Appendix A: SouthCoast Wind National Pollutant Discharge Elimination System Permit Application

SouthCoast Wind – National Pollutant Discharge Elimination System (NPDES) Permit Application

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Acronyms/Abbreviations

µg/L	micrograms per liter
AIF	actual intake flow
BOEM	Bureau of Ocean Energy Management
BTA	Best Technology Available
°C	degrees Celsius
CFR	Code of Federal Regulations
cm	centimeters
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CORMIX	Cornell mixing zone model
CWIS	cooling water intake structure
DIF	design intake flow
DPS	Distinct Population Segment
EcoMon	Ecosystem Monitoring
EFH	essential fish habitat
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FMP	fishery management plan
ft	feet
ft/s	feet per second
GLOBEC	Global Ocean Ecosystems Dynamics
gpm	gallons per minute
HRG	high-resolution geophysical survey
HVAC	high-voltage alternating-current
HVDC	high-voltage direct-current
HZI	Hydraulic Zone of Influence
in	inches
kg	kilograms
km	kilometers
knots	nautical miles per hour

Lease Area	Lease Area OCS-A0521
m	meters
m^3	cubic meters
MA DMF	Massachusetts Division of Marine Fisheries
MARMAP	Marine Resources Monitoring, Assessment, and Prediction program
MassDEP	Massachusetts Department of Environmental Protection
MBES	multibeam echosounder
mg/L	milligrams per liter
MGD	million gallons per day
mi	miles
MLLW	mean lower low water
mm	millimeters
NAD1983	North American Datum of 1983
NaOCl	Sodium Hypochlorite
NCCA	National Coastal Condition Assessment
NDBC	National Data Buoy Center
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NFR	near-field region
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries unit
NPDES	National Pollutant Discharge Elimination System
OCS	Outer Continental Shelf
Offshore Project Area	Lease Area and offshore export cable corridor
OSP	offshore substation platform
POI	point of interconnection
ppm	parts per million
Project	SouthCoast Wind Project
PV	plan view
RI DEM	Rhode Island Department of Environmental Management
RSDs	rippled scour depressions

SL	standard length
SouthCoast Wind	SouthCoast Wind Energy LLC
SPI	sediment profile imaging
TL	total length
TOC	Total Organic Content
US DOC	United States Department of Commerce
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WEA	Wind Energy Area
WTG	wind turbine generator

1.0 INTRODUCTION

This application provides the required supplemental information in support of the National Pollutant Discharge Elimination System (NPDES) permit application for the discharge of water into United States federal waters during the operation of the SouthCoast Wind (formerly Mayflower Wind)[1] Offshore Wind Project (the Project). This permit application is filed specifically for discharge at the cooling water intake structure (CWIS) at the high voltage direct current (HVDC) converter located at an offshore substation platform (OSP) in the SouthCoast Wind Outer Continental Shelf Lease Area OCS-A 0521 (Lease Area). The information contained herein addresses the NPDES permit application requirements at 40 Code of Federal Regulations (CFR) §122.21(r)(2) through (r)(4), as well as compliance with §125.80 to 125.89. The layout of this document is organized to follow those requirements outlined in the regulations[2] cited herein (as links to the electronic Code of Federal Regulations – eCFR), where applicable.

The Project will comply with §316(a) and §316(b) Phase I Rule requirements for new power generating facilities by meeting the best technology available (BTA) standards to minimize the impacts of impingement and entrainment on the marine environment. Section 2 describes the characteristics of the source water physical data. Section 3 provides a detailed summary of the intakes and discharges. Section 4 provides a biological characterization of the source water. Section 5 provides information relevant to ocean discharge criteria. Section 6 includes the “Track-1” requirements under §125.84. This application also includes three appendices (Appendix A: SouthCoast Wind CORMIX Mixing Zone Results, Appendix B: Construction and Operations Plan References, and Appendix C: NPDES Application Form 1 and form 2E) that are referenced in the applicable sections of the document.

In accordance with §125.84 the owner or operator of a new power generation facility must comply with either “Track I” or “Track 2” requirements. SouthCoast Wind intends to comply with “Track I” requirements defined at §125.84 and inclusive of §316(b) Phase I Rule for new power generating facilities, or implemented as a site-specific Best Professional Judgement for this Facility.

Under the Phase I 316(b) Rule of 2001, later amended in 2003, the §122.21(r) submittals accompany the facility’s NPDES application. The Project is located in federal waters, approximately 26 nautical miles (nm, 48 kilometers[km]) south of Martha’s Vineyard and 20 nm (37 km) south of Nantucket (see **Figure 1**) Massachusetts, which does not have delegated authority under the Clean Water Act, therefore the permit application and associated materials are submitted to U.S. Environmental Protection Agency (EPA) Region 1.

The Phase I Rule establishes categorical requirements under section 316(b) of the Clean Water Act for new power generating facilities that have a design intake flow (DIF) threshold of greater than 2 million gallons per day (MGD) and that withdraw at least 25 percent of the water exclusively for cooling purposes. While the Phase I Rule was intended for power generating facilities, a pre-consultation

[1] SouthCoast Wind Energy LLC

[2] **§122.21** – Permit Application and Special NPDES Program Requirements. Application for a permit; https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-122/subpart-B

§125.84 – As an owner or operator of a new power generating facilities, what must I do to comply with this subpart?; https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-125/subpart-I/section-125.84

§125.86 – As an owner or operator of a new power generating facilities, what must I collect and submit when I apply for my new or reissued NPDES permit?; https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-125/subpart-I/section-125.86

meeting with EPA Region 1 indicated that the type of offshore converter station proposed in this Project will likely be permitted similarly to other offshore energy facilities within EPA Region 1, such as the Northeast Gateway Offshore LNG Project, located approximately 13 miles (21 km) offshore of Massachusetts. However, SouthCoast Wind acknowledges 316(b) requirements may be implemented as a site-specific Best Professional Judgement for this Facility.

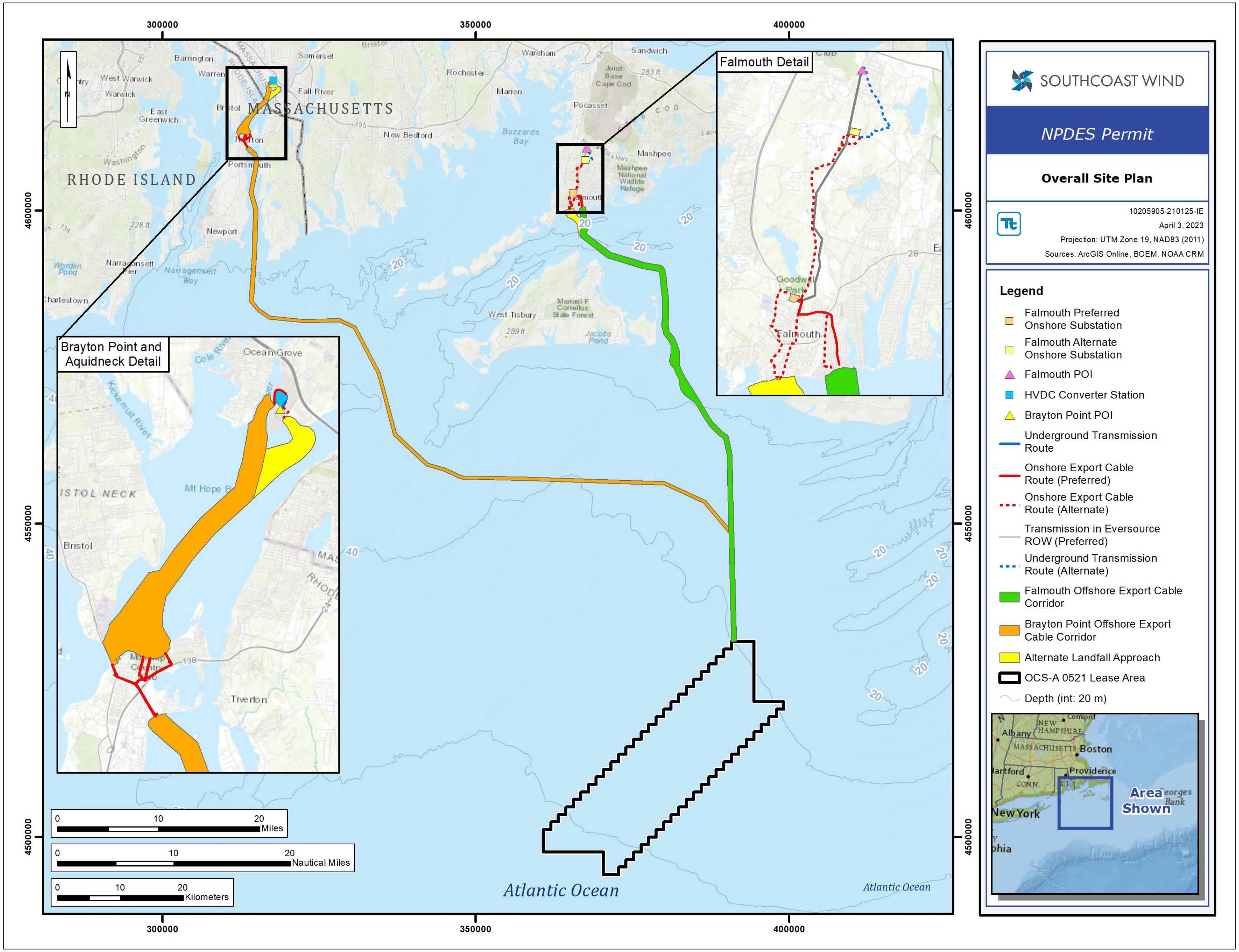

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Figure 1. SouthCoast Wind Project Location

2.0 SOURCE WATER PHYSICAL DATA – SECTION §122.21(r)(2)

2.1 Description – (r)(2)(i)

SouthCoast Wind proposes an offshore wind renewable energy generation project (Project) located in federal waters off the southern coast of Massachusetts in the Outer Continental Shelf (OCS) Lease Area OCS-A 0521 (the Lease Area). There will be up to 149 positions in the Lease Area to be occupied by wind turbine generators (WTGs) and offshore substation platforms (OSPs). The 149 positions will conform to a 1.0 nm x 1.0 nm (1.9 km x 1.9 km) grid layout with an east-west and north-south orientation across the entire Massachusetts Rhode Island Wind Energy Area (MA/RI WEA), as agreed upon by SouthCoast Wind and the other MA/RI WEA leaseholders. WTGs and OSPs will be connected via inter-array cables within the Lease Area. The Project will deliver electricity to the regionally administered transmission system via export cables with landfalls and Points of Interconnection (POIs) in Falmouth, Massachusetts (MA) and at Brayton Point in Somerset, MA.

The proposed HVDC converter Offshore Substation Platform (OSP) will convert electric power from high voltage alternating current (HVAC) to high voltage direct current (HVDC) for transmission to the onshore grid system. The HVDC converter OSP design includes a topside, which will house the electrical equipment, and a jacket foundation substructure (up to nine legs with up to three piles per leg) will support the topside. The HVDC converter OSP will be installed on a piled jacket structure. The HVDC converter OSP will serve as a gathering platform for inter-array cables and then convert power from HVAC to HVDC, as described in COP Sections 3.3.3.1 and 3.3.3.2. This NPDES Permit Application is for the first HVDC converter OSP to be installed within the SouthCoast Wind Lease Area. Additional NPDES Permits that will be required for future HVDC converter OSPs will be permitted under separate cover in the future.

Source water for the Project is the Atlantic Ocean. The Project, for the purposes of this NPDES permit application, is the HVDC Offshore Converter Station located at the Offshore Substation Platform (OSP). **Figure 2** shows the location of the Project in reference to the source water, physiographic features, and general layout of the facility. The Project's Lease Area (OCS-A 0521) is bordered by Lease Area OCS-A 0520 (Beacon Wind) to the northeast and OCS-A 0522 (Copenhagen Infrastructure Partners/Vineyard Wind) to the southeast. This portion of the Atlantic Ocean is part of the Northeast U.S. Continental Shelf Large Marine Ecosystem, located between Nantucket Shoals and the Nantucket to Ambrose Safety Fairway. The water depths, in relation to Mean Lower Low Water (MLLW), within the Lease Area range from 121.7 to 208.3 feet (ft) (37.1 to 63.5 meters [m]), with deeper waters in the southwestern portion. The average depth is 164.0 ft (50.0 m), as depicted in **Figure 2**.

