as above**
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Black sea bass	Juvenile	Benthic complex													Yes	Yes	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Haddock	Juvenile	Benthic complex													Yes	Yes	--						
	Little skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Monkfish	Juvenile	Benthic complex													Yes	Yes	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	Yes	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Red hake	Juvenile	Benthic non-complex													Yes	Yes	--						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sand tiger shark	Neonate/ YOY	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Sandbar shark	Neonate/ YOY	Benthic non-complex													Yes	Yes	Yes						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Summer flounder	Juvenile	Benthic non-complex/ complex													--	--	Yes						

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Juveniles	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--				Same as above	Same as above	Same as above
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	Yes	--						

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Adult Flatfish	Summer flounder	Adult	Benthic non-complex/ complex													Yes	Yes	Yes	**Monopile and Scour Protection** Placement - Behavioral: 15 acres (6 hectares) **Inter-array Cable Installation** - Behavioral: 348.7 acres (141.1 hectares) total **Vessel Anchoring** - Behavioral: 820 acres (332 hectares)	**Cable Protection Placement** Hither Hills Alternative - Behavioral: 4.4 acres (1.8 hectares) Beach Lane Alternative - Behavioral: 7.9 acres (3.2 hectares) **SFEC Installation** Hither Hills Alternative - Behavioral: 462 acres (187 hectares) Beach Lane Alternative - Behavioral: 573 acres (232 hectares) **Sea-to-shore Transition** - Behavioral: 1.80 acres (0.73 hectares)	**Dredging** Behavioral avoidance - 0.035 acres (0.014 hectares) **Beach Nourishment** Behavioral avoidance - 0.69 acres (0.28 hectares) **Mooring Improvements** Behavioral avoidance/ displacement - 19.4 square feet (1.8 square meters)	**Same as above**	**Same as above**	**Same as above**
	Windowpane flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Spawning	Benthic non-complex													--	Yes	Yes						
	Witch flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Witch flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Adult Finfish	Atlantic cod	Adult	Benthic complex													Yes	Yes	--	**Monopile and Scour Protection** Placement - Behavioral: 15 acres (6 hectares) **Inter-array Cable Installation Installation** - Behavioral: 348.7 acres (141.1 hectares) total **Vessel Anchoring** - Behavioral: 820 acres (332 hectares)	**Cable Protection Placement** Hither Hills Alternative - Behavioral: 4.4 acres (1.8 hectares) Beach Lane Alternative - Behavioral: 7.9 acres (3.2 hectares) **SFEC Installation** Hither Hills Alternative - Behavioral: 462 acres (187 hectares) **Beach Lane Alternative** - Behavioral: 573 acres (232 hectares) **Sea-to-shore Transition** - Behavioral: 0.161 acres (0.065 hectares)	**Dredging** Behavioral avoidance - 0.035 acres (0.014 hectares) **Beach Nourishment** Behavioral (avoidance) - 0.69 acres (0.28 hectares) **Mooring Improvements** Behavioral avoidance/ displacement - 19.4 square feet (1.8 square meters)	**Same as above**	**Same as above**	**Same as above**
	Atlantic cod	Spawning	Benthic complex/ non-													Yes	Yes	--						
	Atlantic herring	Spawning	Benthic complex													Yes	Yes	--						
	Black sea bass	Adult	Benthic complex													Yes	Yes	--						
	Butterfish	Adult	Pelagic/ benthic non-													Yes	Yes	--						
	Haddock	Adult	Benthic complex													Yes	Yes	--						
	Haddock	Spawning	Benthic complex													Yes	Yes	--						
	Monkfish	Adult	Benthic complex													Yes	Yes	--						
	Monkfish	Spawning	Benthic complex													Yes	Yes	--						
	Ocean pout	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Spawning	Benthic complex													Yes	Yes	--						
	Red hake	Adult	Benthic non-complex													Yes	Yes	--						
	Red hake	Spawning	Benthic non-complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/													Yes	Yes	Yes						
Adult Sharks and Skates	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--	**Monopile and Scour Protection** Placement - 15 acres (6 hectares) **Inter-array Cable Installation** - Behavioral: 348.7 acres (141.1 hectares) totall **Vessel Anchoring** - Behavioral: 820 acres (332 hectares)	**Cable Protection Placement** Hither Hills Alternative - Behavioral: 4.4 acres (1.8 hectares) Beach Lane Alternative - Behavioral: 7.9 acres (3.2 hectares) **SFEC Installation** Hither Hills Alternative - Behavioral: 462 acres (187 hectares) Beach Lane Alternative - Behavioral: 573 acres (232 hectares) **Sea-to-shore Transition** - Behavioral: 0.161 acres (0.065 hectares)	**Dredging** **Behavioral avoidance** **- 0.035 acres (0.014 hectares)** **Beach Nourishment** **Behavioral avoidance** **- 0.69 acres (0.28 hectares)** **Mooring Improvements** **Behavioral avoidance/ displacement** **- 19.4 square feet (1.8 square meters)**	**Same as above**	**Same as above**	**Same as above**
	Little skate	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Sandbar shark	Adult	Benthic non-complex													Yes	Yes	Yes						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						

Table A-2. Crushing, Burial, and Entrainment Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association	Timing of Occurrence												Potential Exposure by Project Component			Extent of Crushing, Burial, and Entrainment Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Shellfish	Atlantic sea scallop	Juvenile	Benthic complex													Yes	Yes	--	**Monopile and Scour Protection** Placement Lethal (crushing or burial) - 15 acres (6 hectares) **Inter-array Cable Installation** Lethal (burial and/or entrainment) - 348.7 acres (141.1 hectares) total **Vessel Anchoring** Lethal (crushing or burial) - 820 acres (332 hectares)	**Cable Protection Placement** Crushing or burial Hither Hills Alternative - Lethal: 4.4 acres (1.8 hectares) Beach Lane Alternative - Lethal: 7.9 acres (3.2 hectares) **SFEC Installation** Burial and/or entrainment Hither Hills Alternative - Lethal: 462 acres (187 hectares) Beach Lane Alternative - Lethal: 573 acres (232 hectares) **Sea-to-shore Transition** Lethal (crushing or burial) - Lethal: 0.161 acres (0.065 hectares)	**No shellfish EFH exposure**	**Same as above**	**Same as above**	**Same as above**
	Atlantic sea scallop	Adult	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	Yes	--						
	Atlantic surfclam	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	Yes	--						