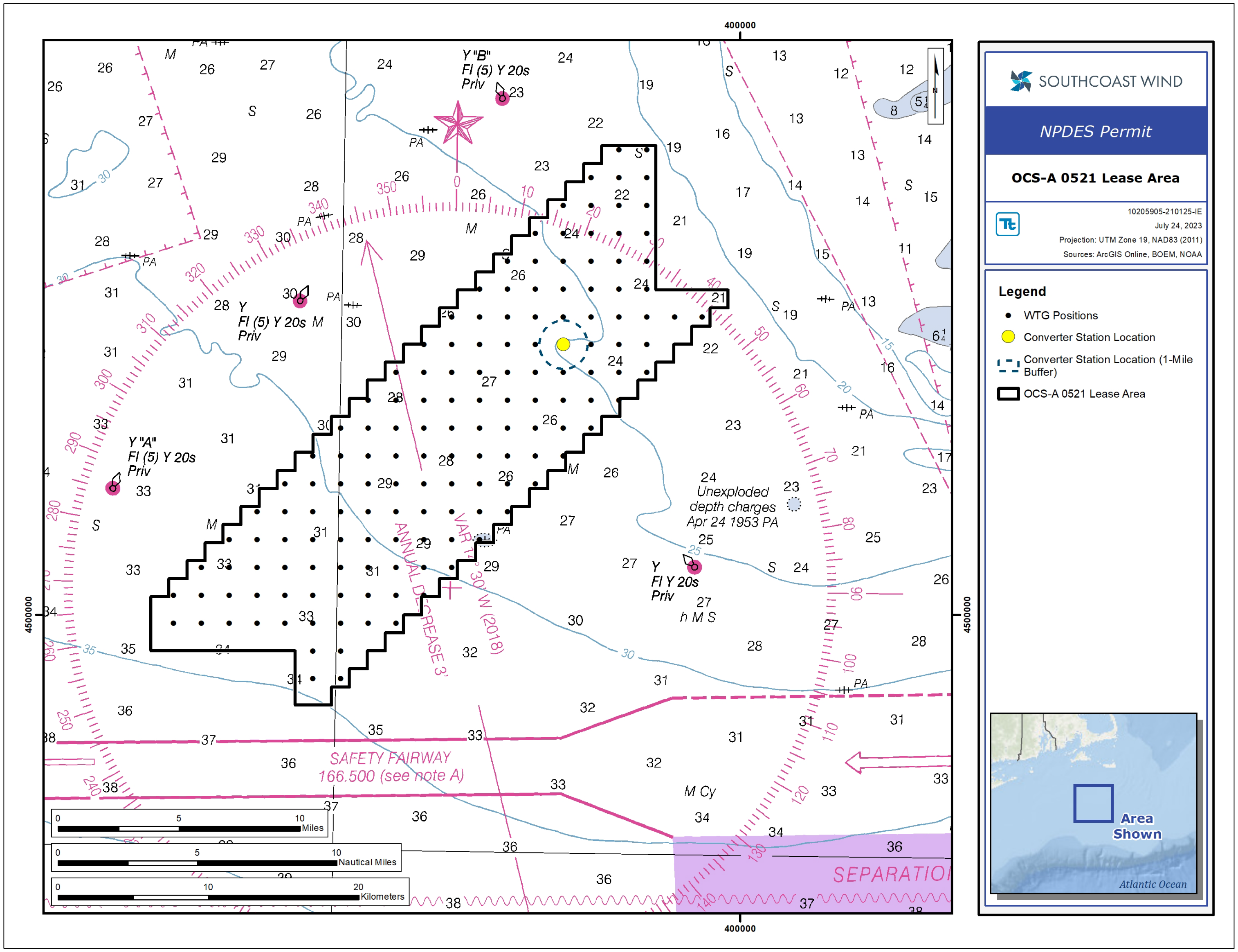


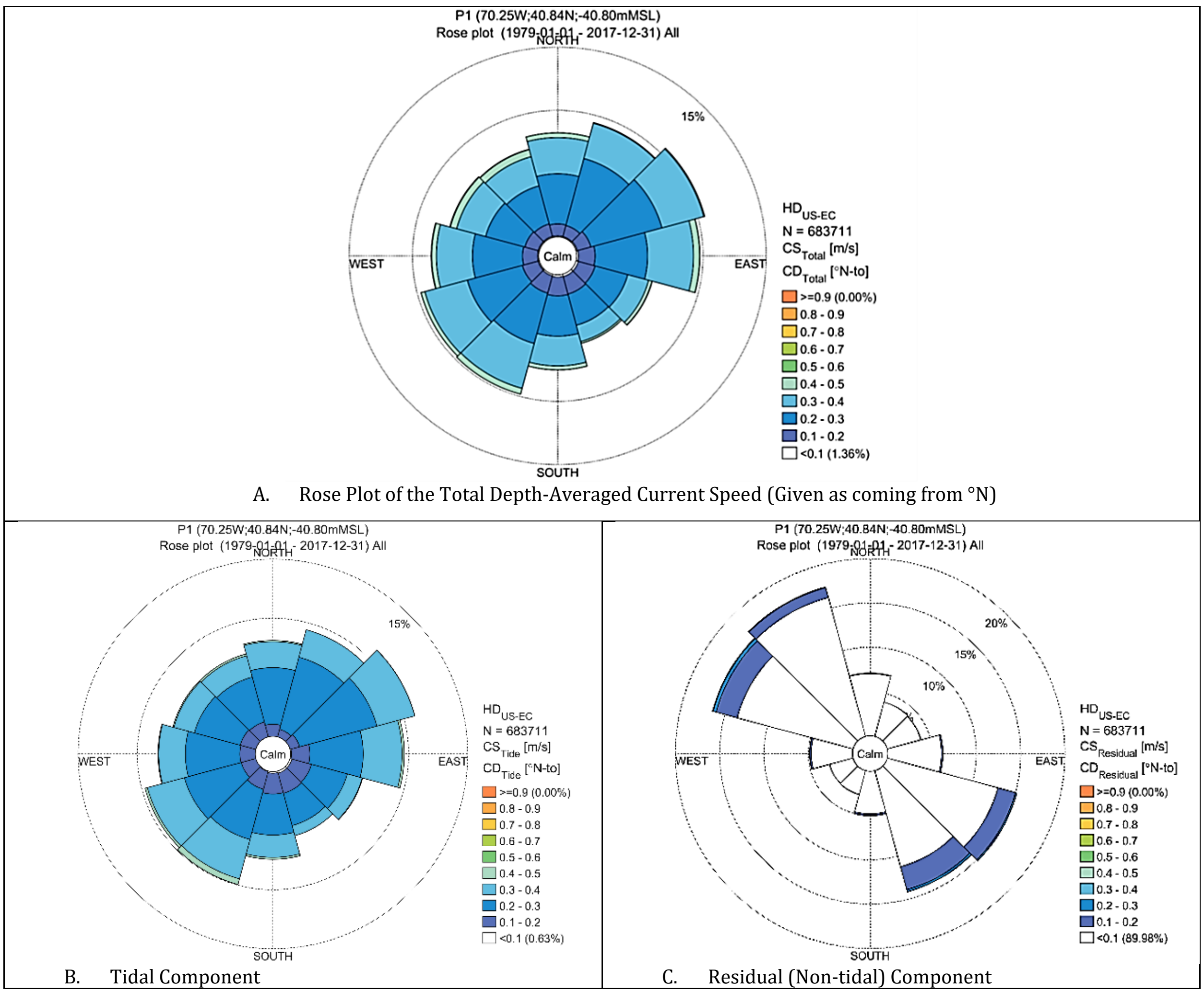
Figure 2. Location of the Offshore Substation Platform with Converter Station, within the Lease Area

2.2 Hydrological and Geomorphological Features – (r)(2)(ii)

2.2.1 Hydrological Features

The tide is semi-diurnal in the Offshore Project Area (includes the Lease Area and offshore export cable corridors), with a tidal range of approximately two to three ft (0.6 to 0.9 m) in Nantucket Sound. Tidal currents are highest in Muskeget Channel as Nantucket Sound flows into the Atlantic Ocean, with speeds exceeding 3.5 nautical miles per hour (knots, 6.5 kilometers per hour; BOEM 2018).

Rose plots showing model-estimated depth-averaged current direction and speeds in the Lease Area are depicted in **Figure 3**. The direction is indicated by the position of the shaded "spokes" on the compass rose. The percentage of time flow is from the spoke direction and is indicated by the concentric circles. The magnitude is indicated by colors. Depth-averaged currents are tidally dominated with residual components mainly aligned in the north-western and south-easterly directions.



A. Rose Plot of the Total Depth-Averaged Current Speed (Given as coming from °N)

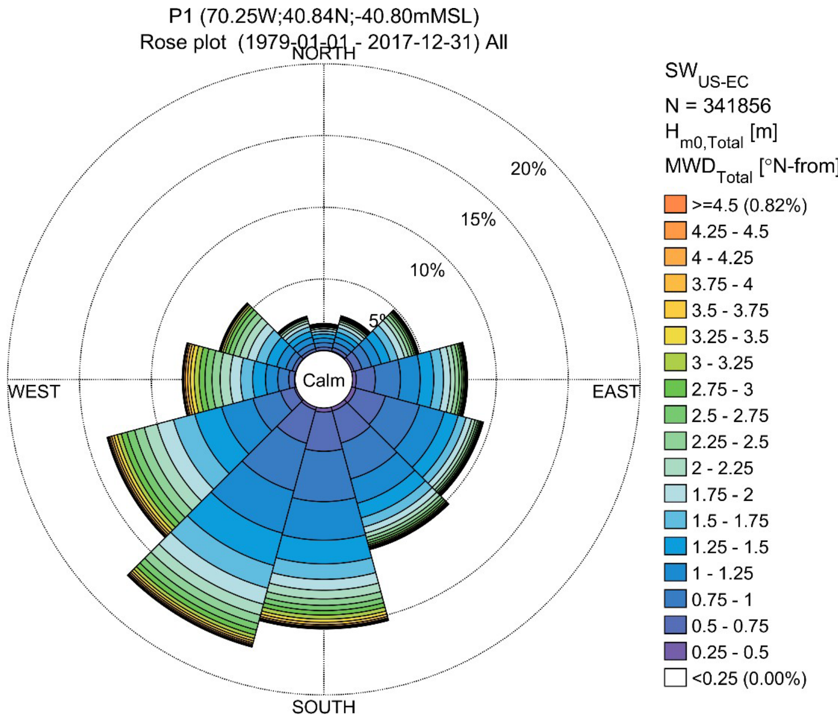
B. Tidal Component

C. Residual (Non-tidal) Component

Source: DHI 2020

Figure 3. Rose Plots Depicting Model-Estimated Depth-Averaged Currents—Tidal and Non-Tidal Components

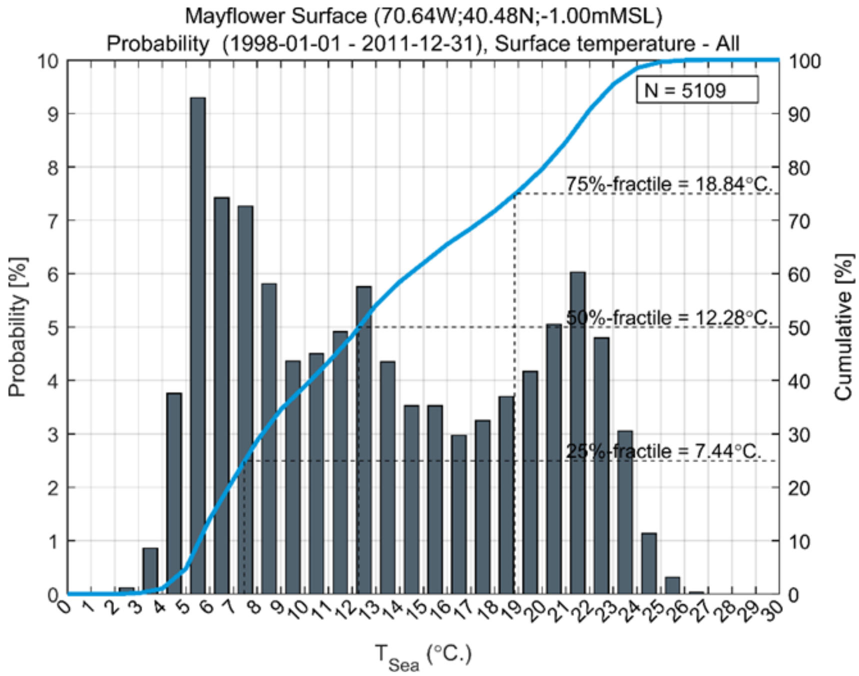
Swells are typically generated from hurricanes or tropical storm low-pressure systems occurring in the southern part of the Atlantic Ocean (Gleen 1992). Swells in the Lease Area occur mainly from the south and southwesterly directions. In **Figure 4** the total estimated sea swell in the Lease Area was visualized on a rose-plot using data spanning 1979 to 2017.



Source: DHI 2020

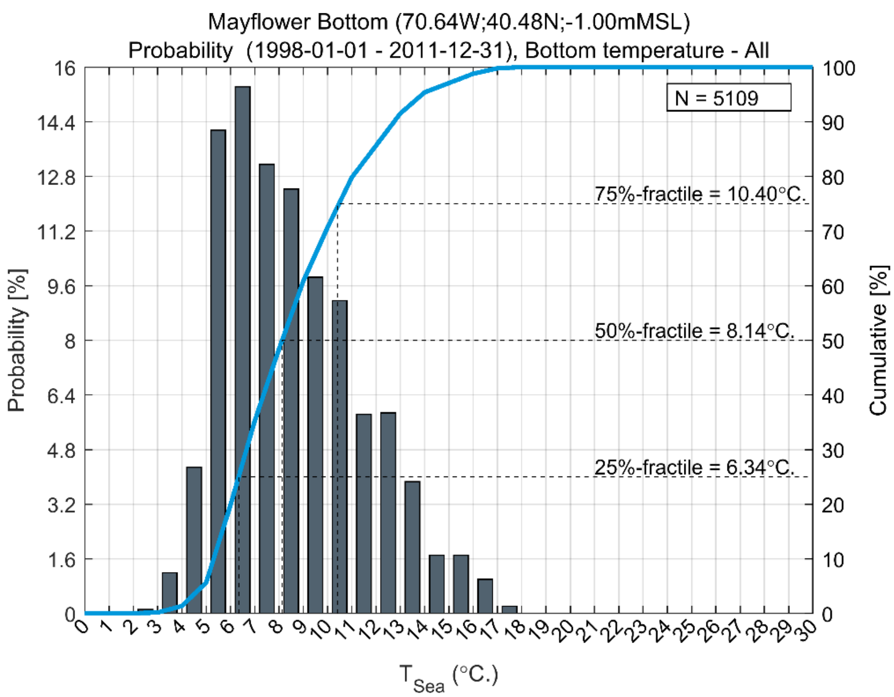
Figure 4. Rose-plot of swell height according to mean wave direction

Water temperatures across the Lease Area display large variations near the surface from 35.6° to 80.6° Fahrenheit (F) (2° to 27° Celsius [C]) with a 50 percentile of 54.1°F (12.3°C). Closer to the seafloor at water depths of up to 196.9 ft (60 m), water temperatures range from 35.6°F to 64.4°F (2°C to 18°C) with a 50th percentile of 46.4°F (8°C). **Figure 5** shows the distribution of water temperature on the sea surface, and **Figure 6** shows the distribution of water temperature near the seafloor for the Lease Area.



Source: DHI 2020

Figure 5. Sea surface water temperature in the Lease Area



Source: DHI 2020

Figure 6. Seafloor water temperature in the Lease Area

The predominant wind direction in the Offshore Project Area is from the west-southwest, as depicted in the wind rose chart in **Figure 7**. Wind direction and speeds can change dramatically during "Nor'easter" storms, when the wind direction is from the north-northeast.

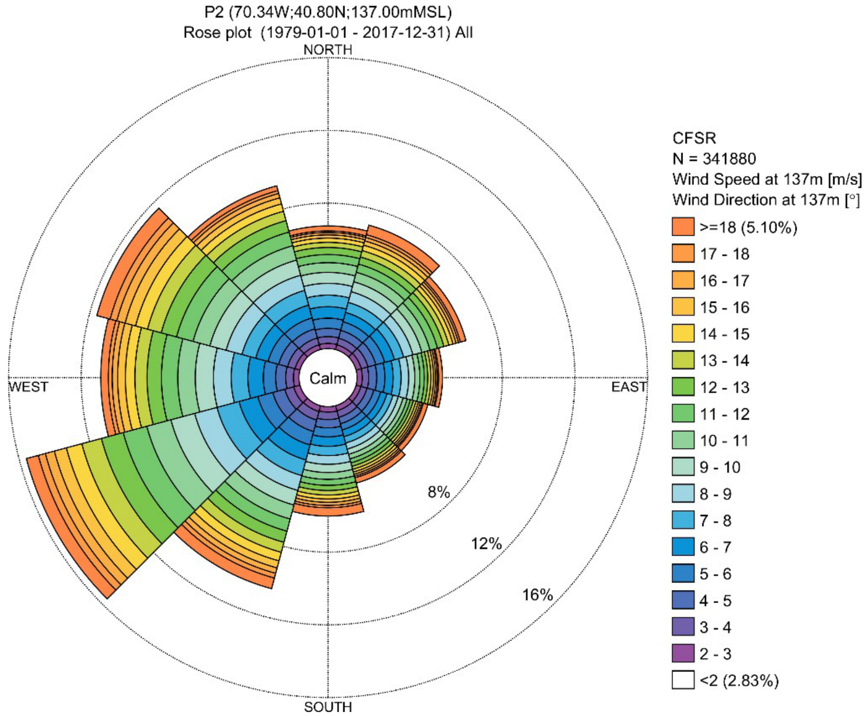


Figure 7. Lease Area Wind rose based on 39 years of data from 1979 to 2017 (DHI 2020)

2.2.2 Water Quality

This section summarizes available water quality data from within coastal and offshore marine waters in the vicinity of the proposed Project that have been collected by government and private entities, including the Northeast Fisheries Science Center (NEFSC), National Oceanic and Atmospheric Administration (NOAA) and EPA. Additional water quality data is available from the U.S. Geological Survey (USGS), and Massachusetts Department of Environmental Protection (MassDEP); however, those data are inshore and not applicable to this facility.

2.2.2.1 Northeast Fisheries Science Center

The NEFSC data, collected between 1963 and 2019 (NEFSC 2020a), includes salinity and temperature measurements from the bottom and surface of the water column. These data were collected during seasonal multispecies bottom trawl surveys occurring in the spring, fall, and winter. Sampling locations are displayed in **Figure 8** and the measurements are detailed in **Table 1**.

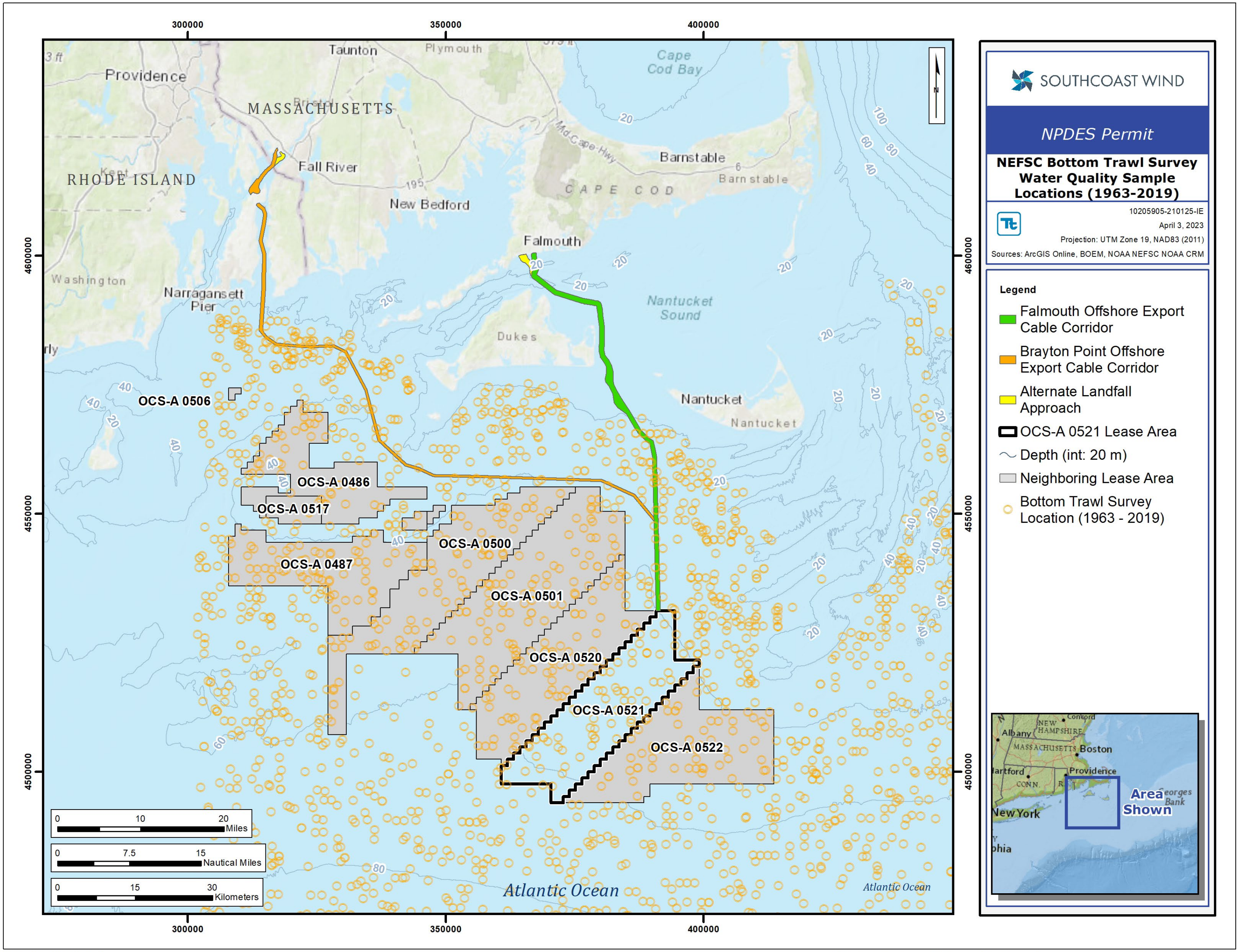


Figure 8. Bottom Trawl Survey – Water Quality Sample Locations (1963-2019)

Table 1. Mean and Standard Deviation for Seasonal Water Temperature and Salinity Data from the NEFSC Multispecies Bottom Trawl Surveys (1963-2019)

Season a/	Average Water Depth (ft [m])	Layer	Water Temperature (°C) b/	Salinity (psu) b/
Winter (n=355) c/	292.7 (89.2)	Bottom	6.9 ±3.5	33.5 ±1.2
		Surface	5.2 ±1.7	32.7 ±0.5
Spring (n=1621) c/	278.2 (84.8)	Bottom	6.7 ±3.2	33.3 ±1.2
		Surface	5.7 ±1.8	32.7 ±0.6
Fall (n=1704) c/	285.1 (86.9)	Bottom	12.7 ±2.4	33.4 ±1.4
		Surface	16.5 ±3.6	32.9 ±1.3

Notes:
a/ Summer data not collected in this survey.
b/ Results show mean ± 1 standard deviation.
c/ n= number of samples (not all samples were analyzed for all parameters).
psu = practical salinity units

Source: NEFSC 2020a

2.2.2.2 National Oceanic and Atmospheric Administration National Data Buoy Center

Long-term water temperature data are available via the NOAA National Data Buoy Center (NDBC) for two buoys located in the vicinity of the Offshore Project Area. Station 44020 is in Nantucket Sound at a water depth of 46.9 feet (14.3 m) and Station 44097 is located near Block Island at a water depth of 158 feet (48.16 m). Water temperature data were downloaded from the NDBC website (NOAA NDBC 2020) for the period from 2009 through 2019 with seasonal values summarized in **Table 2** for Station 44020 and **Table 3** for Station 44097, with locations shown in **Figure 9**.

Table 2. Mean and Standard Deviation for Seasonal Water Temperature Data from NOAA NDBC Station 44020 (2009-2019)

Season	Number of Samples	Water Temperature (°C) a/
Spring	35,207	7.9 ± 3.9
Summer	45,520	20.9 ± 3.2
Fall	45,395	15.7 ± 4.8
Winter	33,529	3.9 ± 2.3

Note:
a/ Results show mean ± 1 standard deviation

Table 3. Mean and Standard Deviation for Seasonal Water Temperature Data from NOAA NDBC Station 44097 (2009-2019)

Season	Number of Samples	Water Temperature (°C) a/
Spring	39,154	7.6 ± 3.3
Summer	39,122	19.6 ± 3.3
Fall	32,521	17.0 ± 2.9
Winter	34,735	8.2 ± 2.8

Note:
a/ Results show mean ± 1 standard deviation.

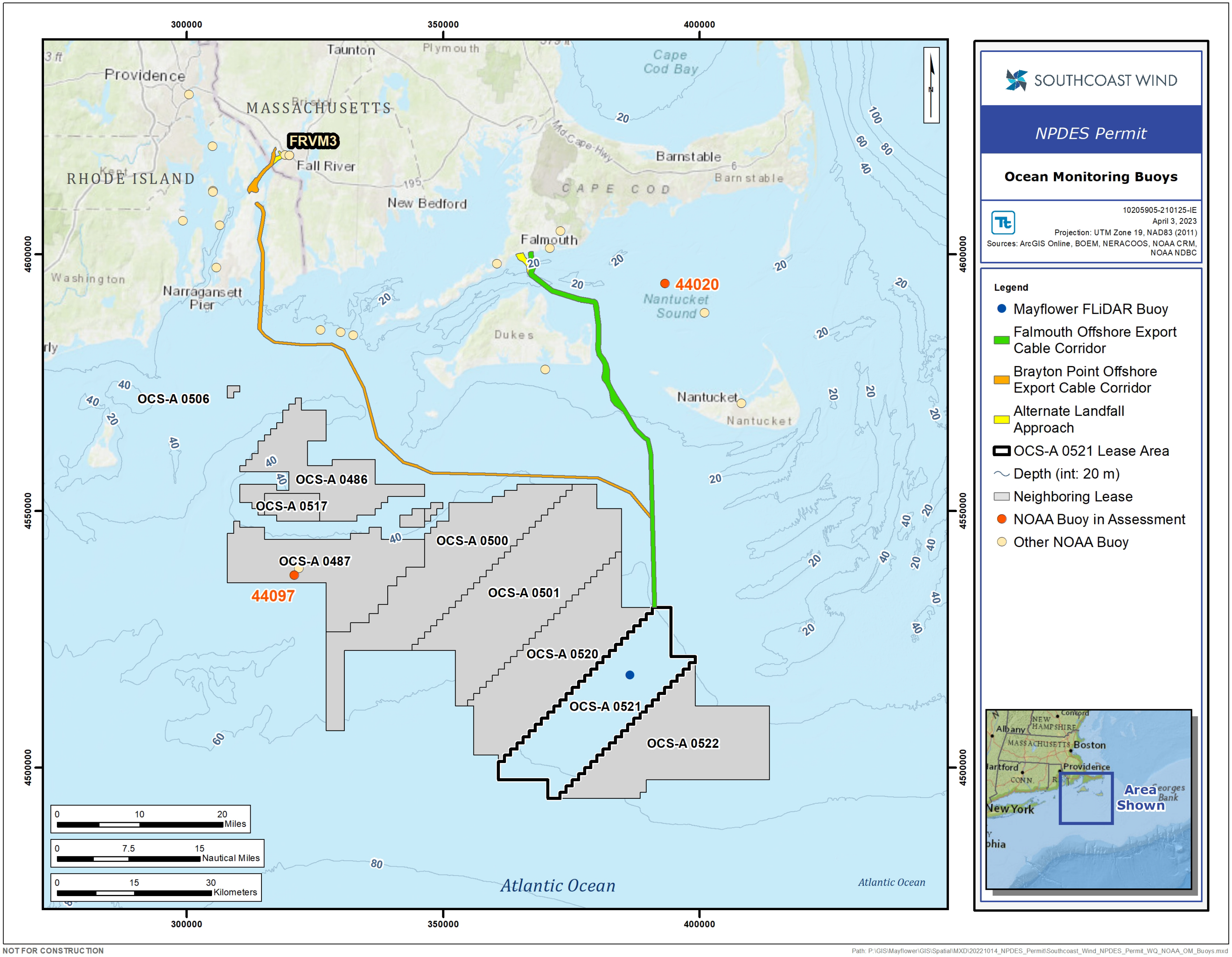


Figure 9. Location of Ocean Monitoring Buoys 44020, 44097, and FRVM3

2.2.2.3 Environmental Protection Agency

The condition of coastal water was assessed by the EPA in the 2010 National Coastal Condition Assessment (NCCA; EPA 2015). Water quality data from the 2010 NCCA are available for eight stations within Nantucket Sound. This assessment included chlorophyll *a*, dissolved inorganic nitrogen, dissolved inorganic phosphorus, dissolved oxygen at the bottom of the water column, and light transmissivity measurements. Water quality results for the Nantucket Sound data set are provided in **Table 4**. Four NCCA water quality sample locations were identified along the Brayton Point export cable corridor.

Table 4. Mean and Standard Deviation for Water Quality Parameters Measured in the 2010 NCCA

Area	Chlorophyll *a* (ug/L) a/	Dissolved Inorganic Nitrogen (mg/L) a/	Dissolved Inorganic Phosphorus (mg/L) a/	Dissolved Oxygen (mg/L) a/	Light Transmissivity (% at 1 m depth) a/
Nantucket Sound (n=8) b/	3.9 ± 1.1	0.019 ± 0.002	0.017 ± 0.003	6.5 ± 1.3	63.1 ± 5.1

Notes:
a/ Results show mean ± 1 standard deviation. mg/L = milligrams per liter; µg/L = micrograms per liter
b/ n= number of samples (not all samples were analyzed for all parameters)

2.2.3 Thermal Plume Modeling

The thermal plume associated with the discharge of cooling water from the OSP was modeled for this Project, summarized in this section and with additional detail included in Appendix A (SouthCoast Wind CORMIX Mixing Zone Results), including rationale for selection of modeled scenarios and input parameters. The four modeled scenarios based on maximum temperature delta are consistent with the approach used in recent CORMIX modeling for another offshore wind project in the RI-MA Wind Energy Areas (Woods Hole Group 2022), for which a Draft NPDES Permit has been issued. In this revision, the four (4) scenarios include the maximum seasonal temperature delta between ambient and the thermal effluent during the four seasons (fall, winter, spring, and summer) at the outfall location, as described in Appendix A (SouthCoast Wind CORMIX Mixing Zone Results).

A thermal mixing zone analysis was performed using CORMIX v12.0GTD Advanced Tools, to predict and analyze the temperature changes in the Atlantic Ocean during the highest temperature differences between ambient (intake) and effluent (discharge) conditions in fall, winter, spring, and summer months. The Metocean data were provided by SouthCoast Wind to identify and calculate the velocity, temperature, and salinity model input parameters for the CORMIX mixing zone model. Data outputs from the data-assimilative hybrid isopycnal-sigma-pressure (generalized) coordinate ocean model (called Hybrid Coordinate Ocean Model or HYCOM) were also used to help support defining the ambient condition and hydrodynamic characteristics for each season and tidal condition (HYCOM 2002). A mixing zone analysis was performed at the discharge location of the OSP into the Atlantic Ocean under a variety of conditions to evaluate the spatial extent of the rise in temperatures of the receiving water in the vicinity of the discharge. For modeling purposes (CORMIX thermal modeling and hydraulic zone of influence calculations), the following parameters are used to define the typical operating conditions utilizing two-pumps, based on the DIF of 9.9 MGD:

- *DIF* = 1,560 m^3/h (9.9 MGD) during two-pump operations.
- *Depth of discharge* = 42.7 ft (13 m) below the surface, 108.9 ft (33.2 m) above the seafloor
- *Maximum discharge temperature* = 86°F (30°C).

All specifications and parameters associated with the cooling water intake structure and discharge are included in Section 3 (Cooling Water Intake Structure Data).

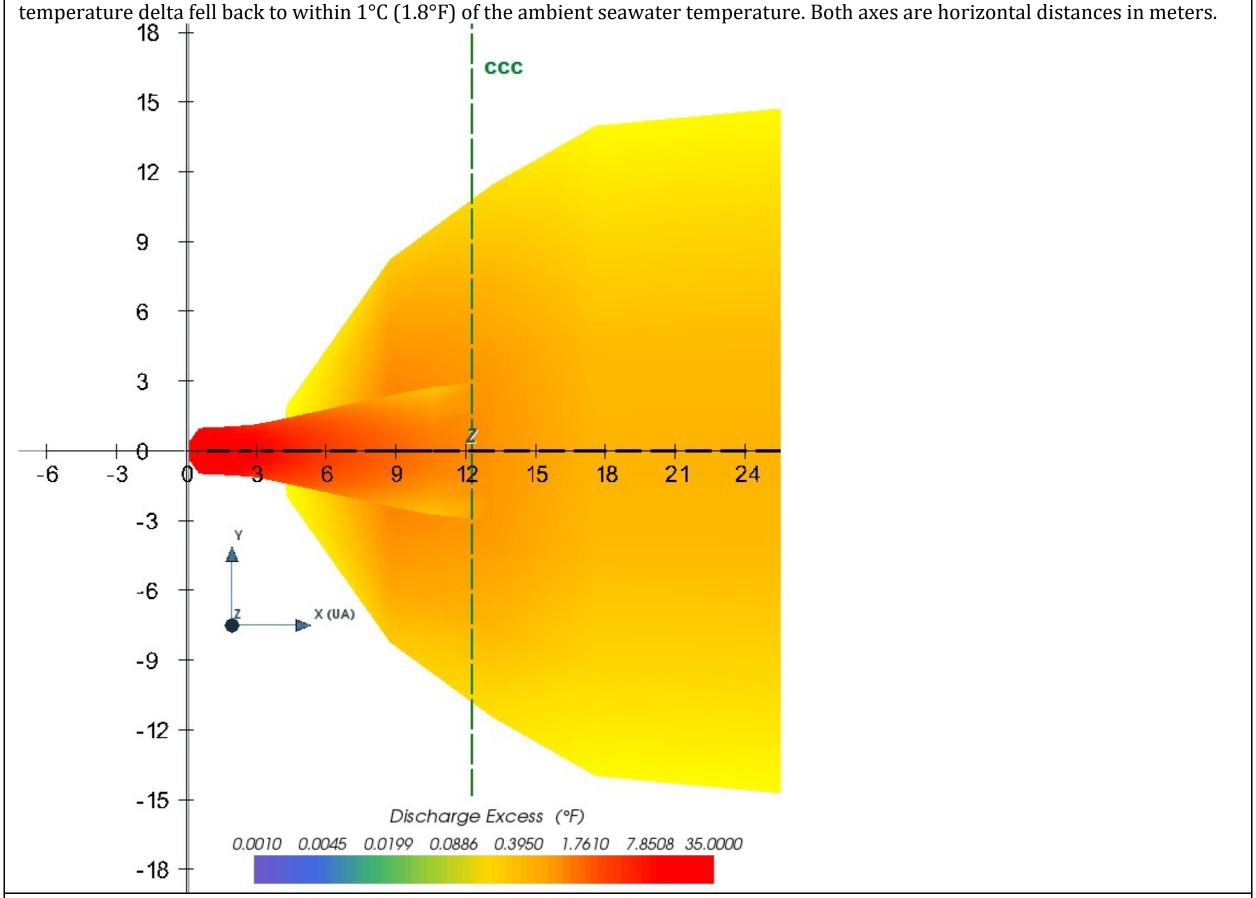
CORMIX serves as a recommended analysis tool in the permitting of industrial, municipal, thermal, and other point source discharges to receiving waters (Doneker and Jirka 2021), including the analysis of mixing zones. The EPA's current national recommendations for temperature-based water quality criteria indicates that the maximum acceptable increase in the weekly average temperature resulting from artificial sources is 1°C (1.8°F) during all seasons of the year (EPA 1986). This is also known as the Criterion Continuous Concentration (CCC). The CORMIX results were interpreted to identify the thermal and spatial extent of the mixing zone – with results of the predicted zone of initial dilution consistent with the < 100 m (330 ft) radius requirement for this 1°C (1.8°F) temperature increase, as described in the Ocean Discharge Criteria at §125.121(c). **Table 5** summarizes the key numerical results of each CORMIX scenario, including the Atlantic Ocean temperature and the location and dimensions of the plume when the temperature delta is 1°C (1.8°F). The maximum length of the edge of the plume when the temperature delta reached 1°C (1.8°F) ranged between 41.9 ft (12.8 m) and 84.9 ft (25.9 m) for the maximum temperature delta scenarios, based on maximum DIF of 9.9 MGD during all four seasons. These results indicate that impacts to the ocean temperature are minimal when the maximum temperature increases occur and that the water quality standard is expected to be met well within the 100 m (330 ft) radius mixing zone for initial dilution of discharges which is allowed for by the Ocean Discharge Criteria. The plan and profile views of the excess temperature from Scenarios 1 through 4 can be found in **Figure 10** through **Figure 13**, shown at scales appropriate for each scenario.

Table 5. CORMIX Results for SouthCoast Wind, based on maximum temperature delta scenarios.

Parameter	Scenario 1: Fall	Scenario 2: Winter	Scenario 3: Spring	Scenario 4: Summer
Maximum Discharge Temperature, °F (°C)	86 (30)			
Minimum Ambient Atlantic Ocean temperature, lowest seasonal observed, °F (°C)	54.1 (12.3)	39.6 (4.2)	38.6 (3.7)	51.3 (10.7)
Maximum Temperature Delta, °F (°C)	31.9 (17.7)	46.4 (25.8)	47.4 (26.3)	34.7 (19.3)
Thermal Plume Length[a/], ft (m)	41.9 (12.8)	84.9 (25.9)	67.5 (20.6)	46.6 (14.2)
Thermal Plume Width, ft (m)	11.8 (3.6)	11.1 (3.4)	12.8 (3.9)	28.7 (8.7)
Plume Area, ft^2 (m^2)	407.0 (37.8)	792.1 (73.6)	721.2 (67.0)	657.1 (61.0)
Resulting Atlantic Ocean temperature at the edge of the plume, °F (°C)	55.9 (13.3)	41.4 (5.2)	40.4 (4.7)	53.1 (11.7)

Notes:
a/ Distance from the outfall, where the temperature delta reaches 1°C (1.8°F)

Scenario 1, Fall: Plan View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Both axes are horizontal distances in meters.



Scenario 1, Fall: Profile View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Vertical axis is height above seafloor.