Notes

Peak occurrence in the Analysis Area

Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Eggs and Larvae	Atlantic cod	Larvae	Pelagic													Yes	Yes	--	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm): ~2,268 acres (~918 hectares) - 0.39 in (10 mm): ~465 acres (~188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Sublethal to lethal exposure for benthic eggs and larvae	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~804.6 acres (325.6 hectares) - 0.39 in (10 mm): ~4.2 acres (~1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Beach Lane alternative - 0.12 in (3 mm): 1,032.2 acres (417.7 hectares) - 0.39 in (10 mm): 4.2 acres (1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L	**Dredging** Maximum TSS concentration - 282 to 485 mg/L (depending on method) Maximum plume height above bed - ~6.6 feet (~2 meters) Maximum plume extent - 984 to 3,937 feet (300 to 1,200 meters) (depending on method) Sublethal to lethal exposure for benthic or epibenthic eggs and larvae	**Inter-array Cable Installation** Construction Window - May to December 2023 Activity duration - Approximately 60 days total Instantaneous TSS plume duration (return to ambient) - ~0.3 hours	**SFEC Installation** Construction Window - 2023 Activity duration - Approximately 74 days total TSS plume duration (return to ambient) - 1.3 to 1.4 hours **Sea-to-shore Transition (cofferdam excavation)** Construction Window - September 2021 to May 2022 Activity duration - ~3 to 4 days Instantaneous TSS plume duration (return to ambient) - 1.1 hours	**Construction and Maintenance Dredging** Timing window - Annual, starting in 2022 Duration - 60 days
	Atlantic sea scallop	Eggs	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Larvae	Pelagic/ benthic complex													Yes	Yes	--						
	Longfin squid	Eggs	Benthic complex													Yes	Yes	Yes						
	Monkfish	Larvae	Pelagic													Yes	Yes	--						
	Ocean pout	Eggs	Benthic complex													Yes	Yes	--						
	Pollock	Eggs	Benthic complex/ non-complex													Yes	Yes	--						
	Pollock	Larvae	Benthic complex/ non-complex													Yes	Yes	--						
	Scup	Larvae	Pelagic													Yes	Yes	Yes						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Eggs and Larvae	Summer flounder	Larvae	Pelagic													Yes	Yes	--		Maximum plume height above bed - ~6.6 feet (~2 meters) Area of deposition exceeding - 0.12 in (3 mm): 2.37 acres (0.96 hectares) - 0.39 in (10 mm): 1.38 acres (0.56 hectares) - 1.2 in (30 mm): 1.19 acres (0.48 hectares) Sublethal to lethal exposure for benthic eggs and larvae				
	Windowpane flounder	Larvae	Pelagic													Yes	Yes	Yes						
	Winter flounder	Eggs	Benthic non-complex													--	Yes	Yes						
	Winter flounder	Larvae	Pelagic/ benthic non-complex													--	Yes	Yes						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Juveniles	Atlantic cod	Juvenile	Benthic complex													Yes	Yes	--	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm): ~2,268 acres (~918 hectares) - 0.39 in (10 mm): ~465 acres (188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Behavioral to sublethal exposure for benthic and epibenthic juveniles	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~804.6 acres (325.6 hectares) - 0.39 in (10 mm): ~4.2 acres (1.7 hectares) - 1.2 in (3mm): 0 acres (0 hectares) Beach Lane alternative - 0.12 in (3 mm): 1,032.2 acres (417.7 hectares) - 0.39 in (10 mm): 4.2 acres (1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L Maximum plume height above bed - ~6.6 feet (~2 meters)	**Dredging** Maximum TSS concentration - 282 to 485 mg/L (depending on method) Maximum plume height above bed - ~6.6 feet (~2 meters) Maximum plume extent - 984 to 3,937 feet (300 to 1,200 meters) (depending on method) Behavioral to sublethal exposure for benthic or epibenthic juveniles	**Same as above**	**Same as above**	**Same as above**
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Black sea bass	Juvenile	Benthic complex													Yes	Yes	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Dusky shark	Juvenile	Pelagic													Yes	Yes	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Haddock	Juvenile	Benthic complex													Yes	Yes	--						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Monkfish	Juvenile	Benthic complex													Yes	Yes	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	Yes	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Red hake	Juvenile	Benthic non-complex													Yes	Yes	--						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	Yes	Yes						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	Yes	Yes						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	Yes						
	Shortfin mako shark	Juvenile	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	Yes	--						
	Smooth dogfish	Neonate	Pelagic													Yes	Yes	--						
	Summer flounder	Juvenile	Benthic non-complex/ complex													--	--	Yes						
	Tiger shark	Juvenile	Pelagic													--	Yes	--						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Juveniles	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--		Area of deposition exceeding - 0.12 in (3 mm): 2.37 acres (0.96 hectares) - 0.39 in (10 mm): 1.38 acres (0.56 hectares) - 1.2 in (30 mm): 1.19 acres (0.48 hectares) Behavioral to sublethal exposure for benthic or epibenthic juveniles				
	White shark	Juvenile	Pelagic													Yes	Yes	--						
	White shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	Yes	--						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Adult Flatfish	Summer flounder	Adult	Benthic complex/ non-complex													Yes	Yes	Yes	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm): ~2,268 acres (~918 hectares) - 0.39 in (10 mm): ~465 acres (~188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Behavioral exposure for adult flatfish	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~804.6 acres (~325.6 hectares) - 0.39 in (10 mm): ~4.2 acres (~1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Beach Lane alternative - 0.12 in (3 mm): 1,032.2 acres (417.7 hectares) - 0.39 in (10 mm): 4.2 acres (1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L Maximum plume height above bed - ~6.6 feet (~2 meters)	**Dredging** Maximum TSS concentration - 282 to 485 mg/L (depending on method) Maximum plume height above bed - ~6.6 feet (~2 meters) Maximum plume extent - 984 to 3,937 feet (300 to 1,200 meters) (depending on method) Behavioral to sublethal exposure for adult flatfish	**Same as above**	**Same as above**	**Same as above**
	Windowpane flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Spawning	Benthic non-complex													Yes	Yes	Yes						
	Witch Flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Adult Flatfish	Yellowtail flounder	Adult	Benthic non-complex													Yes	Yes	--		Area of deposition exceeding - 3 mm: 2.37 acres (0.96 hectares) - 10 mm: 1.38 acres (0.56 hectares) - 30 mm: 1.19 acres (0.48 hectares) Behavioral to sublethal exposure for adult flatfish				
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Adult Finfish	Atlantic cod	Adult	Benthic complex													Yes	Yes	--	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm): ~2,268 acres (~918 hectares) - 0.39 in (10 mm): ~465 acres (~188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Behavioral exposure for benthic and epibenthic adult finfish	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~804.6 acres (~325.6 hectares) - 0.39 in (10 mm): ~4.2 acres (~1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Beach Lane alternative - 0.12 in (3 mm): 1,032.2 acres (417.7 hectares) - 0.39 in (10 mm): 4.2 acres (1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L Maximum plume height above bed - ~6.6 feet (~2 meters) Area of deposition exceeding - 0.12 in (3 mm): 2.37 acres (0.96 hectares) - 0.39 in (10 mm): 1.38 acres (0.56 hectares) - 1.2 in (30 mm): 1.19 acres (0.48 hectares) Behavioral to sublethal exposure for benthic or epibenthic adult finfish	**Dredging** Maximum TSS concentration - 282 to 485 mg/L (depending on method) Maximum plume height above bed - ~6.6 feet (~2 meters) Maximum plume extent - 984 to 3,937 feet (300 to 1,200 meters) (depending on method) Behavioral to sublethal exposure for benthic or epibenthic adult finfish	**Same as above**	**Same as above**	**Same as above**
		Spawning	Benthic non-complex/ complex													Yes	Yes	--						
	Atlantic herring	Spawning	Benthic complex													Yes	Yes	--						
	Black sea bass	Adult	Benthic complex													Yes	Yes	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	Yes	--						
	Haddock	Adult	Benthic complex													Yes	Yes	--						
	Haddock	Spawning	Benthic complex													Yes	Yes	--						
	Monkfish	Adult	Benthic complex													Yes	Yes	--						
	Monkfish	Spawning	Benthic complex													Yes	Yes	--						
	Ocean pout	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Spawning	Benthic complex													Yes	Yes	--						
	Red hake	Adult	Benthic non-complex													Yes	Yes	--						
	Red hake	Spawning	Benthic non-complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Adult Sharks and Skates	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm): ~2,268 acres (~918 hectares) - 0.39 in (10 mm):~465 acres (~188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Behavioral exposure for adult sharks and skates	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~804.6 acres (~325.6 hectares) - 0.39 in (10 mm): ~4.2 acres (~1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Beach Lane alternative - 0.12 in (3 mm): 1,032.2 acres (417.7 hectares) - 0.39 in (10 mm): 4.2 acres (1.7 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L Maximum plume height above bed - ~6.6 feet (~2 meters) Area of deposition exceeding - 0.12 in (3 mm): 2.37 acres (0.96 hectares) - 0.39 in (10 mm): 1.38 acres (0.56 hectares) - 1.2 in (30 mm): 1.19 acres (0.48 hectares) Behavioral to sublethal exposure for adult skates and rays	**Dredging** Maximum TSS concentration - 282 to 485 mg/L (depending on method) Maximum plume height above bed - ~6.6 feet (~2 meters) Maximum plume extent - 984 to 3,937 feet (300 to 1,200 meters) (depending on method) Behavioral to sublethal exposure for adult sharks and skates	**Same as above**	**Same as above**	**Same as above**
	Dusky shark	Adult	Pelagic													Yes	Yes	--						
	Little skate	Adult	Benthic non-complex/ complex													Yes	Yes	Yes						
	Sandbar shark	Adult	Benthic non-complex													Yes	Yes	Yes						
	Shortfin mako shark	Adult	Pelagic													Yes	Yes	--						
	Smooth dogfish	Adult	Pelagic													Yes	Yes	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	Yes	--						
	Spiny dogfish	Adult (m)	Pelagic													Yes	Yes	Yes						
	Spiny dogfish	Sub-Adult (f)	Pelagic													Yes	Yes	Yes						
	Spiny dogfish	Sub-Adult (m)	Pelagic													Yes	Yes	Yes						
	Tiger shark	Adult	Pelagic													--	Yes	--						
	White shark	Adult	Pelagic													Yes	Yes	--						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Shellfish	Atlantic sea scallop	Juvenile	Benthic complex													Yes	Yes	--	**Inter-array Cable** Installation (hydroplow) Maximum TSS concentration - 82-100 mg/L Maximum plume height above bed - ~4.9 ft (~1.5 m) Area of deposition exceeding: - 0.12 in (3 mm):~2,268 acres (~918 hectares) - 0.39 in (10 mm): ~465 acres (~188 hectares) - 1.2 in (30 mm): 0 acres (0 hectares) Behavioral exposure for shellfish	**SFEC Installation** (hydroplow) Maximum TSS concentration - 1,347 mg/L Maximum plume height above bed - ~8.2 feet (~2.5 meters) Area of deposition exceeding: Hither Hills alternative - 0.12 in (3 mm): ~325.6 hectares - 0.39 in (10 mm): ~1.7 hectares - 1.2 in (30 mm): 0 hectares Beach Lane alternative - 0.12 in (3 mm): 417.7 hectares - 0.39 in (10 mm): 1.7 hectares - 1.2 in (30 mm): 0 hectares **Sea-to-shore Transition** (cofferdam excavation) Maximum TSS concentration - 562 mg/L Maximum plume height above bed - ~6.6 feet (~2 meters) Area of deposition exceeding - 0.12 in (3 mm): 2.37 acres (0.96 hectares) - 0.39 in (10 mm): 1.38 acres (0.56 hectares) - 1.2 in (30 mm): 1.19 acres (0.48 hectares) Behavioral exposure for shellfish	**No EFH species exposure**	**Same as above**	**Same as above**	**Same as above**
	Atlantic sea scallop	Adult	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	Yes	--						
	Atlantic surfclam	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	Yes	--						
	Longfin squid	Juvenile	Pelagic													Yes	Yes	Yes						
	Longfin squid	Adult	Pelagic													Yes	Yes	Yes						

Table A-3. Total Suspended Solids and Sedimentation Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of TSS and Sedimentation Effects by Project Component			Timing and Duration of Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility

Notes

(dark shading)	Peak occurrence in the Analysis Area
(light shading)	Occurrence in the Analysis Area
*	Benthic complex includes both complex and potentially-complex benthic habitat