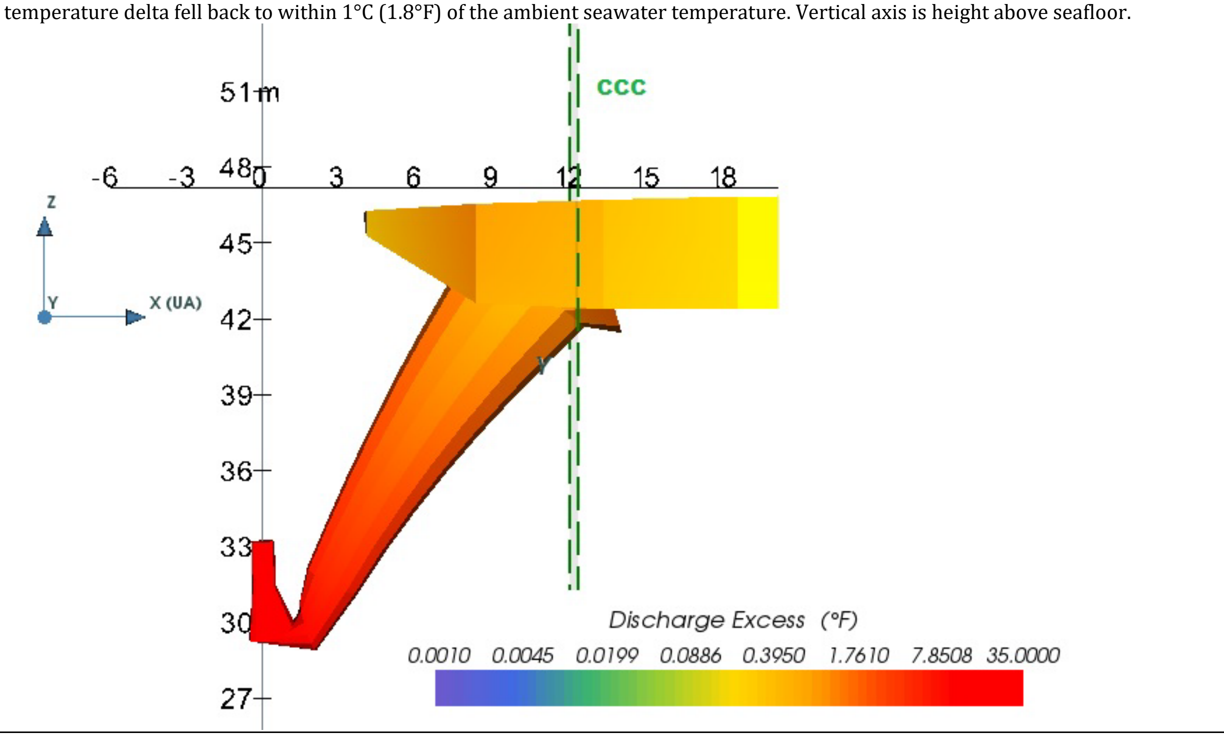
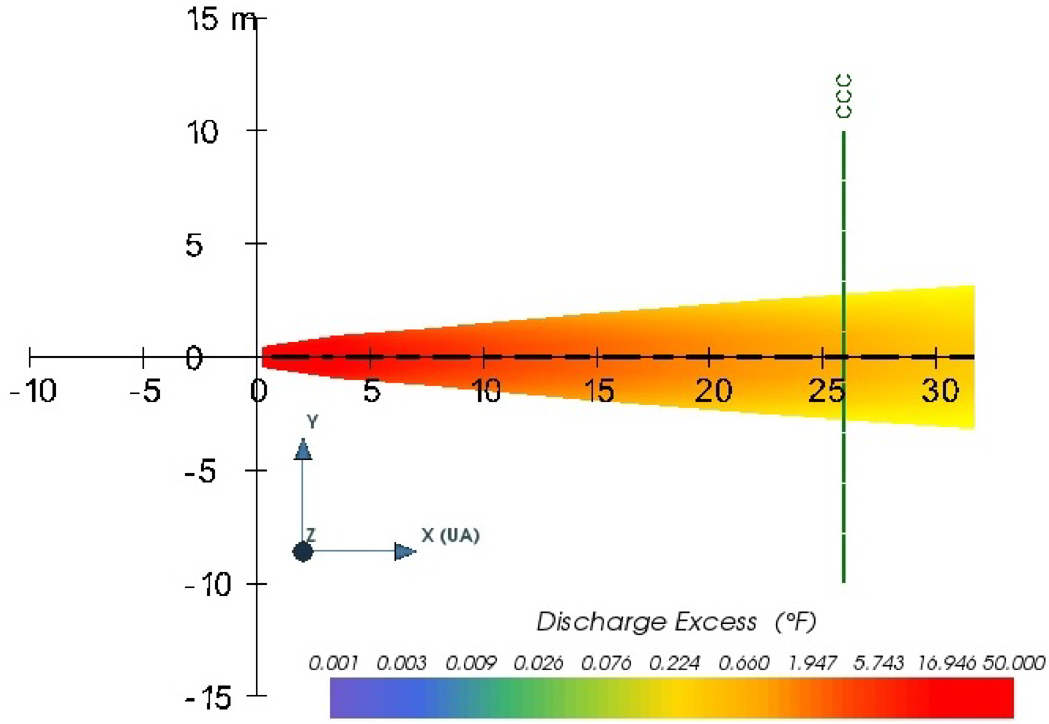


Figure 10. Thermal plume dimensions: Fall

Scenario 2, Winter: Plan View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Both axes are horizontal distances in meters.



Scenario 2, Winter: Profile View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Vertical axis is height above seafloor.

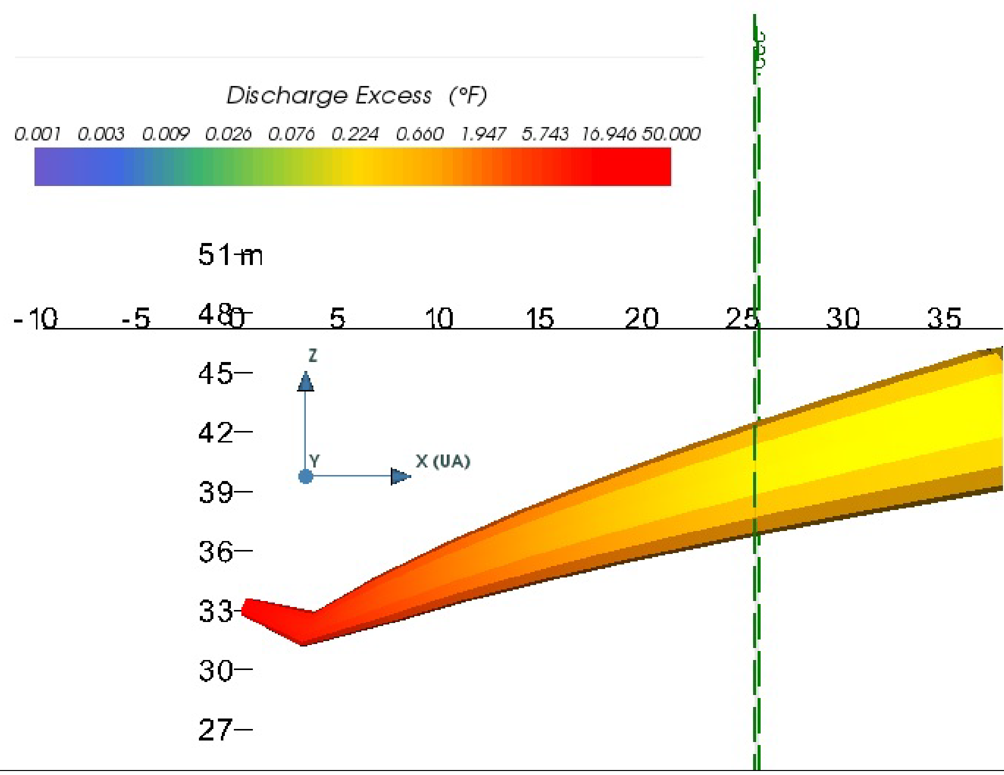
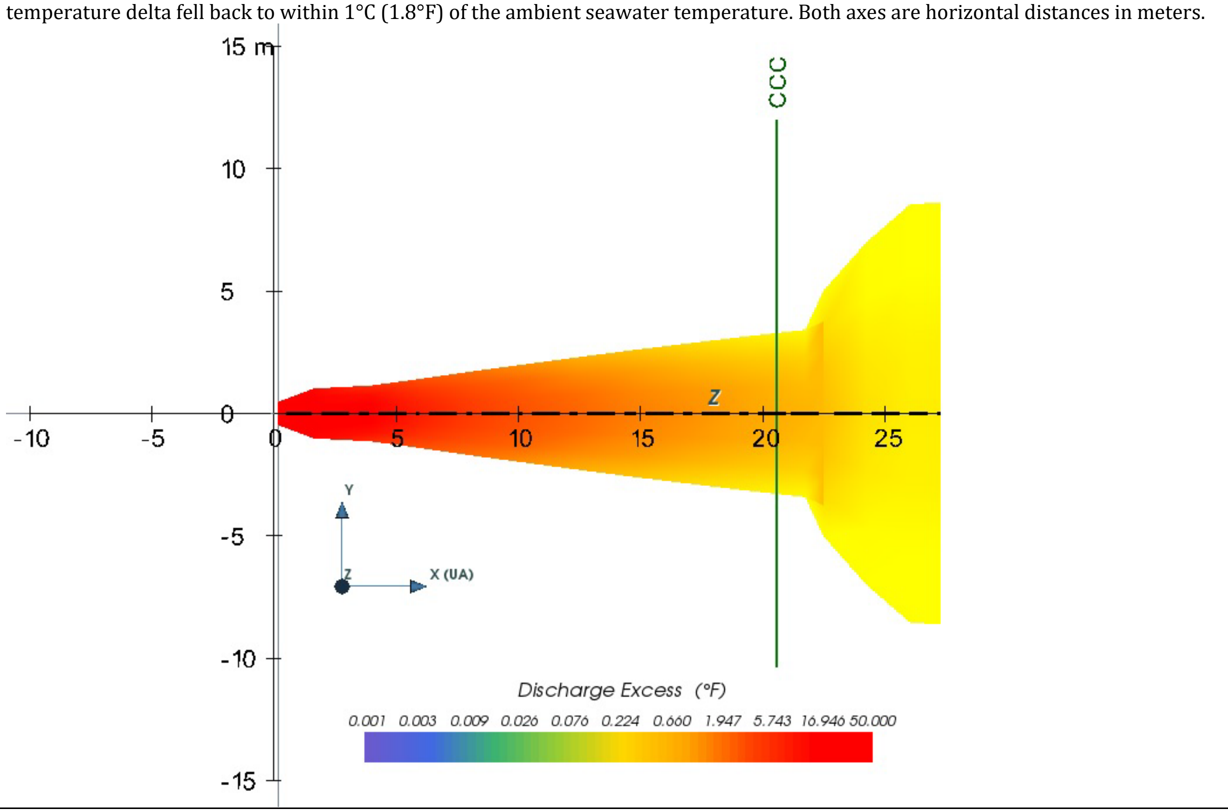


Figure 11. Thermal plume dimensions: Winter (note scale differences)

Scenario 3, Spring: Plan View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Both axes are horizontal distances in meters.



Scenario 3, Spring: Profile View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Vertical axis is height above seafloor.

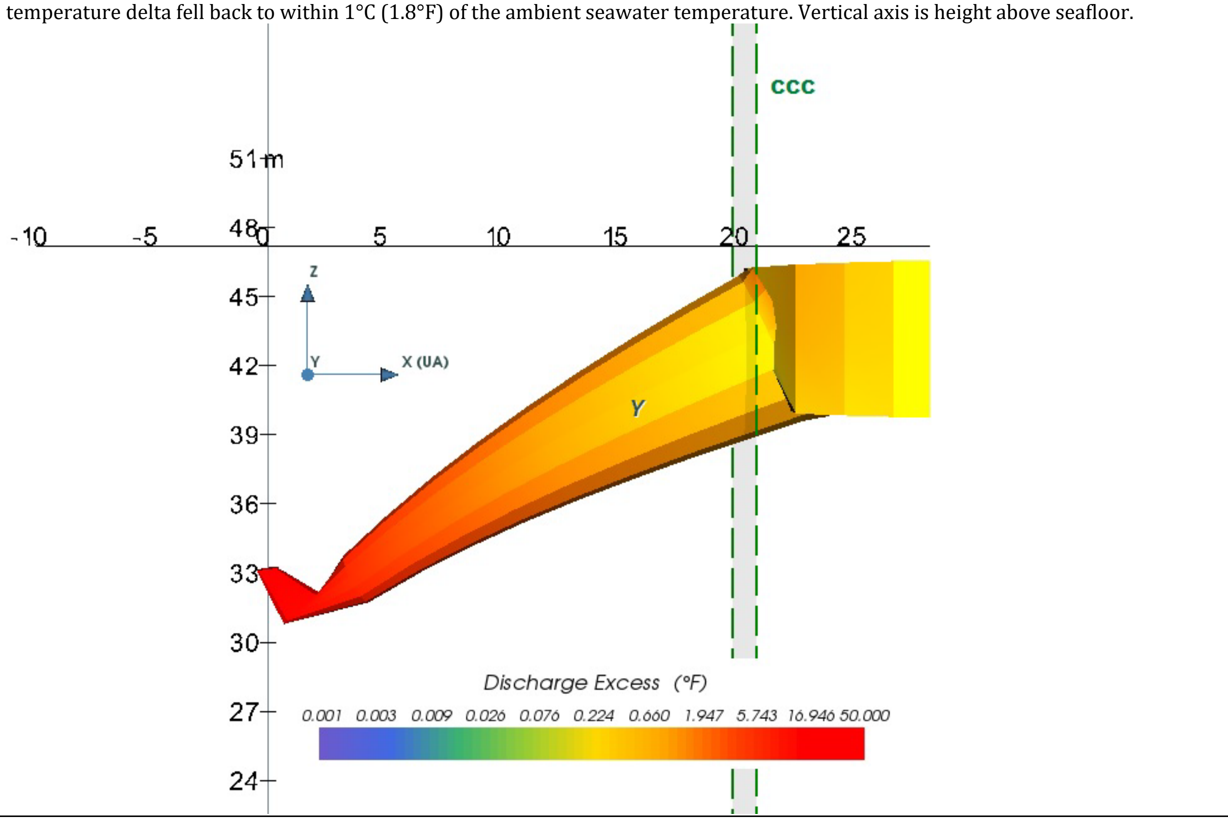
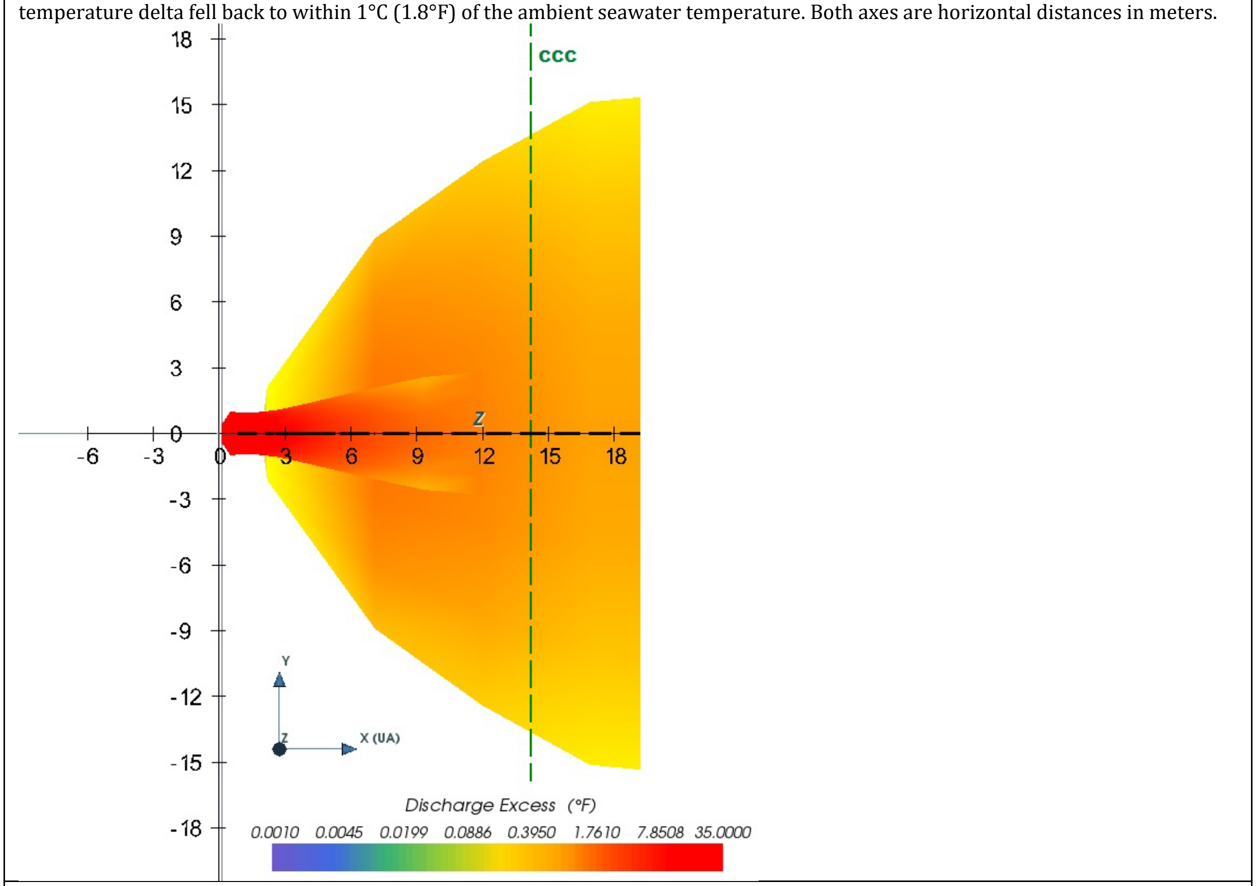


Figure 12. Thermal plume dimensions: Spring (note scale differences)

Scenario 4, Summer: Plan View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Both axes are horizontal distances in meters.



Scenario 4, Summer: Profile View. Criterion Continuous Concentration (CCC) represents the distance from the discharge where the temperature delta fell back to within 1°C (1.8°F) of the ambient seawater temperature. Vertical axis is height above seafloor.

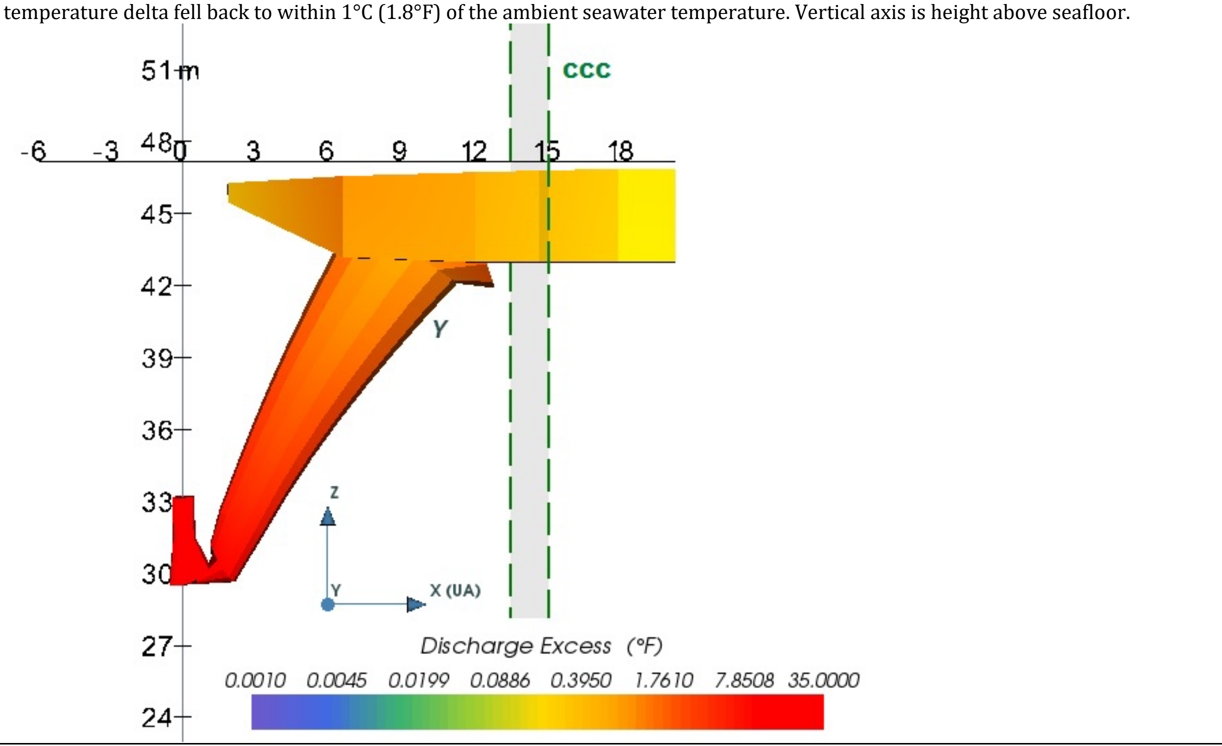


Figure 13. Thermal plume dimensions: Summer (note scale differences)

The area of influence (hydraulic zone of influence [HZI]) of the cooling water intake structure (CWIS) is described in Section 6.4.4.

Additional detail on the methods and results associated with the CORMIX modeling are included in Appendix A (SouthCoast Wind CORMIX Mixing Zone Results).

2.2.4 Geomorphological Features

The seafloor within the Lease Area is generally flat with slopes ranging from very gentle (less than 1°) to gentle (1° to 4.9°) (as described in the SouthCoast Wind COP Section 4). Lease Area water depths range from 121.7 ft (37.1 m) below MLLW at the north to 208.3 ft (63.5 m) below MLLW at the southernmost end. The central portion of the Lease Area has ridges with moderate slopes (5.0° to 9.9°) associated with shallow channels. No large-scale seabed topographic features or bedforms larger than ripples are present within the Lease Area. Multibeam echosounder (MBES) bathymetry data collected during the 2019 and 2020 High Resolution Geophysical (HRG) survey campaigns within the Lease Area are depicted in the SouthCoast Wind COP Section 4.1 (Site Geology). Sediment profile imaging and plan view (SPI/PV) data collected as part of the benthic surveys indicates varying levels of surficial sediment mobility throughout the Lease Area, evidenced by the ubiquitous presence of bedforms (ripples) both large and small. The deeper shelf waters of the Lease Area and export cable corridors are characterized by predominantly rippled sand and soft bottoms.

Sediments were characterized using the NOAA Coastal and Marine Ecological Classification Standard (CMECS). Within the Lease Area, sediments were characterized as CMECS Subclass Fine Unconsolidated (i.e., less than 5 percent gravel), as described in the SouthCoast Wind COP Appendix M (Benthic Characterization Report) during the Spring survey. Two samples collected (113 and 115) during the Summer survey were classified Coarse Unconsolidated – Gravelly – Gravelly Muddy Sand, as shown in **Figure 14**. The remaining Group classifications were mostly Mud, Sandy Mud, and Muddy Sand. A few stations (Spring [061] and Summer [062, 068, 078, 121, and 122]) were Sand with Subgroup Fine/Very Fine Sand (**Figure 14)**. The Lease Area is mostly homogenous soft bottom with little relief and no complex habitat features. Total Organic Content (TOC) was generally less than 1 percent.

The SouthCoast Wind COP Section 4.1 (Site Geology) describe the distribution of seafloor morphological types within the Lease Area and at the Project, as a mix of irregular small-scale pitting and mobile bedforms/ripples (wave-generated). Small-scale pitting describes a subtle texture comprising smooth seafloor with a relatively high density of small pits, probably of biotic origin, and typically 6.6 ft (2 m) in diameter and 0.3 ft (0.1 m) to 0.7 ft (0.2 m) deep. The texture is unlikely to indicate the presence of any sort of constraint on the proposed Project. Negative relief “rippled scour depressions” (RSDs) are a common and distinctive feature of shallow continental shelves with a low sediment supply, low tidal currents, and high wave energy. The generally random directionality of the RSDs and lack of consistent asymmetry supports an origin related to oscillatory bottom currents rather than any aggregate or net current flow or sediment transport. The wave-generated origin of the ripples within RSDs is also evidenced by their symmetrical profile and time-variable strike in response to passing storms. Wave generated ripples have a typical wavelength of 2.3 ft (0.7 m) to 4.9 ft (1.5 m) and trough-to-peak height of 0.07 ft (0.02 m) to 0.3 ft (0.10 m). Their morphology can be described as two-and-a-half dimensional or 2.5 D (i.e., generally straight crestlines but also slightly curvilinear and discontinuous).

Unconsolidated sediments make up the top-most layer of the seabed, which has been further characterized and quantified by geophysical data and ground-truthed by grab samples taken of the uppermost 0.16 to 0.33 ft (0.05 to 0.10 m) of the seabed. Sediment from grab samples were analyzed using the Simplified Folk scheme (Long 2006). Under this scheme, surficial sediments within the Lease Area fall into either sand and muddy sand or coarse sediment classifications. The surficial seabed sediment comprises sand and muddy sand, except for a few distinct areas of more coarse sediment found in well-defined rippled scoured depressions. No boulder fields nor individual boulders have been mapped within the Lease Area based on the 2020 and 2021 HRG survey data.

The shallow subsurface of the Lease Area is characterized by a thick sequence of alternating Quaternary-aged deposits of coarse-grained and fine-grained sediments, overlying older pre-Quaternary age Coastal Plain Deposits. The Coastal Plain Deposits are interpreted to be between approximately 148 ft and 263 ft (45 and 80 m) below seafloor beneath the southwest portion of the Lease Area. Ravinement surfaces and associated channelized units infilled with transgressive deposits have been mapped across the Lease Area. The sediment type within these channels consists of both fine-grained clays and silts, as well as coarser-grained sands.

2.2.5 Benthic Habitat Features

Benthic habitat features were assessed in a seasonal benthic survey campaign between 2020-2021 (COP Appendix M: Benthic and Shellfish Resources Characterization Report), which utilized grab samples and SPI/PV seafloor imagery. SPI/PV data collected as part of the benthic surveys indicates varying levels of surficial sediment mobility throughout the Lease Area, evidenced by the ubiquitous presence of bedforms (ripples) both large and small. The deeper shelf waters of the Lease Area are characterized by predominantly rippled sand and soft bottoms.

The dominant benthic habitat type observed in the Lease Area was Sand and Muddy Sand. A small swath of Coarse Sediment was present south of stations 084 and 094 (**Figure 14**), associated with an area of Wave Generated Ripples. Areas of Low Density Mounds were observed at the northernmost portion. Organisms found in the Lease Area included those taxa typically found in Sand and Muddy Sand habitats, such as bivalves (e.g., clams), polychaetes and tube-forming amphipods. The complete classification of the seafloor in the Offshore Project Area is provided in the COP.

Seafloor conditions in the Lease Area align with the findings at nearby leases showing low complexity, homogeneous, fine sand to silt with little relief (Epsilon Associates, Inc. 2018). Based on the NOAA Deep-Sea Coral Data Portal, there are no live bottom areas (e.g., reef type habitat near the Lease Area (NOAA 2020a). The closest live bottom areas are stony coral habitats observed approximately 19 mi (30 km) north and southwest of the Lease Area. Results of the benthic community structure analysis of Spring and Summer 2020 samples within the Lease Area confirmed the softbottom substrate was habitat for common benthic Soft Sediment Fauna with benthic infaunal assemblages dominated by tube-dwelling amphipods such as *Ampelisca* species (spp.), bivalves, and surface burrowing worm species (e.g., Cossuridae and Paraonidae).

Physical habitat characteristics were also interpreted from the SPI/PV and geophysical survey data. The SPI/PV images, grain size data from benthic survey grab samples, and images (grab camera) were used to identify the CMECS Substrate Components in terms of habitat type and substrate class/subclass/group/subgroup, where applicable. Within the Lease Area, the sediment was characterized as CMECS Subclass Fine Unconsolidated (i.e., less than 5 percent gravel) (**Figure 14**) during the Spring survey. Two samples (113 and 115, shown in **Figure 14** during the summer survey were classified as Coarse Unconsolidated – Gravelly – Gravelly Muddy Sand. The remaining Group classifications were mostly Mud, Sandy Mud, and Muddy Sand. A few stations (Spring [061] and Summer [062, 068, 078, 121 and 122], shown in **Figure 14** were Sand with Subgroup Fine/Very Fine Sand. The Lease Area is mostly homogenous with little relief. The Lease Area is considered Soft Bottom habitat with no complex habitat features.

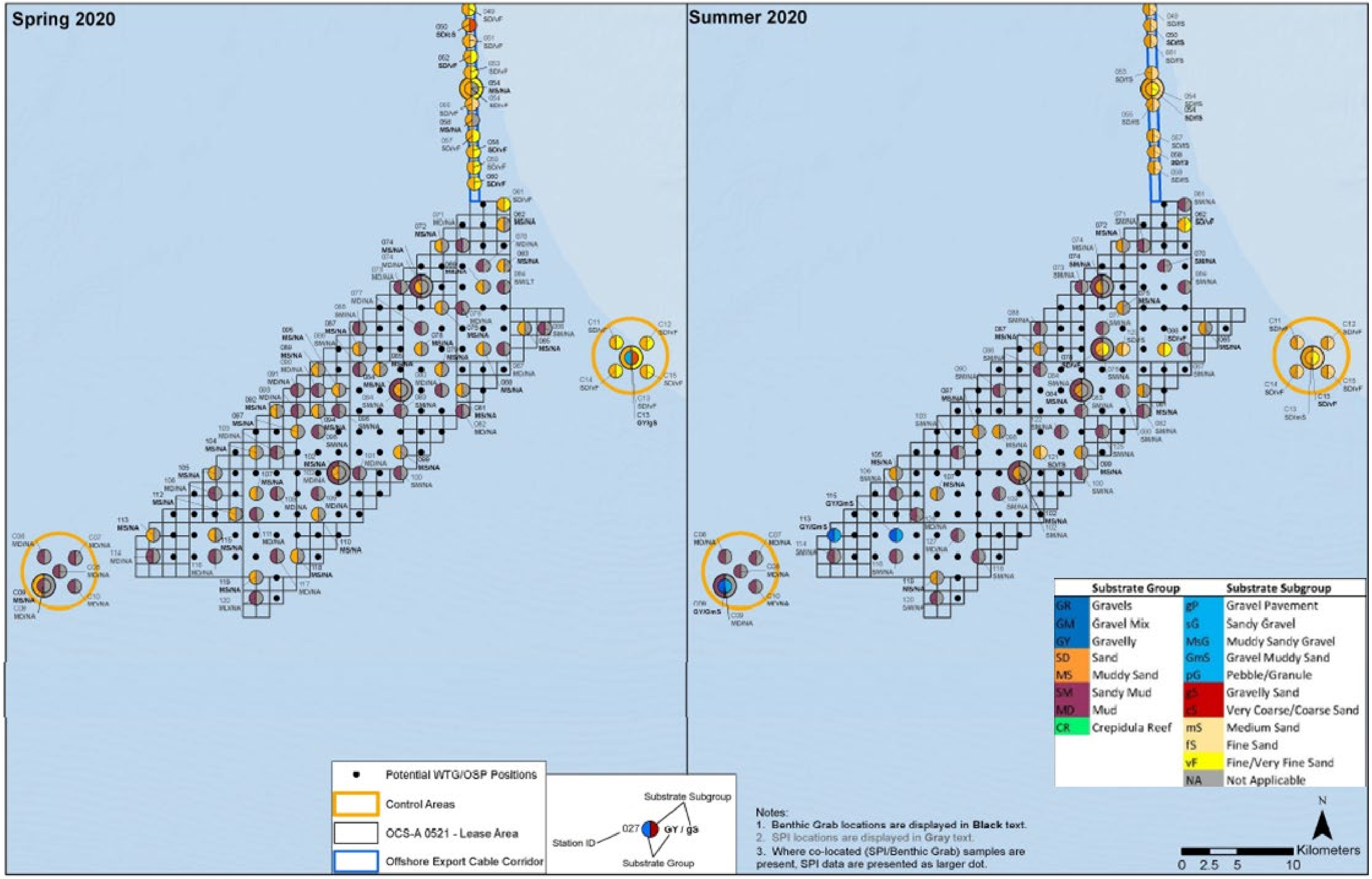


Figure 14. Sediment Types Observed during the Spring and Summer 2020 Benthic Surveys

Epifauna/megafauna and epiflora observed included macroalgae (red, green and brown), sponges, bryozoans, hydroids, barnacles, tunicates, anemones, gastropods, bivalves, nudibranchs, urchins, brittle stars, starfish, sand dollars, crabs (hermit, brachyuran, spider), amphipods, isopods, shrimp, squid, skates, and some finfish.

The Lease Area is classified as Fine Unconsolidated material, generally homogeneous and considered soft bottom habitat with no complex habitat features. Epifauna/megafauna found in the Lease Area were classified as Soft Sediment Fauna, predominantly organisms living on the surface (i.e. crabs, sand dollars, gastropods) or burrowing into the sediment (i.e. anemones, amphipods, polychaetes).

Consistent with observations of epifauna, the dominant infaunal biotic subclass in the Lease Area was Soft Sediment Fauna (**Figure 15** and **Figure 16**). The biotic and co-occurring biotic groups found in the Lease Area in both Spring and Summer were typical of soft sediment environments and included clam beds (Nucula beds), larger tube-building fauna (*Ampelisca, Corophium*, and *Leptocheirus* amphipod beds), and small surface-burrowing fauna (Paraonidae and Cossuridae polychaetes).

Detailed information on the benthic habitat features of the Lease Area can be found in COP Appendix M, Benthic and Shellfish Resources Characterization Report.