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Near-surface and pelagic habitats	Albacore Tuna	Adult	Pelagic													Yes	--	--	**Monopile Foundation Effects** Introduction of vertical monopile surfaces extending from surface to approximately ~100 feet (30 meters) depth - 26-foot (8-meter) piles: Approx. 129,000 square feet (12,000 square meters) - 36-foot (11-meter) piles: Approx. 172,000 square feet (16,000 square meters)	**No or negligible alteration of water column habitats**	**No or negligible alteration of water column habitats**	**Monopile Effects** - Continuous - Life of project	**Not applicable**	**Not applicable**
	Albacore Tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic Bluefin	Adult	Pelagic													Yes	--	--						
	Atlantic Bluefin	Juvenile	Pelagic													Yes	--	--						
	Atlantic cod	Eggs	Surface													Yes	--	--						
	Atlantic cod	Larvae	Pelagic													Yes	--	--						
	Atlantic herring	Adult	Pelagic													Yes	--	--						
	Atlantic herring	Juvenile	Pelagic													Yes	--	--						
	Atlantic herring	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Adult	Pelagic													Yes	--	--						
	Atlantic mackerel	Eggs	Surface													Yes	--	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Spawning	Pelagic													--	--	--						
	Atlantic Skipjack	Adult	Pelagic													Yes	--	--						
	Atlantic Skipjack	Juvenile	Pelagic													Yes	--	--						
	Atlantic Yellowfin	Adult	Pelagic													Yes	--	--						
	Atlantic Yellowfin	Juvenile	Pelagic													Yes	--	--						
	Basking shark	Adult	Pelagic													Yes	--	--						
	Basking shark	Juvenile	Pelagic													Yes	--	--						
	Basking shark	Neonate/YOY	Pelagic													Yes	--	--						
	Blue shark	Adult	Pelagic													Yes	--	--						
	Blue shark	Juvenile	Pelagic													Yes	--	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	--	--						
	Bluefish	Adult	Pelagic													Yes	--	--						
	Bluefish	Eggs	Pelagic													Yes	--	--						
	Bluefish	Juvenile	Pelagic													Yes	--	--						
	Bluefish	Larvae	Pelagic													Yes	--	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Eggs	Pelagic													Yes	--	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Larvae	Pelagic													Yes	--	--						
	Dusky shark	Adult	Pelagic													Yes	--	--						
	Dusky shark	Juvenile	Pelagic													Yes	--	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	--	--						
	Haddock	Larvae	Surface													Yes	--	--						
	Longfin squid	Adult	Pelagic													Yes	--	--						
	Longfin squid	Juvenile	Pelagic													Yes	--	--						
	Monkfish	Eggs	Surface													Yes	--	--						
	Monkfish	Larvae	Pelagic													Yes	--	--						
	Pollock	Eggs	Pelagic													Yes	--	--						
	Pollock	Larvae	Pelagic													Yes	--	--						
	Red hake	Eggs	Surface													Yes	--	--						
	Red hake	Larvae	Surface													Yes	--	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Near-surface and pelagic habitats	Scup	Eggs	Pelagic													Yes	--	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Scup	Larvae	Pelagic													Yes	--	--						
	Shortfin mako shark	Adult	Pelagic													Yes	--	--						
	Shortfin mako shark	Juvenile	Pelagic													Yes	--	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	--	--						
	Silver hake	Eggs	Surface													Yes	--	--						
	Silver hake	Larvae	Surface													Yes	--	--						
	Smooth dogfish	Adult	Pelagic													Yes	--	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	--	--						
	Smooth dogfish	Neonate	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (m)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub-Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub-Adult (m)	Pelagic													Yes	--	--						
	Summer flounder	Eggs	Pelagic													Yes	--	--						
	Summer flounder	Larvae	Pelagic													Yes	--	--						
	Tiger shark	Adult	Pelagic													Yes	--	--						
	Tiger shark	Juvenile	Pelagic													Yes	--	--						
	White hake	Eggs	Surface													Yes	--	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	White hake	Larvae	Surface													Yes	--	--						
	White shark	Adult	Pelagic													Yes	--	--						
	White shark	Juvenile	Pelagic													Yes	--	--						
	White shark	Neonate/YOY	Pelagic													Yes	--	--						
	Windowpane flounder	Eggs	Surface													Yes	--	--						
	Windowpane flounder	Larvae	Pelagic													Yes	--	--						
	Witch Flounder	Eggs	Surface													Yes	--	--						
	Witch Flounder	Larvae	Surface													Yes	--	--						
	Yellowtail flounder	Eggs	Surface													Yes	--	--						
	Yellowtail flounder	Larvae	Surface													Yes	--	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Complex and potentially complex benthic habitat	Atlantic cod	Adult	Benthic complex/ non-complex													Yes	Yes	--	**Monopile Foundation Effects** Permanent displacement of complex benthic habitat by monopiles: - 26-foot (8-meter) monopile alternative: 0.10 acres (0.04 hectares) - 36-foot (11-meter) monopile alternative: 0.20 acres (0.08 hectares) Permanent displacement of potentially complex benthic habitat by monopiles: - 26-foot (8-meter) monopile alternative: 0.02 acre (0.01 hectares) - 36-foot (11-meter) monopile alternative: 0.05 acres (0.02 hectares)	**Cable Protection Effects** Long-term to permanent alteration of complex habitat - Hither Hills alternative: 70.62 acres (28.58 hectares) - Beach Lane alternative: 75.34 acres (30.49 hectares) Long-term to permanent alteration of potentially-complex habitat - Hither Hills alternative: 1.51 acres (0.61 hectares) - Beach Lane alternative: 1.51 acres (0.61 hectares)	**No or negligible alteration of complex benthic habitat**	**Monopile Foundation Effects** - Continuous - Life of project **Scour Protection Effects** - Long-term effect (years) until hard surfaces are colonized and become functional habitat **Cable Protection Effects** - Long-term to permanent effect, depending on ability of sessile organisms to colonize concrete matresses **Boulder relocation** - Temporary reduction of habitat function	**Cable Protection Effects** - Long-term to permanent effect, depending on ability of sessile organisms to colonize concrete matresses **Boulder relocation** - Temporary reduction of habitat function	**Not applicable**
	Atlantic cod	Juvenile	Benthic complex													Yes	Yes	--						
	Atlantic cod	Spawning	Benthic complex/ non-complex													Yes	Yes	--						
	Atlantic herring	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Adult	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Eggs	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Juvenile	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Larvae	Pelagic/ benthic complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Complex and potentially complex benthic habitat	Atlantic sea scallop	Spawning	Benthic complex													Yes	Yes	--	**Foundation and Cable Protection Effects** Long-term to permanent alteration of complex habitat by scour and cable protection: - 26-foot (8-meter) monopile alternative: 3.48 acres (1.41 hectares) - 36-foot (11-meter) monopile alternative: 6.84 acres (2.77 hectares) - Inter-array cable protection + 20% contingency: 47.20 acres (19.10 hectares)	Boulder relocation Long-term alteration of complex habitat - Hither Hills alternative: 234.80 acres (95.02 hectares) - Beach Lane alternative: 234.80 acres (95.02 hectares) Long-term alteration of potentially-complex habitat - Hither Hills alternative: 6.75 acres (2.73 hectares) - Beach Lane alternative: 6.75 acres (2.73 hectares)				
	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Black sea bass	Adult	Benthic complex													Yes	Yes	--						
	Black sea bass	Juvenile	Benthic complex													Yes	Yes	--						
	Haddock	Adult	Benthic complex													Yes	Yes	--						
	Haddock	Juvenile	Benthic complex													Yes	Yes	--						
	Haddock	Spawning	Benthic complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Complex and potentially complex benthic habitat	Little Skate	Adult	Benthic non-complex/ complex													Yes	Yes	--	Long-term to permanent alteration of potentially-complex habitat by scour and cable protection: - 26-foot (8-meter) monopile alternative: 0.86 acres (0.35 hectares) - 36-foot (11-meter) monopile alternative: 1.75 acres (0.71 hectares) - Inter-array cable protection + 20% contingency: 11.24 acres (4.55 hectares)					
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Longfin squid	Eggs	Benthic complex													Yes	Yes	--						
	Monkfish	Adult	Benthic complex													Yes	Yes	--						
	Monkfish	Juvenile	Benthic complex													Yes	Yes	--						
	Monkfish	Spawning	Benthic complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Complex and potentially complex benthic habitat	Ocean pout	Eggs	Benthic complex													Yes	Yes	--	**Boulder relocation** Short-term alteration of complex habitat: - 26-foot (8-meter) monopile alternative: 240.24 acres (97.22 hectares) - 36-foot (11-meter) monopile alternative: 236.75 (95.81 hectares) - Inter-array cable protection + 20% contingency: 109.67 acres (44.38 hectares) Short-term alteration of potentially complex habitat: - 26-foot (8-meter) monopile alternative: 44.48 acres (18.00 hectares) - 36-foot (11-meter) monopile alternative: 43.59 acres (17.64 hectares) - Inter-array cable protection + 20% contingency: 26.17 acres (10.59 hectares)					
	Ocean pout	Spawning	Benthic complex													Yes	Yes	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Non-complex benthic habitat	Atlantic surfclam	Adult	Benthic non-complex													Yes	Yes	--	**Monopile Foundation Effects** Permanent displacement of non-complex benthic habitat by monopiles - 26-foot (8-meter) monopile alternative: 0.074 acres (0.03 hectares) - 36-foot (11-meter) monopile alternative: 0.37 acres (0.15 hectares) **Monopile and Cable Approach Scour Protection Effects** Permanent alteration of non-complex habitat by scour and cable protection - 26-foot (8-meter) monopile alternative: 2.62 acres (1.06 hectares) - 36-foot (11-meter) monopile alternative: 5.39 acres (2.18 hectares) - Inter-array cable protection + 20% contingency: 54.02 acres (21.86 hectares)	**Cable Protection Effects** Permanent alteration of non-complex habitat - Hither Hills alternative: 71.76 acres (29.04 hectares) - Beach Lane alternative: 101.73 acres (41.17 hectares) **Boulder relocation** Permanent alteration of non-complex - Hither Hills alternative: 104.95 acres (42.47 hectares) - Beach Lane alternative: 104.95 acres (42.47 hectares)	**Construction and Maintenance Dredging Effects** Deepening of non-complex benthic habitat from -4.9 ft to -12.1 ft (-1.5 m to -3.7 m) MLLW - 0.035 acres (0.014 hectares)	**Monopile Foundation Effects** - Permanent habitat conversion - Life of project **Scour Protection Effects** - Permanent habitat conversion - Life of project **Cable Protection Effects** - Permanent habitat conversion - Life of project **Boulder relocation** - Permanent habitat conversion	**Cable Protection Effects** - Permanent habitat conversion - Life of project **Boulder relocation** - Permanent habitat conversion	**Construction and Maintenance Dredging** Initial deepening to -3.7 m MLLW - October 1, 2021 to January 15, 2022 (Based on dredging window for adjacent federal navigation channel) Maintained depths from -3.0 and -3.7 m MLLW - Life of project
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	Yes	--						
	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	Yes	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Little Skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Ocean pout	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Non-complex benthic habitat	Red hake	Adult	Benthic non-complex													Yes	Yes	--	**Boulder Relocation Effects** Permanent conversion of non-complex habitat to complex habitat - 26-foot (8-meter) monopile alternative: 204.95 acres (82.94 hectares) - 36-foot (11-meter) monopile alternative: 5.39 acres (2.18 hectares) - Inter-array cable protection + 20% contingency: 126.47 acres (51.18 hectares)					
	Red hake	Juvenile	Benthic non-complex													Yes	Yes	--						
	Red hake	Spawning	Benthic non-complex													Yes	Yes	--						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	Yes	--						
	Sandbar shark	Adult	Benthic non-complex													Yes	Yes	--						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	Yes	--						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	Yes	--						

Table A-4. Habitat Conversion Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Habitat Conversion Effects by Project Component			Timing and Duration of Habitat Conversion Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Non-complex benthic habitat	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Windowpane flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Winter flounder	Adult	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Eggs	Benthic non-complex/ complex													--	Yes	Yes						
	Winter flounder	Juvenile	Benthic non-complex													Yes	Yes	Yes						
	Winter flounder	Spawning	Benthic non-complex													--	Yes	Yes						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Witch Flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Notes