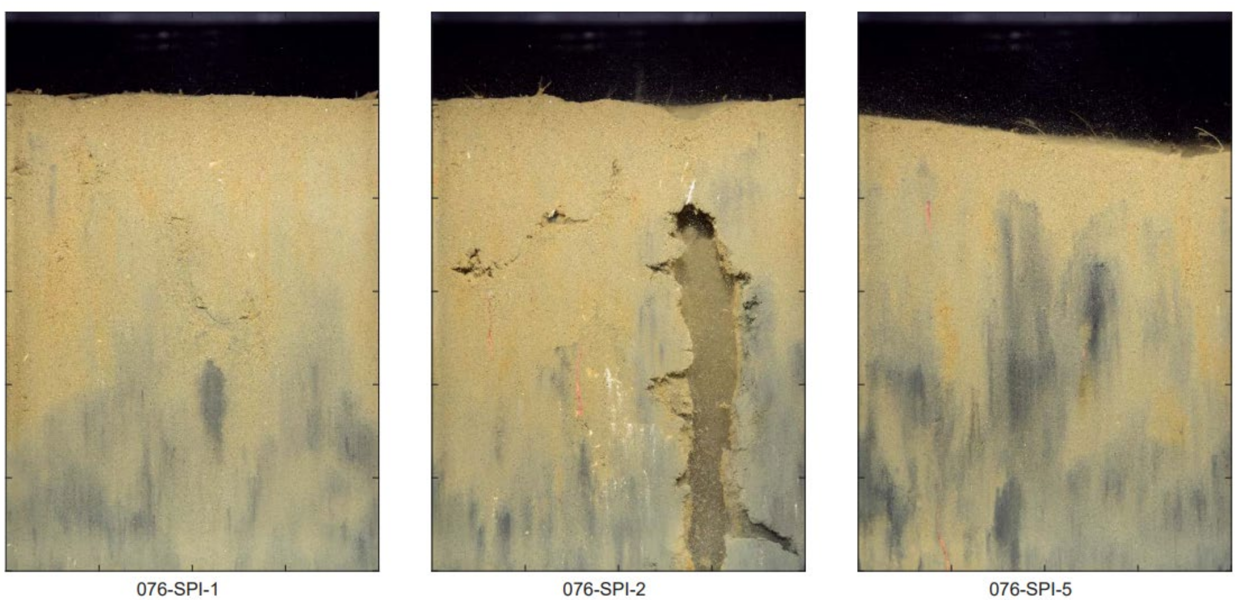
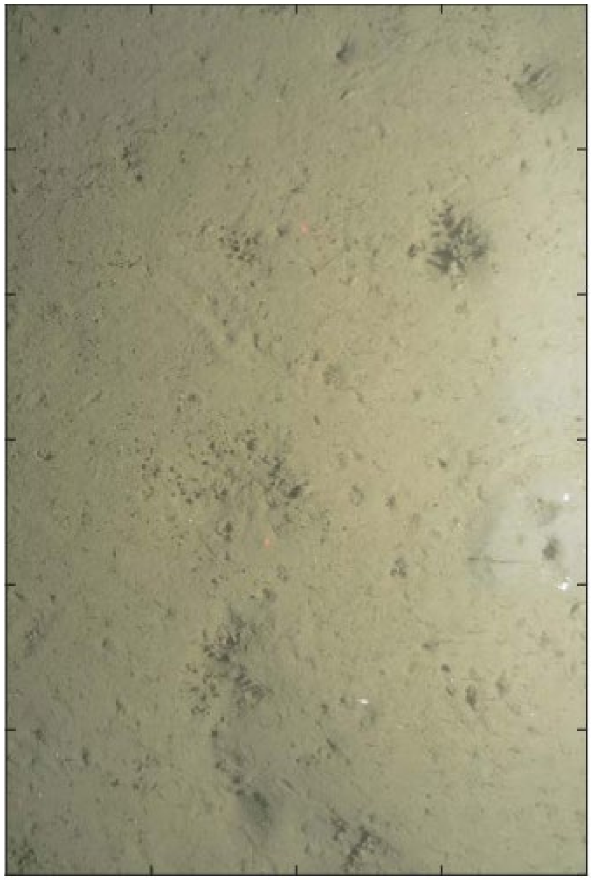


Figure 15. Representative Sediment Profile Imagery (SPI) images from Station 076, adjacent to the OSP Converter Station Location.



076-PV-5

Figure 16. Representative Plan View (PV) seafloor image from Station 076, adjacent to the OSP Converter Station Location.

2.3 Locational Maps – (r)(2)(iii)

Figure 1 and **Figure 2** (see Section 1.0) provide the location of the Project in reference to the source water, physiographic features, and general layout of the facility.

3.0 COOLING WATER INTAKE STRUCTURE DATA – SECTION §122.21(r)(3)

3.1 Configuration – (r)(3)(i)

The facility's CWIS will utilize three separate vertical pipe (caisson) intakes attached to the OSP jacketed foundation structure located in approximately 151.6 ft (46.2 m) of water (**Figure 17** and **Figure 18**). The CWIS will contain a bar rack located at the opening to the intake caisson, to prevent large debris from entering the CWIS, as well as an inline pump filter screen further downstream to protect the pump impellers. There is no dedicated debris/fish return system since there are no traveling screens. The bar rack will serve as the "screen" at which through-screen intake velocity is determined, for the purposes of this permit application.

There will be 3 vertical intake caissons, each with a diameter of 28 in (0.7 m) and equipped with flared ends (bell mouth) to accommodate final intake velocity requirements. The bell mouth opening is set perpendicular to the seafloor, in the middle portion of the water column, located within the jacketed foundation structure. Each intake caisson has its own separate submerged seawater lift pump.

Individual organisms are expected to be able to avoid impingement at the bar rack due to the low intake velocity of 0.5 feet per second (ft/s) or less. Individual planktonic organisms suspended in the water column may enter the intake caisson and become entrained, but those numbers are expected to be a very minor component of overall ichthyoplankton (e.g., eggs, larvae) based on relative densities expected in the water column in the open ocean, at this depth (see Section 6.4.4). The bell mouth and bar rack dimensions (see **Table 6**) is an engineering solution to meet the 0.5 ft/s intake velocity limitation. A bar rack with a smaller opening is not feasible for this unmanned platform, as clogging due to biofouling of a smaller sized opening would result in maintenance and operational concerns. The intake caissons will be set with approximately 1 m (3.3 ft) spacing between each.

The 74 ft (22.6 m) depth of withdrawal, below the water surface (81 ft [24.7 m] above the seafloor), is expected to substantially minimize the intake of floating debris, or otherwise entrainable buoyant eggs/larvae, from entering the CWIS, compared to a surface withdrawal, since the eggs of most offshore species are buoyant (Sundby and Kristiansen 2015). This depth of withdrawal is also optimized due to colder, more consistent water temperatures associated with the middle-portion of the water column, compared to the surface, requiring less water demand for cooling and minimal demand for injection of biocide (sodium hypochlorite).

EPA defines design intake flow (DIF) at §125.92(g) as: "*the value assigned during the cooling water intake structure design to the maximum instantaneous rate of flow of water the cooling water intake system is capable of withdrawing from a source waterbody. The facility's DIF may be adjusted to reflect permanent changes to the maximum capabilities of the cooling water intake system to withdraw cooling water…*". For this facility, a total of three seawater lift-pumps will be installed, each with maximum theoretical nameplate flow capacity of 900 m^3/h, with a representative example shown in **Figure 20**. However, the system is designed such that the maximum capabilities of each seawater lift pump is limited to a maximum operational flow of 780 m^3/h, including contingency. Under normal operating conditions, no more than two seawater lift pumps will operate at this maximum flow, approximately double the operational flow of a single pump, for a combined 1,560 m^3/h at maximum operational design capacity, resulting in a maximum of 9.9 MGD of raw seawater for the facility will be withdrawn from the Atlantic Ocean (**this is the maximum design intake flow [DIF] of 9.9 MGD referenced throughout this permit application**). For modeling purposes (CORMIX thermal modeling and hydraulic zone of influence calculations), the following parameters are used to define the typical operating conditions utilizing two-pumps, based on the DIF of 9.9 MGD:

- *DIF* = 1,560 m^3/h (9.9 MGD) during two-pump operations. This reflects the *maximum* operational flow, as the DIF, during the typical operating conditions with the use of two pumps (not accounting for flow reductions by use of a three-way valve or variable frequency drives on the pump motors, which would result in even lower operational flow).
- *Depth of withdrawal* = 74 ft (22.6 m)
- *Depth of discharge* = 42.7 ft (13 m) below the surface
- *Maximum discharge temperature* = 86°F (30°C).

The system can also be operated with a single pump. However, the typical operating scenario will utilize two pumps. A third pump is for reserve/backup only and no more than two pumps will ever be run simultaneously.

The seawater system has been sized based on the highest cooling demands from the OSP while the seawater temperature at the depth of withdrawal is at its highest according to the available metocean data. Under nearly all normal operating conditions, SouthCoast Wind anticipates needing lower intake flow volumes, relative to design intake flow. Typical operations would utilize two pumps, but with each at a reduced capacity to minimize wear and maintenance on the pump, when the ambient source-water at the 74 ft (22.6 m) intake depth cool enough to allow for such operations at less than the DIF of 9.9 MGD. Internal cooling flow is controlled by use of a 3-way valve while maintaining a constant speed with the seawater once-through (open loop) cooling. The pump speed is further controlled by variable frequency drive (VFD) on the pump motor, which is dependent on cooling demand at any given point in time, and speed adjustment is based on the supply temperature of cooling medium (source water). This is the expected typical operating scenario, with the exception of extremely rare circumstances when this temperature is exceeded at this depth, during any season, resulting in the need to operate either one or two pumps at higher flow capacities (but still only up to the maximum DIF of 9.9 MGD). Therefore, the average intake flow during most months is expected to be approximately 8.18 MGD, as shown in **Table 6**. The absolute minimum flow, adjusted by use of a 3-way valve or VFDs based on cooling demand and source water temperature, is expected to be approximately 200 m^3/hr, or 1.3 MGD. Cooling water will be discharged via a single vertical discharge caisson, approximately 36 in (0.91 m) diameter. Depth of discharge will be 42.7 ft (13 m) below the surface, which provides sufficient separation from the intake to minimize re-circulation of heated discharge water. Maximum discharge temperature will not exceed 86°F (30°C). See Appendix A (SouthCoast Wind CORMIX Mixing Zone Results) for thermal modeling inputs, assumptions, and results.

Table 6 provides an overview of the characteristics of the CWIS.

Table 6. Characteristics of the CWIS at the SouthCoast Wind OSP Converter Station

Configuration Parameter	SouthCoast Wind OSP CWIS
Water Source	Atlantic Ocean
Cooling Water Intake System	Non-contact, once-through cooling. Each of the three intakes pipes (caissons) operates independently with its own seawater lift pump. No common entrance or shared piping between each intake caisson. Typical operations utilize no more than two seawater lift pumps, with the third serving only as a backup to the other two pumps (no operating scenario will utilize three seawater lift pumps simultaneously).
Configuration of intake	There are three, 28 in (0.7 m) diameter vertical-shaft intake caissons, with flared ends to accommodate intake velocity requirements, set perpendicular to the seafloor, in the middle portion of the water column, located within the jacketed foundation structure. The three intake caissons on the OSP are separated by approximately 1 m (3.3 ft) distance from each other, with the first caisson located approximately 28 m (91.9 ft) distance from the center of the platform coordinates (see Section 3.2) Note that the three intake caissons are independently operating structures with no common intake or entrance. See schematic representations in **Figure 18** and **Figure 19**
Configuration of discharge	The cooling water discharge includes one, 36" (0.91 m) diameter vertical-shaft discharge caisson, located in the middle portion of the water column, and set perpendicular to the seafloor, located within the jacketed foundation structure. The discharge depth is 42.7 ft (13m) below the surface, and the location of discharge is within a 20 m radius from the center of the platform coordinates (see Section 3.2). This location/depth ensures sufficient distance is maintained between the lift pump caisson and the overboard water caisson: See schematic representations in **Figure 17** and **Figure 18**.
Trash/debris bar rack	The intake caisson(s) will be equipped with a stainless steel trash or debris bar rack. The proposed bar rack will be similar in concept and analogous to a turtle exclusion device (TED), utilized by some commercial fisheries to prevent sea turtles from becoming entrapped within a trawl net; in this case the bar rack would exclude large marine organisms from entering the intake caisson. The bar rack will consist of three stainless steel bars approximately 20 mm (0.8 in) wide, or similar, fixed to the bell mouth opening of the intake caisson. SouthCoast Wind will require the bar rack to be incorporated into the specific design elements of the OSP fabricator. However, the use of trash or debris bar racks is not optimal for a seawater lift pump caisson installed in an offshore environment. The use of a bar rack at the intake of the pump caisson will create maintenance concerns over time; the bar rack will biofoul with encrusting/fouling organisms and will require direct access to the pump caisson intake periodically for cleaning campaigns. The original design did not include a bar rack for this reason, but a bar rack will be added for compliance requirements for this permit application.
Pump Screens/Strainers	Each seawater intake caisson is equipped with an in-built pump strainer with a typical outer screen size of 3/8 in (9.5 mm) intended to protect the seawater lift pump impeller from debris in the water column. The strainers are retractable on the seawater lift pump for cleaning. At deck level 1 of the OSP, each pump flowline is also equipped with a dedicated filter (typical mesh size of 250 μm), intended to protect the equipment and ensure reliable operation of the CWIS. The filter is provided with an automated backwash cleaning system. No chemicals are involved in the cleaning cycles.
Number of traveling screens/ screen wells	N/A – no traveling screens
Water Depth of withdrawal, below surface at MLLW	74 ft (22.6 m) below the surface
Water Depth of withdrawal, above seafloor	81 ft (24.7 m) above the seafloor

Configuration Parameter	SouthCoast Wind OSP CWIS
Through-screen velocity (calculated from DIF)	**Intake velocity will not exceed 0.5 ft/s** to meet the velocity-based impingement compliance option. A maximum velocity of less than or equal to 0.5 ft/s will be integrated into the engineering design of the CWIS to ensure compliance, as described in Section 6.2. The intake velocity of 0.5 ft/s (or less) will be ensured to be the design limit velocity at the bar rack, accomplished by ensuring the CWIS intake bell mouth diameter is sized in relation to the lift pump maximum flow rate (i.e., determined at the maximum power of the motor driving the pump or the pump curve, whichever is greater) and that the bell mouth face velocity is not exceeding 0.5 ft/s. See Section 6.2 for intake velocity calculation, based on parameters below, including pump data from a submersible seawater lift pump deployed on another project with a similar cooling duty requirement of 50.16 Btu/h (14.7 MW): • Maximum cooling seawater flow required (DIF): 9.9 MGD (2 x 780 m^3/h = 1,560 m^3/h), including contingency • Selected pump maximum operational flow (Q_{max}): (780 m^3/h), based on representative pump data • Typical pump configuration: 2 x up to 50% of operational flow, or 1 x up to 100% of operational flow • Minimum pump flow (Q_{min}): 1.3 MGD (200 m^3/h) • Minimum pump head (H_{min} at Q_{max}): 160.8 ft (49 m) • Maximum pump head (H_{max} at Q_{min}): 239.5 ft (73 m) • CWIS intake bell mouth diameter: 4.74 ft (1.445 m) • CWIS intake bell mouth area: 17.66 ft^2 (1.64 m^2) • CWIS intake velocity (face velocity): < 0.5 ft/s (0.15 m/s) [See Section 6.2 for intake velocity calculation]
Seawater lift pumps (intake pumps)	The seawater cooling system is a once-through (open loop) system. The maximum heat duty of the offshore substation platform (OSP) is 50.16 Btu/h (14.7 MW). This maximum heat duty of 50.16 Btu/h (14.7 MW) requires a maximum seawater flow of 9.9 MGD (i.e.,1,560 m^3/h, including contingency) for cooling. Up to two (2) raw seawater vertical lift pumps are required to fulfill the cooling duty. Each seawater lift pump has a rated maximum nameplate flow capacity of 900 m^3/h, but maximum operational flow would not exceed 780 m^3/h per pump, resulting in a maximum design intake flow (DIF) of 9.9 MGD, with two pumps operating. Only two of the three seawater lift pumps would be used under normal operating conditions, with the third pump serving only as a spare/backup. Each seawater lift pump supplies once-through, non-contact cooling water to a plate heat exchanger, to facilitate heat exchange/cooling with the seawater cooling system (of 7.35 MW heat duty capacity per heat exchanger). Internal cooling flow is controlled with the use of a 3-way valve while maintaining a constant speed with seawater once-through (open loop) cooling. In addition, a variable frequency drive (VFD) on each of the seawater lift pump motors, to accomplish the following: (1) The seawater lift pumps are equipped with VFDs for slow start-up of the seawater supply lines. (2) Fine-scale control of the flow volume, based on cooling requirements. (3) In order to prevent freezing of the standby line, a VFD is used to operate the standby seawater lift pump at minimum flow capacity during the winter season (still within the maximum 9.9 MGD DIF for the facility). See **Figure 20** for example of typical seawater vertical lift pump
Maximum Discharge Temperature	**86°F** (30°C)
Total DIF	**9.9 MGD** = maximum design intake flow required for cooling of the OSP. Two of the seawater lift pumps will provide up to 9.9 MGD (DIF) during normal operating conditions (up to 4.95 MGD each to supply the required cooling water). During normal operating conditions, each individual seawater lift pump will provide up to 4.95 MGD to ensure reliable, safe operating conditions at the unmanned OSP. Seawater lift pump settings can be controlled with or without VFD. Internal cooling flow is also controlled by use of a 3-way valve while maintaining a constant speed with the seawater once-through (open loop) cooling. The system is designed for a rated nameplate capacity of each seawater lift pump of 900 m^3/h. However, SouthCoast Wind is seeking 9.9 MGD maximum design intake flow (DIF) in NPDES permit, to align with the expected maximum operational conditions (two pumps operating at up to 780 m^3/h each), as the seawater lift pumps are not designed to operate at 100 percent of their total rated nameplate capacity to meet the cooling needs of the OSP.

<table>
<tr><th>Configuration Parameter</th><th>SouthCoast Wind OSP CWIS</th></tr>
<tr><td>Actual/ Average Intake Flow (AIF)</td><td>The summary below represents expected maximum, average, and minimum flows during operations for each month. However, the actual AIF will be determined based on CWIS conditions, once operational. Per §125.92(a), AIF represents the average volume of water withdrawn on an annual basis by the cooling water intake structures over the past three years. After October 14, 2019, AIF means the average volume of water withdrawn on an annual basis by the cooling water intake structures over the previous five years.
<table>
<tr><th>Month</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Max. DIF (MGD)</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td><td>9.9</td></tr>
<tr><td>Average Intake Flow (MGD)</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td><td>8.18</td></tr>
<tr><td>Minimum Intake Flow (MGD)</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.3</td></tr>
</table>
</td></tr>
<tr><td>Flow Reduction from Design Capacity</td><td>While 9.9 MGD is the DIF, a 50% flow reduction potential from DIF could be achieved by use of single-pump operation (4.95 MGD), or dual-pumps each operating at reduced capacity during low-load operating conditions.
(see Section 6.4)</td></tr>
<tr><td>Closed-cycle recirculating cooling</td><td>None. Closed-cycle (closed-loop) cooling utilizing air or seawater is not an available technology for this type of unmanned offshore facility (see Section 6.4).</td></tr>
<tr><td>Monitoring parameters and sensor locations</td><td>The intake structure will include the following instrumentation:

temperature & water conductivity monitoring devices installed at the seawater lift pump intake.
the intake seawater flowline has an inline flow meter installed upstream of the seawater filter at the topside of the converter station.
temperature and flow monitoring devices are installed at the feed line and at the discharge outlet of the seawater heat exchanger.
mechanical sampling connections located at the return line of seawater. The samples will be taken as required per NPDES permit conditions, to a laboratory for the analysis of required parameters, per the final NPDES Permit.
</td></tr>
<tr><td>Chlorination System</td><td>The CWIS is equipped with an anti-fouling system to prevent marine growth in the pump caissons and the Seawater System, which consists of Hypochlorite Generator Packages. The Hypochlorite Generator Package produces Sodium Hypochlorite (NaOCl) by seawater electrolysis. The hypochlorite is injected into the pump caissons near the suction level of the Seawater Lift Pumps. Hypochlorite Generator Packages are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 ppm equivalent free chlorine concentration in the seawater intake lines. This method of continuous injection into the pump caisson is preferred because at a low dosage of NaOCl (i.e., 2 mg/l, 95 kg/day), the residual free chlorine at the outlet would be negligible and oxidized in the water with no negative impact.</td></tr>
<tr><td colspan="2">Notes:
All specifications are approximate, based on the experience of previous projects, at the pre-front end engineering design (FEED) stage of this Project, subject to refinements/updates as the engineering design is developed, within permitting constraints.
AIF = Actual Intake Flow; DIF = Design Intake Flow; ft/s = feet per second; ft = feet; in = inch; gpm = gallons per minute; hp = horsepower; MGD = million gallons per day</td></tr>
</table>

The CWIS is located within the jacketed structure associated with the OSP (**Figure 17**). The jacketed structure offers protection from large debris, vessel traffic, or other hazards from contacting the intake pump caissons.

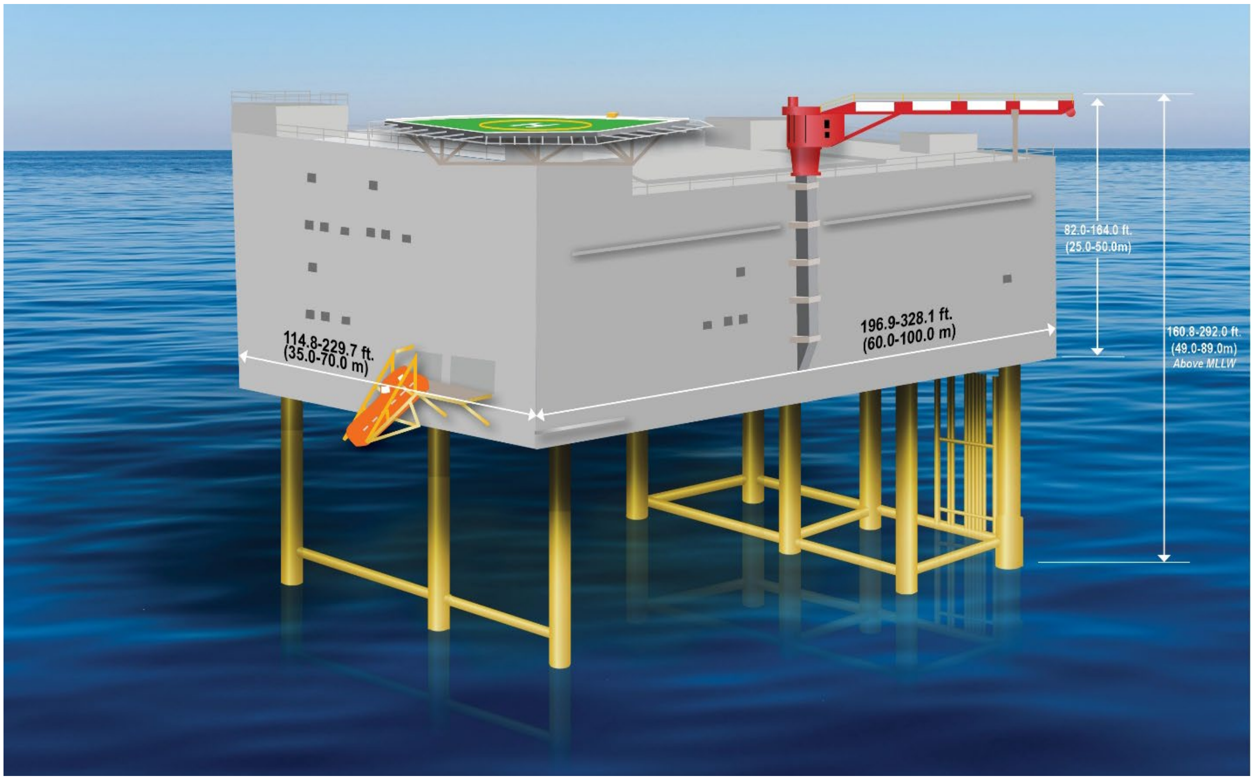


Figure 17. Indicative piled jacket OSP where the HVDC Converter Station will be located

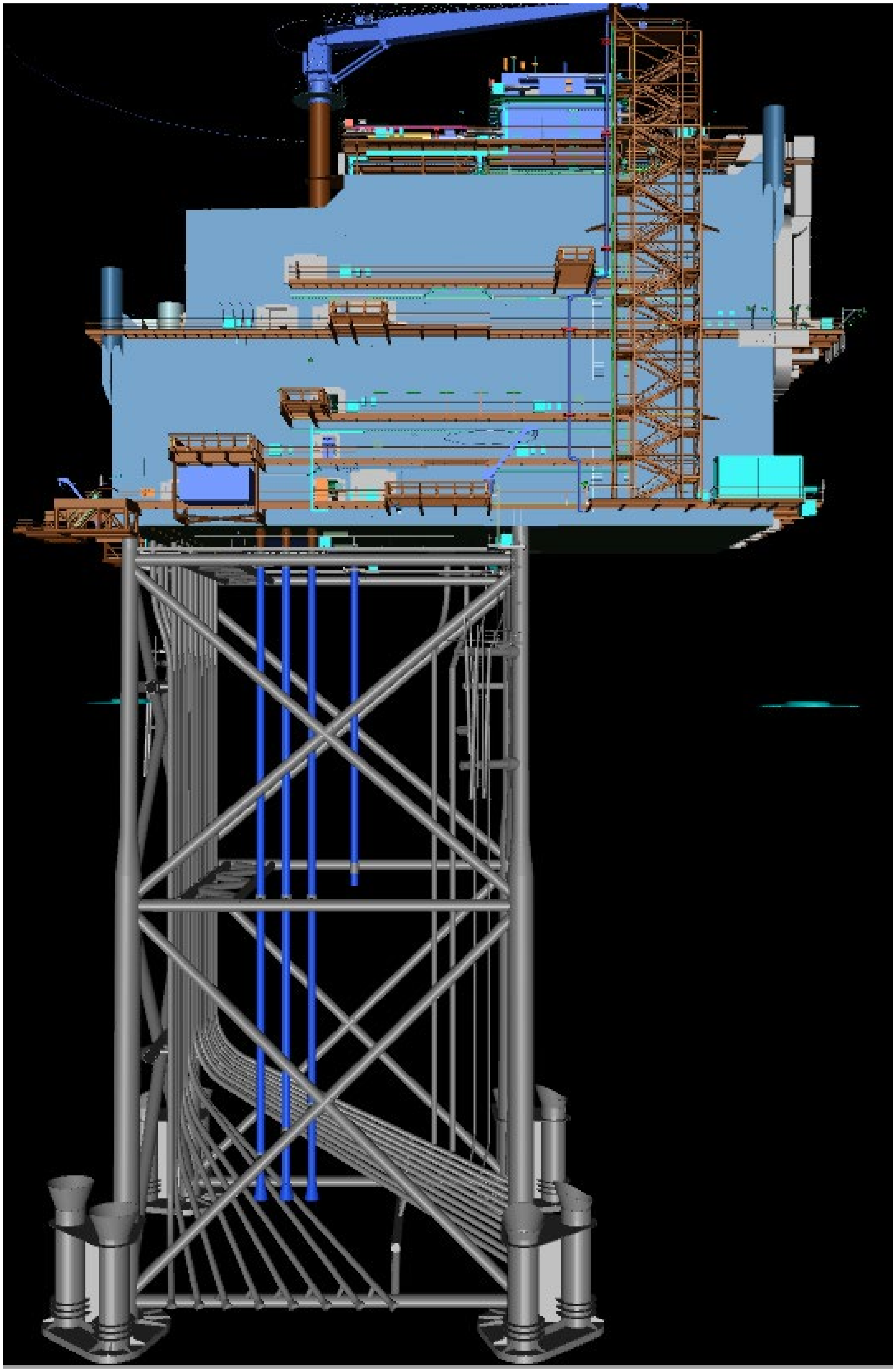


Figure 18. Indicative representation of the cooling water intake (3 longer blue caissons) and discharge (single shorter blue caisson)

Each seawater lift pump is installed within a dedicated pump caisson. Locations and elevation depths of the pump caissons will be offset with that of the seawater discharge caisson to minimize commingling/re-circulation of warm discharge water with the seawater intake at the pump caissons. This will further serve to minimize the potential for re-entrainment of planktonic organisms in the water column, by physically separating the intake from the discharge. The seawater lift pump risers will be designed to ensure sufficient water flow to avoid accumulation of sediments and consequent blocking of caissons, pumps, or equipment.

Intake velocity requirements of 0.5 ft/s will be achieved by incorporating a flared (or bell mouth) caisson opening (see **Figure 19**) sized accordingly in relation to the rated capacity of the pump to ensure the pump caisson's intake velocities do not exceed the 0.5 ft/s maximum velocity as a preferred impingement compliance option (see Section 6.2)

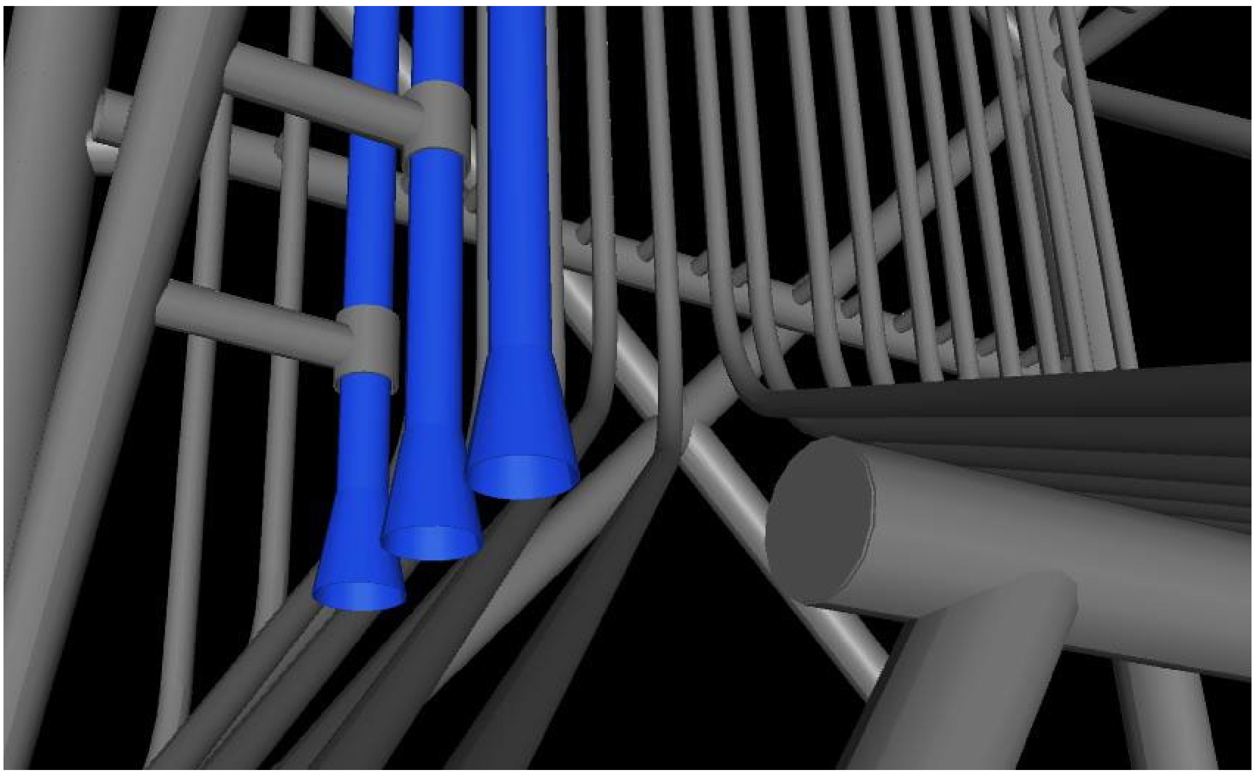


Figure 19. Indicative representation of the cooling water intake caissons, with flared/bell mouth openings sized to achieve intake velocity requirements

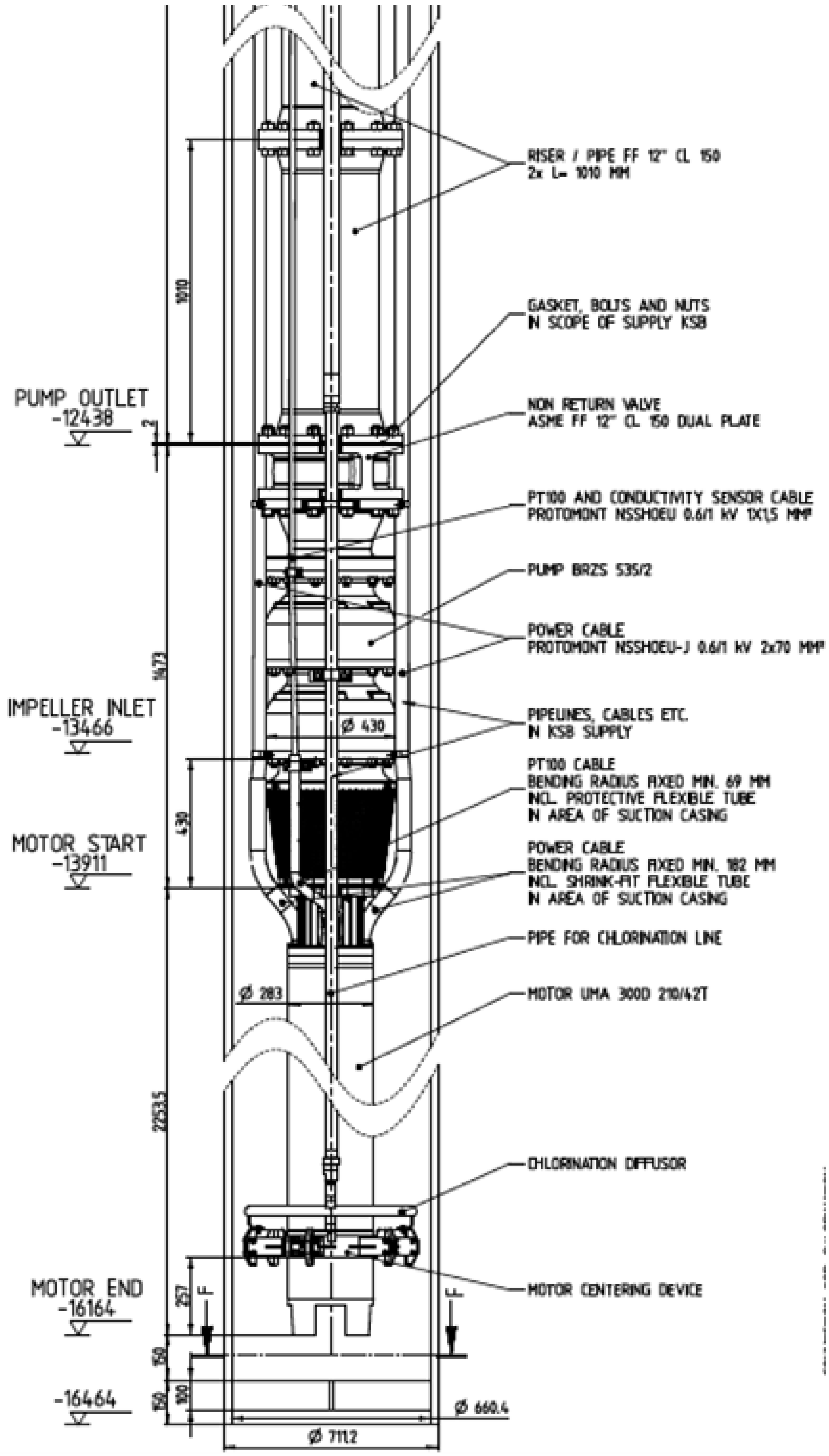


Figure 20. Typical seawater lift pump for the CWIS

3.2 Latitude and Longitude – (r)(3)(ii)

The CWIS to be used by the new facility will be located at the OSP to be sited at the position shown in **Figure 2** (see Section 2.1), centered at approximately 40.805045 N, -70.324838 W (Latitude = 40° 48' 18.16"N, Longitude = -70° 19' 29.41"), based on Northing (4517960 m) and Easting (388250 m) Universal Transverse Mercator (UTM) Zone 19N, North American Datum 1983 (NAD1983).