Peak occurrence in the Analysis Area

Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Eggs and larvae No effect thresholds defined	Atlantic cod	Eggs	Surface													Yes	--	Yes	**WTG Operation** Operational noise range - 110 to 130 dBRMS @ 164 ft (50 m) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - not applicable	**No operational noise**	**Maintenance Dredging** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - not applicable	**WTG Operation** - Ongoing, intermittent - Life of project	**No operational noise**	**Maintenance Dredging** Timing window - October 1 to January 15 Frequency - Annual, beginning in 2022 Duration - 60 days
	Atlantic cod	Larvae	Pelagic													Yes	--	--						
	Atlantic herring	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Eggs	Pelagic													--	--	Yes						
	Atlantic mackerel	Larvae	Pelagic													Yes	--	--						
	Atlantic sea scallop	Eggs	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Larvae	Pelagic / benthic complex													Yes	--	--						
	Bluefish	Eggs	Pelagic													Yes	--	--						
	Bluefish	Larvae	Pelagic													Yes	--	--						
	Butterfish	Eggs	Pelagic													Yes	--	Yes						
	Butterfish	Larvae	Pelagic													Yes	--	--						
	Haddock	Larvae	Surface													Yes	--	--						
	Longfin squid	Eggs	Benthic complex													Yes	--	Yes						
	Monkfish	Eggs	Surface													Yes	--	--						
	Monkfish	Larvae	Pelagic													Yes	--	--						
	Pollock	Eggs	Pelagic													Yes	--	--						
	Pollock	Larvae	Pelagic													Yes	--	--						
	Ocean pout	Eggs	Benthic complex													Yes	--	--						
	Red hake	Eggs	Surface													Yes	--	Yes						
	Red hake	Larvae	Surface													Yes	--	Yes						
	Scup	Eggs	Pelagic													Yes	--	Yes						
	Scup	Larvae	Pelagic													Yes	--	Yes						
	Silver hake	Eggs	Surface													Yes	--	--						
	Silver hake	Larvae	Surface													Yes	--	--						
	Summer flounder	Eggs	Pelagic													Yes	--	--						
	Summer flounder	Larvae	Pelagic													Yes	--	--						
	White hake	Eggs	Pelagic													Yes	--	Yes						
	White hake	Larvae	Surface													Yes	--	Yes						
	Windowpane flounder	Eggs	Surface													Yes	--	Yes						
	Windowpane flounder	Larvae	Pelagic													Yes	--	Yes						
	Winter flounder	Eggs	Benthic non-complex													--	--	Yes						
	Winter flounder	Larvae	Pelagic / benthic non-complex													--	--	Yes						
	Witch Flounder	Eggs	Surface													Yes	--	--						
	Witch Flounder	Larvae	Surface													Yes	--	--						
	Yellowtail flounder	Eggs	Surface													Yes	--	--						
	Yellowtail flounder	Larvae	Surface													Yes	--	--						

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, involved in hearing Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury (LE, 48hr), 170 dB - TTS, (LE, 12hr), 158 dB - Behavioral response (Lpk), 150 dB	Atlantic cod	Juvenile	Benthic complex													Yes	--	--	**WTG Operation** Operational noise range - 110 to 130 dB_{RMS} @ 164 ft (50 m) Lethal injury - Unlikely Recoverable injury/TTS - LE, 24 hr <3.3 ft (1 m) - Unlikely Behavioral - Lpk <9.8 ft (3 m) - Insignificant	**No operational noise**	**Maintenance Dredging and Vessel Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - 2,315 acres (937 hectares)	**Same as above**	**No operational noise**	**Same as above**
	Atlantic cod	Adult	Benthic complex													Yes	--	--						
	Atlantic cod	Spawning	Benthic complex/ non-complex													Yes	--	--						
	Atlantic herring	Juvenile	Pelagic													Yes	--	--						
	Atlantic herring	Adult	Pelagic													Yes	--	--						
	Atlantic herring	Spawning	Benthic complex													Yes	--	--						
	Black sea bass	Juvenile	Benthic complex													Yes	--	--						
	Black sea bass	Adult	Benthic complex													Yes	--	--						
	Bluefish	Juvenile	Pelagic													Yes	--	--						
	Bluefish	Adult	Pelagic													Yes	--	--						
	Haddock	Juvenile	Benthic complex													Yes	--	--						
	Haddock	Adult	Benthic complex													Yes	--	--						
	Haddock	Spawning	Benthic complex													Yes	--	--						
	Monkfish	Juvenile	Benthic complex													Yes	--	--						
	Monkfish	Adult	Benthic complex													Yes	--	--						
	Monkfish	Spawning	Benthic complex													Yes	--	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	--	--						
	Red hake	Juvenile	Benthic non-complex													Yes	--	--						
	Red hake	Adult	Benthic non-complex													Yes	--	--						
	Red hake	Spawning	Benthic non-complex													Yes	--	--						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	--	--						
	White hake	Juvenile	Pelagic / benthic non-complex													Yes	--	--						

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Fishes with swim bladder, not involved in hearing Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury, n/a - TTS, n/a - Behavioral response (Lpk), 150 dB	Albacore tuna	Adult	Pelagic													Yes	--	--	**WTG Operation** Operational noise range - 110 to 130 dBRMS @ 164 ft (50 m) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Lpk <9.8 ft (3 m) - Insignificant	**No operational noise**	**Maintenance Dredging and Vessel Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - 2,315 acres (937 hectares)	**Same as above**	**No operational noise**	**Same as above**
	Albacore tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Adult	Pelagic													Yes	--	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Spawning	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Adult	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Juvenile	Pelagic													Yes	--	--						
	Butterfish	Adult	Pelagic / benthic non-complex													Yes	--	--						
	Butterfish	Juvenile	Pelagic / benthic non-complex													Yes	--	--						
	Ocean pout	Adult	Benthic non-complex													Yes	--	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean pout	Spawning	Benthic complex													Yes	--	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	--	Yes						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	--	Yes						

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bony fishes and Elasmobranchs - no swim bladder Non-impulsive noise sources - Lethal injury, n/a - Recoverable injury, n/a - TTS, n/a - Behavioral response (Lpk), 150 dB	Barndoor skate	Adult	Benthic non-complex/ complex													--	--	--	**WTG Operation** Operational noise range - 110 to 130 dBRMS @ 164 ft (50 m) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Lpk <9.8 ft (3 m) - Insignificant	**No operational noise**	**Maintenance Dredging and Vessel Noise** Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - 2,315 acres (937 hectares)	**Same as above**	**No operational noise**	**Same as above**
	Barndoor skate	Juvenile	Benthic non-complex/ complex													--	--	--						
	Basking shark	Adult	Pelagic													Yes	--	Yes						
	Basking shark	Juvenile	Pelagic													Yes	--	Yes						
	Basking shark	Neonate/YOY	Pelagic													Yes	--	Yes						
	Blue shark	Adult	Pelagic													Yes	--	--						
	Blue shark	Juvenile	Pelagic													Yes	--	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	--	--						
	Dusky shark	Adult	Pelagic													Yes	--	--						
	Dusky shark	Juvenile	Pelagic													Yes	--	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	--	--						
	Little Skate	Adult	Benthic non-complex/ complex													Yes	--	Yes						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	--	Yes						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	--	Yes						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	--	Yes						
	Sandbar shark	Adult	Benthic non-complex													Yes	--	Yes						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	--	Yes						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	--	Yes						
	Shorfin mako shark	Adult	Pelagic													Yes	--	--						
	Shorfin mako shark	Juvenile	Pelagic													Yes	--	--						
	Shorfin mako shark	Neonate/YOY	Pelagic													Yes	--	--						
	Smooth dogfish	Adult	Pelagic													Yes	--	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	--	--						
	Smooth dogfish	Neonate	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (m)	Pelagic													Yes	--	Yes						
	Spiny dogfish	Sub-Adult (f)	Pelagic													Yes	--	Yes						
	Spiny dogfish	Sub-Adult (m)	Pelagic													Yes	--	Yes						
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	--	Yes						

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bony fishes and Elasmobranchs - no swim bladder	Summer flounder	Juvenile	Benthic non-complex/ complex													--	--	Yes	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Tiger shark	Adult	Pelagic													Yes	--	--						
	Tiger shark	Juvenile	Pelagic													Yes	--	--						
	White shark	Adult	Pelagic													Yes	--	--						
	White shark	Juvenile	Pelagic													Yes	--	--						
	White shark	Neonate/YOY	Pelagic													Yes	--	--						
	Windowpane flounder	Adult	Benthic non-complex													Yes	--	Yes						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	--	Yes						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	--	Yes						
	Winter flounder	Adult	Benthic non-complex													Yes	--	Yes						
	Winter flounder	Juvenile	Benthic non-complex													Yes	--	Yes						
	Winter flounder	Spawning	Benthic non-complex													Yes	--	Yes						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	--	Yes						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	--	Yes						
	Witch Flounder	Adult	Benthic non-complex													Yes	--	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	--	--						

Table A-5. Operational Noise Impacts

Noise Sensitivity Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Operational Noise Effects by Project Component			Timing and Duration of Operational Noise Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Invertebrates Particle motion effects only	Atlantic sea scallop	Juvenile	Benthic complex													Yes	--	--	**WTG Operation** Operational noise range - 110 to 130 dBRMS @ 164 ft (50 m) Lethal injury - Unlikely Recoverable injury/TTS - Unlikely Behavioral - Unlikely	**No operational noise**	**Maintenance Dredging** Lethal injury - Unlikely Sublethal injury - Unlikely Behavioral - Insignificant	**Same as above**	**No operational noise**	**Same as above**
	Atlantic sea scallop	Adult	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	--	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													--	--	--						
	Atlantic surfclam	Adult	Benthic non-complex													--	--	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	--	--						
	Longfin squid	Juvenile	Pelagic													Yes	--	Yes						
	Longfin squid	Adult	Pelagic													Yes	--	Yes						

Notes

Peak occurrence in the Analysis Area

Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic, Epibenthic, or Pelagic Eggs and Larvae Minimum physiological effect threshold, magnetic field: 1,000 mG (developmental delay with prolonged exposure) (Brouard et al. 1996) Minimum physiological effect threshold, electrical field >500 mV/m (Brouard et al. 1996)	Atlantic cod	Larvae	Pelagic													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 21 mG, 1.4 mV/m @ seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 65.1 mG, 4.3 mV/m @ seabed - Maximum induced electrical field: Insignificant based on body size **EMF exposure effects** Physological: Insignificant Behaviorial: Not applicable	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 30 mG 2.1 mV/m, @ seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles): 76.6 mG, 5.4 mV/m @ seabed Hither Hills Alternative - Buried cable, 48.1 statute miles (77.4 km, 41.8 nautical miles): 30 mG, 2.1 mV/m @ seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles): 76.6 mG, 5.4 mV/m @ seabed - Maximum induced electrical field: Insignificant based on body size **EMF exposure effects** Physiological detection: No data Behavioral: Not applicable	**No EMF or heat effects**	**Inter-array Cable Operation** - Ongoing, variable intermittent - Life of project	**SFEC Operation** - Ongoing, variable intermittent - Life of project	**No EMF or heat effects**
	Atlantic herring	Larvae	Pelagic													Yes	Yes	--						
	Atlantic sea scallop	Eggs	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Larvae	Pelagic/ benthic complex													Yes	Yes	--						
	Bluefish	Eggs	Pelagic													Yes	Yes	--						
	Bluefish	Larvae	Pelagic													Yes	Yes	--						
	Butterfish	Eggs	Pelagic													Yes	Yes	--						
	Butterfish	Larvae	Pelagic													Yes	Yes	--						
	Longfin squid	Eggs	Benthic complex													Yes	Yes	--						
	Monkfish	Larvae	Pelagic													Yes	Yes	--						
	Ocean pout	Eggs	Benthic complex													Yes	Yes	--						
	Pollock	Eggs	Benthic complex/ non-complex													Yes	Yes	--						
	Pollock	Larvae	Benthic complex/ non-complex													Yes	Yes	--						
	Scup	Eggs	Pelagic													Yes	Yes	--						
	Scup	Larvae	Pelagic													Yes	Yes	--						
	Summer flounder	Eggs	Pelagic													Yes	Yes	--						
	Summer flounder	Larvae	Pelagic													Yes	Yes	--						
	Windowpane flounder	Larvae	Pelagic													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Flatfish Minimum detection threshold, induced electrical field: 20 mV/m (Basov 1999) Minimum detection threshold, magnetic field: Unknown Minimum behavioral threshold, magnetic: >1,000 mG (Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015)	Summer flounder	Juvenile	Benthic non-complex/ complex													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 21 mG, 1.4 mV/m @ seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 65.1 mG, 4.3 mV/m @ seabed -Maximum induced electrical field at seabed: <0.4 mV/m within 3.3 ft (1 m) of exposed cable EMF exposure effects Physological detection: No data Behaviorial effect: Not applicable	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable,58.6 statute miles (94.3 km, 50.9 nautical miles): 30 mG 2.1 mV/m, @ seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles): 76.6 mG, 5.4 mV/m @ seabed Hither Hills Alternative - Buried cable,48.1 statute miles (77.4 km, 41.8 nautical miles): 30 mG, 2.1 mV/m @ seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles): 76.6 mG, 5.4 mV/m @ seabed - Maximum induced electrical field: <0.6 mV/m within 3.3 ft (1 m) of exposed cable **EMF exposure effects** Physiological detection: No data Behavioral: Not applicable	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Windowpane flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Winter flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Winter flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Winter flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Witch Flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	Yes	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Finfish Life Stages Minimum detection threshold, induced electrical field: 20 mV/m (Basov 1999) Minimum detection threshold, magnetic field: Unknown Minimum behavioral threshold, magnetic: >1,000 mG (Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015)	Atlantic cod	Juvenile	Benthic complex													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 21 mG, 1.4 mV/m @ seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 65.1 mG, 4.3 mV/m @ seabed - Maximum induced electrical field: <0.4 mV/m (juvenile) to 0.7 mV/m (adult) within 3.3 ft (1 m) of exposed cable **EMF exposure effects** Magnetic field effect: Insignificant (below detection threshold) Induced electrical field effect: Insignificant (below detection threshold) Behaviorial effect: Insignificant (below behavioral threshold)	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 30 mG 2.1 mV/m, @ seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles): 76.6 mG, 5.4 mV/m @ seabed Hither Hills Alternative - Buried cable, 48.1 statute miles (77.4 km, 41.8 nautical miles): 30 mG, 2.1 mV/m @ seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles): 76.6 mG, 5.4 mV/m @ seabed - Maximum induced electrical field: <0.6 mV/m (juvenile) to 1.1 mV/m (adult) within 3.3 ft (1 m) of exposed cable **EMF exposure effects** Physiological detection: No data Behavioral: Insignificant (below behavioral threshold)	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Atlantic cod	Adult	Benthic complex													Yes	Yes	--						
	Atlantic cod	Spawning	Benthic complex/ non-complex													Yes	Yes	--						
	Pollock	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Red hake	Juvenile	Benthic non-complex													Yes	Yes	--						
	Red hake	Adult	Benthic non-complex													Yes	Yes	--						
	Red hake	Spawning	Benthic non-complex													Yes	Yes	--						
	Silver hake	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Atlantic herring	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic herring	Adult	Pelagic													Yes	Yes	--						
	Atlantic herring	Juvenile	Pelagic													Yes	Yes	--						
	Black sea bass	Juvenile	Benthic complex													Yes	Yes	--						
	Black sea bass	Adult	Benthic complex													Yes	Yes	--						
	Bluefish	Juvenile	Pelagic													Yes	Yes	--						
	Bluefish	Adult	Pelagic													Yes	Yes	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	Yes	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	Yes	--						
	Haddock	Juvenile	Benthic complex													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Finfish Life Stages	Haddock	Adult	Benthic complex													Yes	Yes	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Haddock	Spawning	Benthic complex													Yes	Yes	--						
	Monkfish	Juvenile	Benthic complex													Yes	Yes	--						
	Monkfish	Adult	Benthic complex													Yes	Yes	--						
	Monkfish	Spawning	Benthic complex													Yes	Yes	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean pout	Spawning	Benthic complex													Yes	Yes	--						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Benthic or Epibenthic Shark and Skate Life Stages Minimum detection threshold, electrical fields: 20-50 µV/cm (2-5 mV/m) for fields <20 Hz (Bedore and Kajiura 2013), no response to electrical fields above 20 Hz (Kempster et al. 2013) Minimum detection threshold, magnetic field: Unknown Minimum behavioral threshold, magnetic: 250-1,000 mG	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 21 mG, 1.4 mV/m @ seabed - Cable on surface,5.8 statute miles (9.3 km, 5.0 nautical miles): 65.1 mG, 4.3 mV/m @ seabed - Maximum induced electrical field <0.4 mV/m (juvenile) <0.7 mV/m (adult) within 3.3 ft (1 m) of exposed cable **EMF exposure effects** Physiological detection: Unlikely based on 60 Hz electrical field Behaviorial effect: Insignificant (60-Hz electrical field)	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 30 mG 2.1 mV/m, @ seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles): 76.6 mG, 5.4 mV/m @ seabed Hither Hills Alternative - Buried cable, 48.1 statute miles (77.4 km, 41.8 nautical miles): 30 mG, 2.1 mV/m @ seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles): 76.6 mG, 5.4 mV/m @ seabed - Maximum induced electrical field: <0.6 mV/m (juvenile) to 1.5 mV/m (adult) within 3.3 ft (1 m) of exposed cable **EMF exposure effects** Physiological detection: No data Behavioral: Insignificant (below behavioral threshold)	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Little Skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						
	Sand tiger shark	Neonate/YOY	Benthic complex/ non-complex													Yes	Yes	--						
	Sand tiger shark	Juvenile	Benthic complex/ non-complex													Yes	Yes	--						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	Yes	--						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	Yes	--						
	Sandbar shark	Adult	Benthic non-complex													Yes	Yes	--						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	Yes	--						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Pelagic Finfish Life Stages Minimum detection threshold, electrical fields: 20 mV/m (Basov 1999) Minimum detection threshold, magnetic field: Unknown Minimum behavioral threshold, magnetic: >1,000 mG (Armstrong et al. 2015; Bevelhimer et al. 2013; Orpwood et al. 2015)	Albacore Tuna	Juvenile	Pelagic													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 9 mG, 0.9 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 27.9 mG, 2.8 mV/m @ 3.3 ft (1 m) above seabed - Maximum induced electrical field @ 3.3 ft (1 m) above seabed, <0.2 mV/m (juvenile) <0.4 mV/m (adult) **EMF exposure effects** Physological detection: Unknown Behaviorial effect: Insignificant	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed Hither Hills Alternative - Buried cable, 48.1 statute miles (77.4 km, 41.8 nautical miles): 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed - Maximum induced electrical field @ 3.3 ft (1 m) above seabed: <0.2 mV/m (juvenile) <0.6 mV/m (adult) **EMF exposure effects** Physological detection: Unknown Behaviorial effect: Insignificant	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Albacore Tuna	Adult	Pelagic													Yes	Yes	--						
	Atlantic Bluefin	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic Bluefin	Adult	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Adult	Pelagic													Yes	Yes	--						
	Atlantic mackerel	Spawning	Pelagic													Yes	Yes	--						
	Atlantic Skipjack	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic Skipjack	Adult	Pelagic													Yes	Yes	--						
	Atlantic Yellowfin	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic Yellowfin	Adult	Pelagic													Yes	Yes	--						
	Atlantic herring	Juvenile	Pelagic													Yes	Yes	--						
	Atlantic herring	Adult	Pelagic													Yes	Yes	--						
	Bluefish	Juvenile	Pelagic													Yes	Yes	--						
	Bluefish	Adult	Pelagic													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Pelagic Invertebrates Minimum detection threshold, electrical fields: Unknown Minimum detection threshold, induced electrical field: Unknown Minimum behavioral threshold, magnetic field: >800 mG	Longfin squid	Juvenile	Pelagic													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 9 mG, 0.9 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 27.9 mG, 2.8 mV/m @ 3.3 ft (1 m) above seabed Maximum induced electrical field, at 3.3 ft (1 m) above seabed <0.2 mV/m **EMF exposure effects** Physiological detection: Unknown Behavioral effect: Insignificant	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed Hither Hills Alternative - Buried cable,48.1 statute miles (77.4 km, 41.8 nautical miles): 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed - Maximum induced electrical field @ 3.3 ft (1 m) above seabed: <0.2 mV/m (juvenile) <0.6 mV/m (adult) **EMF exposure effects** Physiological detection: Unknown Behavioral effect: Insignificant	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Longfin squid	Adult	Pelagic													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Pelagic Shark Life Stages Minimum detection threshold, electrical fields: 20-50 µV/cm (2-5 mV/m) for fields <20 Hz (Bedore and Kajiura 2013), no response above 20 Hz (Kempster et al. 2013) Minimum detection threshold, magnetic field: Unknown Minimum behavioral threshold, magnetic: 250-1,000 mG	Basking shark	Adult	Pelagic													Yes	Yes	--	**EMF from Inter-array** Habitat area exposed to EMF effects: - Buried cable, 15.6 statute miles (25.1 km, 13.6 nautical miles): 9 mG, 0.9 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 5.8 statute miles (9.3 km, 5.0 nautical miles): 27.9 mG, 2.8 mV/m @ 3.3 ft (1 m) above seabed Maximum induced electrical field at 3.3 ft (1 m) above seabed <0.06 mV/m **EMF exposure effects** Magnetic field effect: Insignificant (below detection threshold) Induced electrical field effect: Insignificant (below detection threshold, 60 Hz field source) Behaviorial effect: Insignificant (below detection threshold)	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Buried cable, 58.6 statute miles (94.3 km, 50.9 nautical miles): 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 3.23 statute miles (5.2 km, 2.8 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed Hither Hills Alternative - Buried cable, 77.4 km: 21 mG, 1.4 mV/m @ 3.3 ft (1 m) above seabed - Cable on surface, 1.9 statute miles (3.0 km, 1.6 nautical miles) 53.6 mG, 3.6 mV/m @ 3.3 ft (1 m) above seabed - Maximum induced electrical field @ 3.3 ft (1 m) above seabed: <0.2 mV/m (juvenile) <0.6 mV/m (adult) **EMF exposure effects** Physological detection: Unknown Behaviorial effect: Insignificant	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Basking shark	Juvenile	Pelagic													Yes	Yes	--						
	Basking shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Blue shark	Adult	Pelagic													Yes	Yes	--						
	Blue shark	Juvenile	Pelagic													Yes	Yes	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Dusky shark	Adult	Pelagic													Yes	Yes	--						
	Dusky shark	Juvenile	Pelagic													Yes	Yes	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Adult	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Juvenile	Pelagic													Yes	Yes	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	Yes	--						
	Smooth dogfish	Adult	Pelagic													Yes	Yes	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	Yes	--						
	Smooth dogfish	Neonate	Pelagic													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Pelagic Shark Life Stages	Spiny dogfish	Adult (f)	Pelagic													Yes	Yes	--	**Same as above**	**Same as above**	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Spiny dogfish	Adult (m)	Pelagic													Yes	Yes	--						
	Spiny dogfish	Sub Adult (f)	Pelagic													Yes	Yes	--						
	Spiny dogfish	Sub Adult (m)	Pelagic													Yes	Yes	--						
	Tiger shark	Adult	Pelagic													Yes	Yes	--						
	Tiger shark	Juvenile	Pelagic													Yes	Yes	--						
	White shark	Adult	Pelagic													Yes	Yes	--						
	White shark	Juvenile	Pelagic													Yes	Yes	--						
	White shark	Neonate/YOY	Pelagic													Yes	Yes	--						

Table A-6. EMF and Heat Impacts

EMF Sensitivy Group and Thresholds	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of EMF and Heat Effects by Project Component			Timing and Duration of EMF and Heat Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Shellfish EMF sensitivity, physological: 3-10 mG EMF sensitivity, behavioral: >360 mG Cable heat: Thermal sensitivity of buried species/life stages	Atlantic sea scallop	Juvenile	Benthic complex													Yes	Yes	--	**EMF from inter-array** Habitat area exposed to EMF effects: - Total cable length 21.4 statute miles (34.4 km, 18.6 nautical): 21 to 65.1 mG depending on cable proximity **EMF exposure effects** Magnetic field: 85 acres (34.4 hectares) exposed to EMF >1 mG Induced electrical field: Unknown **Heat from inter-array** - 50 to 68°F (10 to 20°C) above ambient within 15.75 to 23.6 in (40 to 60 cm) of buried cable, depending on sediment permeability **Heat exposure effect** - Sediment temperatures may exceed thermal limits for ocean quahog and surfclam occuring along 0.15 acres (0.06 hectares) of habitat above near surface cable segments	**EMF from SFEC** Habitat area exposed to EMF effects: Beach Lane Alternative - Total cable length 61.8 statute miles (99.5 km, 53.7 nautical miles): 30 to 76.6 mG depending on proximity to cable - 245.9 acres (99.5 hectares) exposed to EMF >1 mG Hither Hills Alternative - Total cable length 50.0 statute miles (80.4 km, 43.4 nautical miles): 30 to 76.6 mG depending on proximity to cable - 199 acres (80.4 hectares) exposed to EMF >1 mG **EMF exposure effects** Magnetic field: Unknown Induced electrical field: Unknown **Heat from inter-array** - 50 to 68°F (10 to 20°C) above ambient within 15.75 to 23.6 in (40 to 60 cm) of buried cable, depending on sediment permeability **Heat exposure effect** - Sediment temperatures may exceed thermal limits for ocean quahog (64.4°F (18°C)) within 3.3 ft (1 m) of buried cable	**No EMF or heat effects**	**Same as above**	**Same as above**	**No EMF or heat effects**
	Atlantic sea scallop	Adult	Benthic complex													Yes	Yes	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	Yes	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	Yes	--						
	Atlantic surfclam	Adult	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	Yes	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	Yes	--						

Notes
Peak occurrence in the Analysis Area
Occurrence in the Analysis Area
* Benthic complex includes both complex and potentially-complex benthic habitat

Table A-7. Hydrodynamic Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Hydrodynamic Effects by Project Component			Timing and Duration of Hydrodynamic Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Surface and water column habitats used by pelagic eggs and larvae	Atlantic cod	Eggs	Surface													Yes	--	--	**Monopile Hydrodynamic Effects** - Localized hydrodynamic effects extending 656 to 1,312 feet (200 to 400 meters) down current of 16 monopiles - Insignificant survival effect on surface oriented and pelagic eggs and larvae	**No or neglgible hydrodynamic effects**	**No or neglgible hydrodynamic effects**	**Monopile and Scour Protection Effects** - Ongoing and variable - Life of project	**Not applicable**	**Not applicable**
	Atlantic cod	Larvae	Pelagic													Yes	--	--						
	Atlantic herring	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Eggs	Pelagic													Yes	--	--						
	Atlantic sea scallop	Larvae	Pelagic/ benthic complex													Yes	--	--						
	Basking shark	Neonate/YOY	Pelagic													Yes	--	--						
	Bluefish	Eggs	Pelagic													Yes	--	--						
	Bluefish	Larvae	Pelagic													Yes	--	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	--	--						
	Butterfish	Eggs	Pelagic													Yes	--	--						
	Butterfish	Larvae	Pelagic													Yes	--	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	--	--						
	Haddock	Larvae	Surface													Yes	--	--						
	Monkfish	Eggs	Surface													Yes	--	--						
	Monkfish	Larvae	Pelagic													Yes	--	--						
	Red hake	Eggs	Surface													Yes	--	--						
	Red hake	Larvae	Surface													Yes	--	--						
	Scup	Eggs	Pelagic													Yes	--	--						
	Scup	Larvae	Pelagic													Yes	--	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	--	--						
	Silver hake	Eggs	Surface													Yes	--	--						
	Silver hake	Larvae	Surface													Yes	--	--						
	Smooth dogfish	Neonate	Pelagic													Yes	--	--						
	Summer flounder	Eggs	Pelagic													Yes	--	--						
	Summer flounder	Larvae	Pelagic													Yes	--	--						
	White hake	Eggs	Surface													Yes	--	--						
	White hake	Larvae	Surface													Yes	--	--						
	White shark	Neonate/YOY	Pelagic													Yes	--	--						
	Windowpane flounder	Eggs	Surface													Yes	--	--						
	Windowpane flounder	Larvae	Pelagic													Yes	--	--						
	Witch Flounder	Eggs	Surface													Yes	--	--						
	Witch Flounder	Larvae	Surface													Yes	--	--						
	Yellowtail flounder	Eggs	Surface													Yes	--	--						
	Yellowtail flounder	Larvae	Surface													Yes	--	--						

Table A-7. Hydrodynamic Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Hydrodynamic Effects by Project Component			Timing and Duration of Hydrodynamic Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Water column habitats used by pelagic juveniles and adults	Albacore tuna	Adult	Pelagic													Yes	--	--	**Monopile Hydrodynamic Effects** - Localized hydrodynamic effects extending 656 to 1,312 feet (200 to 400 meters)s down current of 16 monopiles - Insignificant survival effect on pelagic fish and invertebrate life stages	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Albacore tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic herring	Adult	Pelagic													Yes	--	--						
	Atlantic herring	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Adult	Pelagic													Yes	--	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Spawning	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Adult	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Juvenile	Pelagic													Yes	--	--						
	Basking shark	Adult	Pelagic													Yes	--	--						
	Basking shark	Juvenile	Pelagic													Yes	--	--						
	Blue shark	Adult	Pelagic													Yes	--	--						
	Blue shark	Juvenile	Pelagic													Yes	--	--						
	Bluefish	Adult	Pelagic													Yes	--	--						
	Bluefish	Juvenile	Pelagic													Yes	--	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Dusky shark	Adult	Pelagic													Yes	--	--						
	Dusky shark	Juvenile	Pelagic													Yes	--	--						
	Longfin squid	Adult	Pelagic													Yes	--	--						
	Longfin squid	Juvenile	Pelagic													Yes	--	--						
	Shortfin mako shark	Adult	Pelagic													Yes	--	--						
	Shortfin mako shark	Juvenile	Pelagic													Yes	--	--						
	Smooth dogfish	Adult	Pelagic													Yes	--	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (m)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub Adult (m)	Pelagic													Yes	--	--						
	Tiger shark	Adult	Pelagic													Yes	--	--						
	Tiger shark	Juvenile	Pelagic													Yes	--	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	White shark	Adult	Pelagic													Yes	--	--						
	White shark	Juvenile	Pelagic													Yes	--	--						

Table A-7. Hydrodynamic Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Hydrodynamic Effects by Project Component			Timing and Duration of Hydrodynamic Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bottom habitats used by eggs, larvae, and benthic-oriented juveniles and adults	Atlantic cod	Adult	Benthic complex													Yes	--	--	**Monopile Hydrodynamic Effects** - Localized hydrodynamic effects extending 656 to 1,312 feet (200 to 400 meters) down current of 16 monopiles - Insignificant survival effect on pelagic fish and invertebrate life stages	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Atlantic cod	Juvenile	Benthic complex													Yes	--	--						
	Atlantic cod	Spawning	Benthic complex/ benthic non-complex													Yes	--	--						
	Atlantic herring	Spawning	Benthic complex													Yes	--	--						
	Black sea bass	Adult	Benthic complex													Yes	--	--						
	Black sea bass	Juvenile	Benthic complex													Yes	--	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Haddock	Adult	Benthic complex													Yes	--	--						
	Haddock	Juvenile	Benthic complex													Yes	--	--						
	Haddock	Spawning	Benthic complex													Yes	--	--						
	Little Skate	Adult	Benthic non-complex/ complex													Yes	--	--						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Longfin squid	Eggs	Benthic complex													Yes	--	--						
	Monkfish	Adult	Benthic complex													Yes	--	--						
	Monkfish	Juvenile	Benthic complex													Yes	--	--						
	Monkfish	Spawning	Benthic complex													Yes	--	--						
	Ocean pout	Adult	Benthic non-complex													Yes	--	--						
	Ocean pout	Eggs	Benthic complex													Yes	--	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean pout	Spawning	Benthic complex													Yes	--	--						
	Pollock	Eggs	Benthic complex/ benthic non-complex													Yes	--	--						
	Pollock	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--						
	Pollock	Larvae	Benthic complex/ benthic non-complex													Yes	--	--						
	Red hake	Adult	Benthic non-complex													Yes	--	--						
	Red hake	Juvenile	Benthic non-complex													Yes	--	--						
	Red hake	Spawning	Benthic non-complex													Yes	--	--						
	Sand tiger shark	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--						

Table A-7. Hydrodynamic Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Hydrodynamic Effects by Project Component			Timing and Duration of Hydrodynamic Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Bottom habitats used by eggs, larvae, and benthic-oriented juveniles and adults	Sand tiger shark	Neonate/YOY	Benthic complex/ benthic non-complex													Yes	--	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Sandbar shark	Adult	Benthic non-complex													Yes	--	--						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	--	--						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	--	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	--	--						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Silver hake	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--						
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	--	--						
	Summer flounder	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Windowpane flounder	Adult	Benthic non-complex													Yes	--	--						
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	--	--						
	Winter flounder	Adult	Benthic non-complex													Yes	--	--						
	Winter flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Winter flounder	Spawning	Benthic non-complex													Yes	--	--						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	--	--						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Witch Flounder	Adult	Benthic non-complex													Yes	--	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	--	--						

Table A-7. Hydrodynamic Impacts

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Hydrodynamic Effects by Project Component			Timing and Duration of Hydrodynamic Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M Facility	SFWF	SFEC	O&M Facility
Habitats used by EFH shellfish	Atlantic sea scallop	Eggs	Benthic complex													Yes	--	--	**Monopile Hydrodynamic Effects** - Localized hydrodynamic effects extending 656 to 1,312 feet (200 to 400 meters) down current of 16 monopiles - Insignificant survival effects on benthic shellfish - Localized insignificant effect on scallop larval dispersal - Localized insignificant effects on prey distribution	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Atlantic sea scallop	Larvae	Pelagic/ benthic non-complex													Yes	--	--						
	Atlantic sea scallop	Juvenile	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Adult	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	--	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	--	--						
	Longfin squid	Eggs	Benthic complex													Yes	--	--						

Notes

Peak occurrence in the Analysis Area

Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Surface and water column habitats used by pelagic eggs and larvae	Atlantic cod	Eggs	Surface													Yes	--	--	**Monopile Foundation Effects** Increased abundance of filter-feeding invertebrates on vertical monopile surfaces, surface to ~100 feet (30 meters) depth - 26-foot (8-meter) piles: Approx. 129,000 square feet (12,000 square meters) - 36-foot (11-meter) piles: Approx. 172,000 square feet (16,000 square meters) Negligible increase in predation-related mortality from filter-feeding organisms	**No or negligible food web effects**	**No or neglgible food web effects**	**Monopile and Scour Protection Effects** - Continuous - Life of project	**Not applicable**	**Not applicable**
	Atlantic cod	Larvae	Pelagic													Yes	--	--						
	Atlantic herring	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Larvae	Pelagic													Yes	--	--						
	Atlantic mackerel	Eggs	Pelagic													Yes	--	--						
	Atlantic sea scallop	Larvae	Pelagic/ benthic complex													Yes	--	--						
	Basking shark	Neonate/YOY	Pelagic													Yes	--	--						
	Bluefish	Eggs	Pelagic													Yes	--	--						
	Bluefish	Larvae	Pelagic													Yes	--	--						
	Blue shark	Neonate/YOY	Pelagic													Yes	--	--						
	Butterfish	Eggs	Pelagic													Yes	--	--						
	Butterfish	Larvae	Pelagic													Yes	--	--						
	Dusky shark	Neonate/YOY	Pelagic													Yes	--	--						
	Haddock	Larvae	Surface													Yes	--	--						
	Monkfish	Eggs	Surface													Yes	--	--						
	Monkfish	Larvae	Pelagic													Yes	--	--						
	Red hake	Eggs	Surface													Yes	--	--						
	Red hake	Larvae	Surface													Yes	--	--						
	Scup	Eggs	Pelagic													Yes	--	--						
	Scup	Larvae	Pelagic													Yes	--	--						
	Shortfin mako shark	Neonate/YOY	Pelagic													Yes	--	--						
	Silver hake	Eggs	Surface													Yes	--	--						
	Silver hake	Larvae	Surface													Yes	--	--						
	Smooth dogfish	Neonate	Pelagic													Yes	--	--						
	Summer flounder	Eggs	Pelagic													Yes	--	--						
	Summer flounder	Larvae	Pelagic													Yes	--	--						
	White hake	Eggs	Surface													Yes	--	--						
	White hake	Larvae	Surface													Yes	--	--						
	White shark	Neonate/YOY	Pelagic													Yes	--	--						
	Windowpane flounder	Eggs	Surface													Yes	--	--						
	Windowpane flounder	Larvae	Pelagic													Yes	--	--						
	Witch Flounder	Eggs	Surface													Yes	--	--						
	Witch Flounder	Larvae	Surface													Yes	--	--						
	Yellowtail flounder	Eggs	Surface													Yes	--	--						
	Yellowtail flounder	Larvae	Surface													Yes	--	--						

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Water column habitats used by pelagic juvenile and adult EFH species	Albacore tuna	Adult	Pelagic													Yes	--	--	**Monopile Foundation Effects** Food web effects from differential attraction to complex vertical surfaces, surface to ~100 feet (30 meters) depth - 26-foot (8-meter) piles: Approx. 129,000 square feet (12,000 square meters) - 36-foot (11-meter) piles: Approx. 172,000 square feet (16,000 square meters)	**No or negligible food web effects**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Albacore tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic bluefin tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic herring	Adult	Pelagic													Yes	--	--						
	Atlantic herring	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Adult	Pelagic													Yes	--	--						
	Atlantic mackerel	Juvenile	Pelagic													Yes	--	--						
	Atlantic mackerel	Spawning	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Adult	Pelagic													Yes	--	--						
	Atlantic skipjack tuna	Juvenile	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Adult	Pelagic													Yes	--	--						
	Atlantic yellowfin tuna	Juvenile	Pelagic													Yes	--	--						
	Basking shark	Adult	Pelagic													Yes	--	--						
	Basking shark	Juvenile	Pelagic													Yes	--	--						
	Blue shark	Adult	Pelagic													Yes	--	--						
	Blue shark	Juvenile	Pelagic													Yes	--	--						
	Bluefish	Adult	Pelagic													Yes	--	--						
	Bluefish	Juvenile	Pelagic													Yes	--	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Dusky shark	Adult	Pelagic													Yes	--	--						
	Dusky shark	Juvenile	Pelagic													Yes	--	--						
	Longfin squid	Adult	Pelagic													Yes	--	--						
	Longfin squid	Juvenile	Pelagic													Yes	--	--						
	Shortfin mako shark	Adult	Pelagic													Yes	--	--						
	Shortfin mako shark	Juvenile	Pelagic													Yes	--	--						
	Smooth dogfish	Adult	Pelagic													Yes	--	--						
	Smooth dogfish	Juvenile	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Adult (m)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub Adult (f)	Pelagic													Yes	--	--						
	Spiny dogfish	Sub Adult (m)	Pelagic													Yes	--	--						
	Tiger shark	Adult	Pelagic													Yes	--	--						
	Tiger shark	Juvenile	Pelagic													Yes	--	--						
	White hake	Juvenile	Pelagic/ benthic non-complex																					
	White shark	Adult	Pelagic																					
	White shark	Juvenile	Pelagic													Yes	--	--						

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Bottom habitats used by eggs, larvae, and benthic-oriented juveniles and adults	Atlantic cod	Adult	Benthic complex													Yes	--	--	**Monopile and Inter-array Cable Protection** Food web effects from differential attraction to new complex habitats created by scour protection: 24.96 acres (10.1 hectares)	**Cable Protection** Food web effects from differential attraction to new complex habitats created by scour protection - Hither Hills Alternative: 4.4 acres (1.8 hectares) - Beach Lane Alternative: 7.9 acres (3.2 hectares)	**Same as above**	**Same as above**	**Cable Protection Effects** - Continuous - Life of project	**Same as above**
	Atlantic cod	Juvenile	Benthic complex													Yes	--	--						
	Atlantic cod	Spawning	Benthic complex/ benthic non-complex													Yes	--	--						
	Atlantic herring	Spawning	Benthic complex													Yes	--	--						
	Barndoor skate	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Barndoor skate	Adult	Benthic non-complex/ complex													Yes	--	--						
	Black sea bass	Adult	Benthic complex													Yes	--	--						
	Black sea bass	Juvenile	Benthic complex													Yes	--	--						
	Butterfish	Adult	Pelagic/ benthic non-complex													Yes	--	--						
	Butterfish	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						
	Haddock	Adult	Benthic complex													Yes	--	--						
	Haddock	Juvenile	Benthic complex													Yes	--	--						
	Haddock	Spawning	Benthic complex													Yes	--	--						
	Little Skate	Adult	Benthic non-complex/ complex													Yes	--	--						
	Little Skate	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Longfin squid	Eggs	Benthic complex													Yes	--	--						
	Monkfish	Adult	Benthic complex													Yes	--	--						
	Monkfish	Juvenile	Benthic complex													Yes	--	--						
	Monkfish	Spawning	Benthic complex													Yes	--	--						
	Ocean pout	Adult	Benthic non-complex													Yes	--	--						
	Ocean pout	Eggs	Benthic complex													Yes	--	--						
	Ocean pout	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean pout	Spawning	Benthic complex													Yes	--	--						
	Pollock	Eggs	Benthic complex/ benthic non-complex													Yes	--	--						

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Bottom habitats used by eggs, larvae, and benthic-oriented juveniles and adults	Pollock	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Pollock	Larvae	Benthic complex/ benthic non-complex													Yes	--	--						
	Red hake	Adult	Benthic non-complex													Yes	--	--						
	Red hake	Juvenile	Benthic non-complex													Yes	--	--						
	Red hake	Spawning	Benthic non-complex													Yes	--	--						
	Sand tiger shark	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--						
	Sand tiger shark	Neonate/YOY	Benthic complex/ benthic non-complex													Yes	--	--						
	Sandbar shark	Adult	Benthic non-complex													Yes	--	--						
	Sandbar shark	Juvenile	Benthic non-complex													Yes	--	--						
	Sandbar shark	Neonate/YOY	Benthic non-complex													Yes	--	--						
	Scup	Adult	Benthic non-complex/ complex													Yes	--	--						
	Scup	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Silver hake	Juvenile	Benthic complex/ benthic non-complex													Yes	--	--						
	Summer flounder	Adult	Benthic non-complex/ complex													Yes	--	--						
	Summer flounder	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	White hake	Juvenile	Pelagic/ benthic non-complex													Yes	--	--						

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Bottom habitats used by eggs, larvae, and benthic-oriented juveniles and adults	Windowpane flounder	Adult	Benthic non-complex													Yes	--	--	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**	**Same as above**
	Windowpane flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Windowpane flounder	Spawning	Benthic non-complex													Yes	--	--						
	Winter flounder	Adult	Benthic non-complex													Yes	--	--						
	Winter flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Winter flounder	Spawning	Benthic non-complex													Yes	--	--						
	Winter skate	Adult	Benthic non-complex/ complex													Yes	--	--						
	Winter skate	Juvenile	Benthic non-complex/ complex													Yes	--	--						
	Witch Flounder	Adult	Benthic non-complex													Yes	--	--						
	Witch Flounder	Spawning	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Adult	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Juvenile	Benthic non-complex													Yes	--	--						
	Yellowtail flounder	Spawning	Benthic non-complex													Yes	--	--						

Habitat Use	EFH Species	Life Stage	Habitat Association*	Timing of Occurrence												Potential Exposure by Project Component			Extent of Food Web Effects by Project Component			Timing and Duration of Food Web Effects by Project Component		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SFWF	SFEC	O&M	SFWF	SFEC	O&M	SFWF	SFEC	O&M
Bottom habitats used by EFH shellfish	Atlantic sea scallop	Eggs	Benthic complex													Yes	--	--	**No or negligible food web effects**	**No or negligible food web effects**	**Same as above**	**Same as above**	**Not applicable**	**Same as above**
	Atlantic sea scallop	Larvae	Pelagic/ benthic non-complex													Yes	--	--						
	Atlantic sea scallop	Juvenile	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Adult	Benthic complex													Yes	--	--						
	Atlantic sea scallop	Spawning	Benthic complex													Yes	--	--						
	Atlantic surfclam	Juvenile	Benthic non-complex													Yes	--	--						
	Atlantic surfclam	Adult	Benthic non-complex													Yes	--	--						
	Ocean quahog	Juvenile	Benthic non-complex													Yes	--	--						
	Ocean quahog	Adult	Benthic non-complex													Yes	--	--						
	Longfin squid	Eggs	Benthic complex																					

Notes

(dark shading) Peak occurrence in the Analysis Area

(light shading) Occurrence in the Analysis Area

* Benthic complex includes both complex and potentially-complex benthic habitat

Appendix B – Project Effects on NOAA Trust Species

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NOAA trust resources are living marine resources that include commercial and recreational fishery resources (marine fish and shellfish and their habitats); anadromous species (fish, such as salmon and striped bass, that spawn in freshwater and then migrate to the sea); endangered and threatened marine species and their habitats; marine mammals, turtles, and their habitats; marshes, mangroves, seagrass beds, coral reefs, and other coastal habitats; and resources associated with National Marine Sanctuaries and National Estuarine Research Reserves.

Sixteen species of NOAA Trust Resources have been identified within the general vicinity of the SFWF, SFEC, and Montauk O&M Facility (Deepwater Wind South Fork 2020). Detailed species descriptions and life history information are provided in fishery management plans[1] and are summarized in Appendix O of the COP (Deepwater Wind South Fork 2020). This information is incorporated by reference and not repeated herein.

The following NOAA Trust Resource species or species groups may utilize habitat within the project area:

- River herring (alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)
- American eel (*Anguilla rostrata*)
- American shad (*Alosa sapidissima*)
- Striped bass (*Morone saxatilis*)
- Blackfish or tautog (*Tautoga onitis*)
- Weakfish or sea trout (*Cynoscion regalis*)
- Forage species (Atlantic menhaden (*Brevoortia tyrannus*), bay anchovy (*Anchoa mitchilli),* and sand eel (*Ammodytes americanus*)
- Blue crab (*Callinectes sapidus*)
- Horseshoe crab (*Limulus polyphemus*)
- Bivalves (Blue mussel *[Mytilus edulis]*, Eastern oyster *[Crassostrea virginica]*, quahog *[Mercenaria mercenaria]*, and soft-shell clams *[Mya Arenaria]*)

Table B-1 describes the effect determination to Trust Resources by species or species-group. Effect determinations include assessment of both direct and indirect impacts.

[1] Sources: ASMFC 2015; MAFMC 1977, 1978a,b,c, 1987, 1989, 2000; MAFMC and NEFMC 1999; NEFMC NDa, NDb, 1982, 1985, 1987, 1999, 2002; NEFMC and MAFMC 1998, NOAA 2019c.

Table B-1 Trust Resources Determinations by Species/Species Group

Species/ Species Group	Life Stages	Impact Determination	Rationale for Determination
River herring (Alewife, Blueback herring)	Juvenile Adult	Negligible temporary and permanent impacts	Short-term disturbance effects would occur over approximately 1,731.2 acres (700.59 hectares) of benthic habitat. Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recovery rapidly, within a few months of the activity. Approximately 306.1 acres (123.9 hectares) of benthic habitat would be displaced or altered over the long-term by placement of the monopile foundations and cable and foundation scour protection (boulders, concrete pillows). The affected area represents a miniscule portion of suitable habitat for these species groups. Once scour protection is colonized it would provide habitat features for species associated with hard substrates. Short-term noise disturbance from monopile installation would reduce habitat suitability for these species within a 16-mile radius of pile driving activity. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish. These species may be present in Lake Montauk Harbor. Seine and trawl sampling by the City of East Hampton between 1998-2008 confirms at least occasional presence of each species in Lake Montauk (Nelson, Pope & Vorhis 2014). Dredging associated with the O&M facility development (0.86 acre [0.35 hectare]) may occur annually, with clamshell or suction dredging occurring for up to 24 hours a day for up to five months. However, this is a conservative window and dredging is not expected to occur throughout this time period. Dredging may result in increased local TSS or temporary displacement, but impacts are expected to be short-term and limited in spatial extent. Collectively, areas affected by short-term construction related impacts would rapidly return to baseline conditions within minutes to months after the project is completed. Long-term habitat alterations and operational effects on habitat would be negligible because: • Impacts are limited in intensity and extent; • Species occurrence is limited; • Long-term impacts may produce new potentially suitable habitats, and/or; • The area affected is insignificant relative to available habitat in the project area.
American eel	Larva Juvenile Adult		
Striped bass	Juvenile Adult		
Blackfish (tautog)	Juvenile Adult		
Weakfish (sea trout)	Juvenile Adult		
Forage Species - Atlantic menhaden, bay anchovy, sand eel	All		
American shad	Juvenile Adult	Negligible temporary and permanent impacts	Short-term noise disturbance from monopile installation would reduce habitat suitability for this species within a 16-mile radius of pile driving activity in the SFWF. Habitat conditions would be unaffected after construction is complete. Operational noise effects are below established behavioral and injury effects thresholds for fish. As an anadromous species, juveniles have the potential to occur within nearshore waters near the SFEC or Montauk O&M facility. Individuals could be displaced for the short-term during construction activities, but long-term impacts are not expected.

Species/ Species Group	Life Stages	Impact Determination	Rationale for Determination
Blue crab	All	Minor temporary and permanent impacts	Both of these species are known to occur within Lake Montauk as adults and may use the habitat for spawning (Nelson, Pope & Vorhis 2014). Dredging associated with the O&M facility would annually impact 0.86 acre (0.35 hectare) of soft-bottom habitat. Dredging impacts could include increased local TSS, loss of larvae due to suction dredging, or temporary displacement of individuals. However, these impacts are either short-term, limited in spatial extent, or insignificant to the success of the species.
Horseshoe crab	All		
Bivalves - Blue mussel, Eastern oyster, ocean quahog, soft-shell clam	All	Minor temporary and permanent impacts	Short-term disturbance effects would occur over approximately 1,731.2 acres (700.6 hectares) of benthic habitat. Only a small area (tens of acres) would be affected at any given time. Benthic community structure would recovery rapidly, within a few months of the activity. Approximately 306.1 acres (123.9 hectares) of benthic habitat would be displaced or altered over the long-term by placement of the monopile foundations and cable and foundation scour protection (boulders, concrete pillows). SFWF and SFEC impacts have been sited to avoid and minimize overlap of long-term effects with known shellfish habitats in designated EFH. Based on the small area affected relative to the extent of designated EFH in the project area and vicinity, the Project would have an insignificant effect on habitat for these species. O&M facility dredging of 0.86 acre (0.35 hectare) of existing regularly-dredged shallow water habitat to depths of -12 feet MLLW represents a short-term habitat disturbance. The benthic community structure would adapt and recover rapidly, within a few months of the activity.