3.3 Operation of Cooling Water Intake Structure – (r)(3)(iii)

The CWIS providing non-contact once-through cooling water to the converter station will be operated 24 hours per day, 365 days per year, with the exception of maintenance periods. Typical operations will utilize two seawater lift pumps. At any time, either one or two seawater lift pumps would be expected to be in operation simultaneously, with the third seawater lift pump serving only as a backup.

3.4 Flow Distribution and Water Balance – (r)(3)(iv)

Figure 21 depicts the facility's flow distribution and water balance. Only non-contact once-through cooling water will be utilized, with no process water as part of facility, and all water withdrawn through the CWIS will be discharged to the single discharge caisson associated with the seawater return. At the intake, several biofouling control systems are being considered, but the most common system would be a Sodium Hypochlorite (NaOCl) Generator.

There would be other expected waste streams being discharged, such as; non-contact stormwater run-off from the top deck, excluding the water from any equipment, and water from the oil/water separator, monitored using an online oil-in-water monitor. No stormwater exposed to industrial activities will be discharged. Collection tanks will be used for stormwater exposed to oily water from the transformers, or spill containment, for off-site (onshore) disposal via appropriate waste streams. This type of stormwater (or spill containment) collected in tanks will not be discharged and therefore is not a regulated activity that is expected to be included or authorized by NPDES permit for the facility. All waste generated will be appropriately contained and disposed of at appropriate offsite (onshore) facilities.

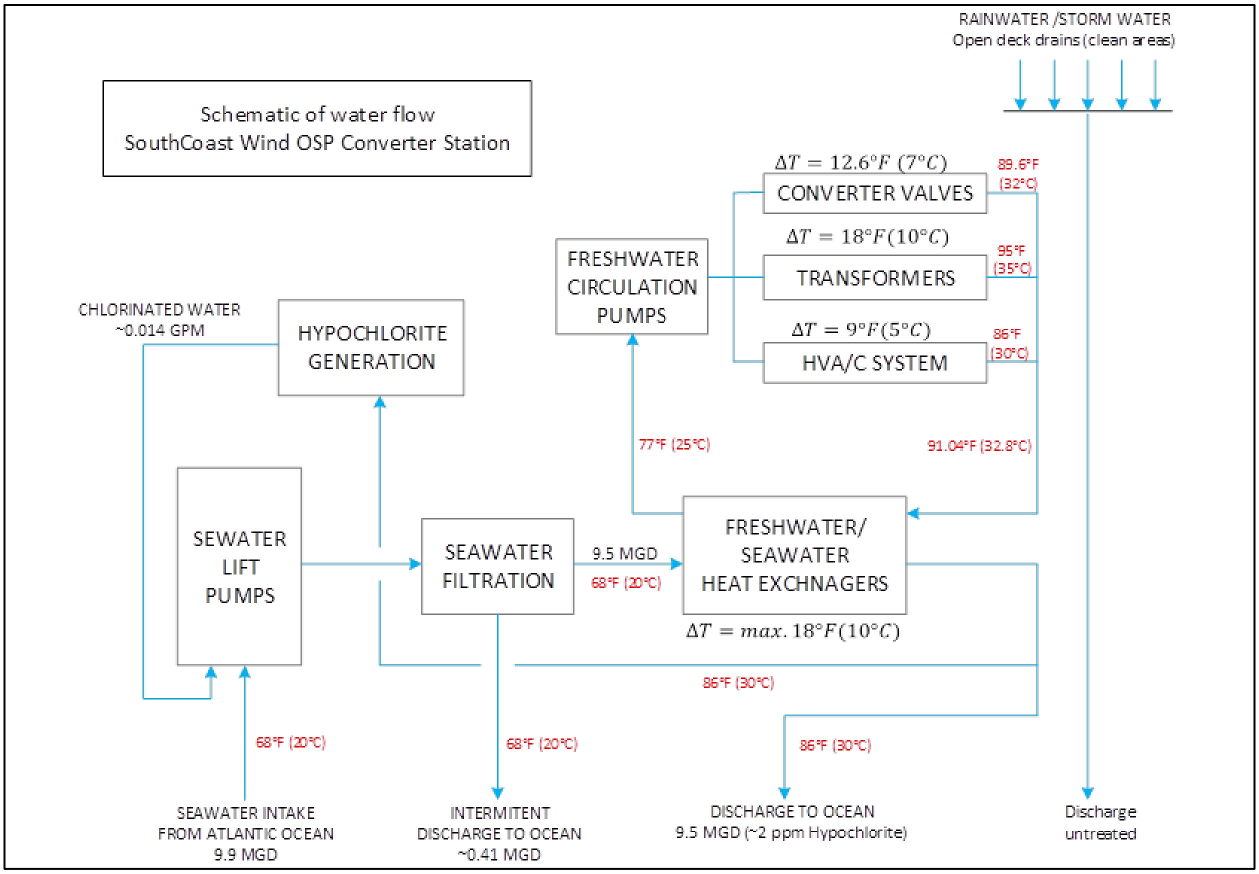


Figure 21. Flow distribution and water balance diagram for the OSP

3.5 Engineering Drawings – (r)(3)(v)

Engineering drawings and schematics provided in the preceding sections of this application are for permitting-level requirements only, with detailed engineering design drawings to be provided (if required) once the substation engineering team enters the detailed design stage, including information from original equipment manufacturers.

4.0 SOURCE WATER BASELINE BIOLOGICAL CHARACTERIZATION DATA – SECTION §122.21(r)(4)

The intake for SouthCoast Wind's offshore HVDC converter station will be located in the marine waters of southern New England, about 25 miles (40 km) south of Martha's Vineyard. The water depth at this location is approximately 151.6 ft (46.2 m) and the seawater intake used for cooling water purposes will be positioned at approximately 74 ft (22.6 m) below the surface, and 81 ft (24.7 m) above the sea floor. Intake velocity will be at or less than 0.5 feet per second.

Biological characteristics of the area surrounding the proposed facility are typical of this portion of the neritic zone; the shallow marine environment extending from mean low water to about 656 ft (200 m) of the southern New England continental shelf region. These waters are considered highly productive, with an extensive array of plant and animal species ranging from phytoplankton to whales. Fish species categorized as pelagic (e.g., herrings and menhaden), demersal (e.g., flounder and gadids), and highly migratory (e.g., tunas and sharks) all inhabit these waters.

4.1 List of Data Not Available – (r)(4)(i)

No site-specific studies have been done to characterize the local composition of species that are susceptible to impacts of impingement and entrainment by SouthCoast Wind's cooling water intake structure (CWIS). No site-specific data are available to provide annual estimates of entrainment and impingement, as the CWIS has not yet been installed. Information for §122.21(r)(4)(ii)–(vi) was obtained from public data sets and the literature, upon which inferences on potential impingement and entrainment impacts are based (see Section 4.3).

4.2 Species and Lifestages – (r)(4)(ii)

Species or relevant taxa and life stages and their relative abundance in the vicinity of the cooling water intake were determined from several publicly available data sets including EcoMon plankton sampling (US DOC/NOAA Fisheries Northeast Fisheries Science Center 2019), the Rhode Island Department of Environmental Management (RI DEM 2022), Massachusetts Division of Marine Fisheries (MA DMF 2021) inshore trawl surveys, NOAA-NEFSC Spring/Fall bottom trawl surveys, and the literature review from the SouthCoast Wind COP(AECOM et al. 2021).

4.2.1 MARMAP/EcoMon Plankton Surveys

The Marine Resources Monitoring, Assessment, and Prediction program (MARMAP) collected zooplankton and ichthyoplankton abundance data on the U.S. Northeast continental shelf extending from North Carolina to Nova Scotia from 1977 through 1987. This survey used 505-micron mesh bongo nets following standardized protocols. The Ecosystem Monitoring (EcoMon) program continued the core part of MARMAP from 1992 to present using 333-micron mesh bongo nets. The herring-sand lance survey (1988–1994) and Georges Bank Global Ocean Ecosystems Dynamics survey (GLOBEC 1995–1999) also provided additional ichthyoplankton data. Ichthyoplankton density data compiled from these four surveys from 1997 through 2019 were obtained from the EcoMon plankton data that are publicly available from U.S. Department of Commerce (US DOC)/NOAA Fisheries Northeast Fisheries Science Center (2019).

The publicly available EcoMon plankton data set is a standardized subset of data that only contained ichthyoplankton from larval stages of common taxa. Taxa included in this EcoMon data set were based on a time series mean abundance greater than 100 per 100 m^3 and occurrence in greater than 5% of samples (US DOC/NOAA Fisheries Northeast Fisheries Science Center 2019). With randomized sampling stations per strata each year, the data set has limitations for representing the complete species and life stage composition immediately in the vicinity of the offshore converter station.

To provide an assessment of species and abundance of ichthyoplankton susceptible to entrainment at the offshore converter station, the EcoMon data were assessed for fish taxa at 43 unique stations in closest proximity (10 miles [16 km]) to the SouthCoast Wind offshore converter station between 1977 and 2019 (**Figure 22**). Over the course of the 42-year time frame 30 unique fish taxa were identified and when combined, had a larval mean annual density of 603.3 larvae/100 m^3 (**Table 7**). However, a large majority (82.1%) of the fish collected in this data set were identified only as “class Pisces”. The only taxa representing more than 1% of the overall larvae density were Atlantic herring (*Clupea harengus;* 4.6%), hakes (*Urophycis spp*; 46%), sand lances (*Ammodytes spp*; 4.1%), and summer flounder (*Paralichthys dentatus*; 1.6%).

To help better understand the ichthyoplankton abundance and composition in recent years in the vicinity of the SouthCoast Wind intake site, a subset of the 42-year data set was used to characterize fish taxa occurring in the most recent 10 years of data (2010-2019). This resulted in 8 unique stations with samples collected in March, May, August, October, and November, which makes this data likely to miss spring spawning fish species (**Table 8**). Given the timing of the cruises and randomization of sampling stations, sampling effort within 10 miles (16 km) of the anticipated location for the offshore converter station was limited. See Walsh et al. (2015) and Richardson et al. (2020) for additional details on these survey methods.

Data from the 8 selected stations from 2010 through 2019 included 17 unique fish taxa with a total larval mean density of 1,274.9 larvae/100m^3. Fish larvae with the most relatively abundant species identified within 10 miles (16 km) of the proposed intake location from 2010 through 2019 were unidentified hakes, summer flounder, and silver hake (*Merluccius bilinearis*).

A large majority (83.9%) of the fish collected in this data set were identified only as “class Pisces” and were therefore limited in creating a complete list of species, though it can be assumed that the majority of the larvae were specimens of the species already identified which were too damaged to identify or not selected for identification in the laboratory. Still, this data allows for confirmation of presence of fish larvae from species with essential fish habitat (see Section 4.2.3) near the intake.

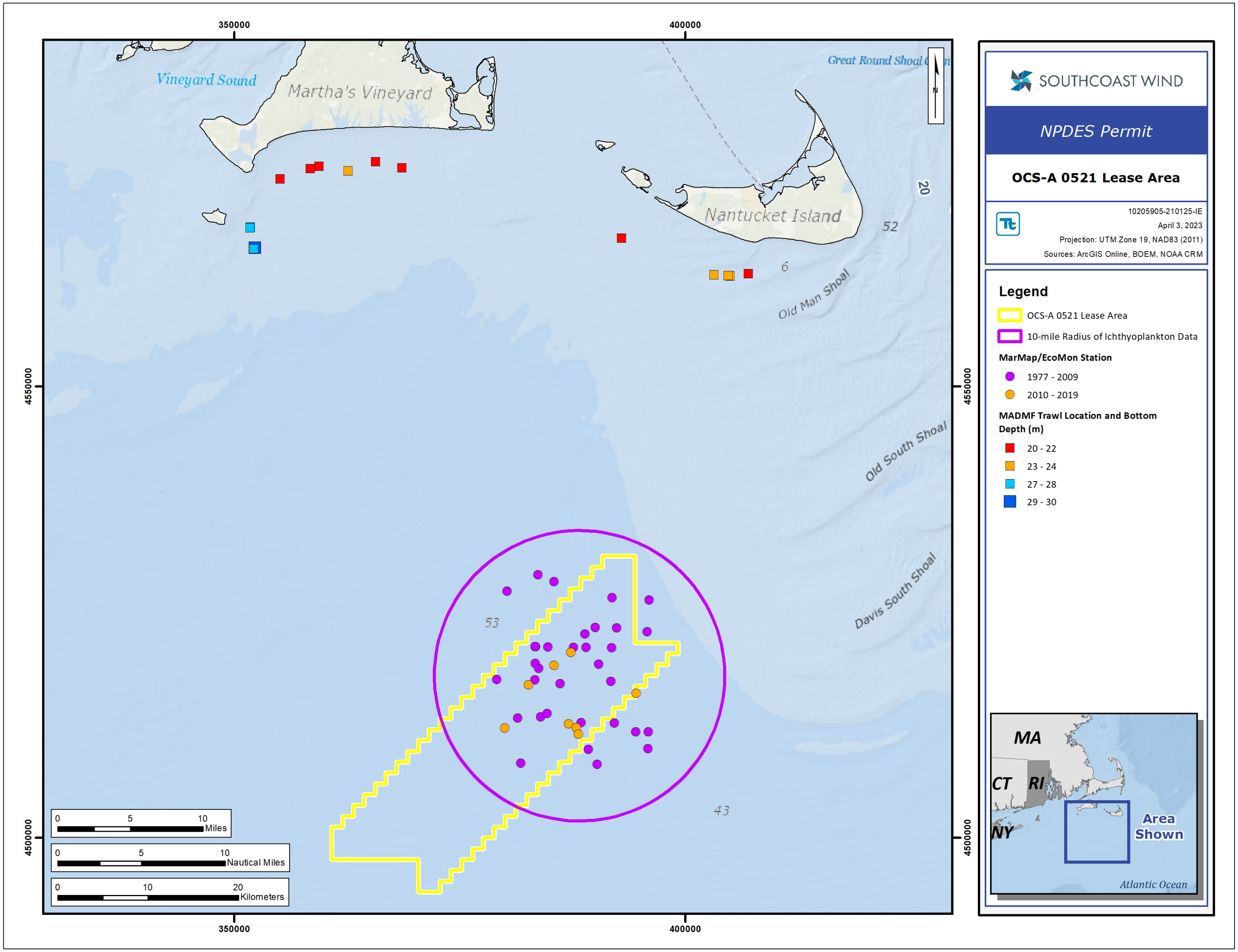


Figure 22. Location of select MARMAP/EcoMon ichthyoplankton bongo tows (US DOC/NOAA Fisheries Northeast Fisheries Science Center 2019) and MA DMF trawl locations with associated bottom depths in relation to the Project

Table 7. Monthly mean larval density (n/100m³) of abundant fish taxa collected in the EcoMon program within 10 miles (16 km) of the SouthCoast Wind offshore HVDC converter station during 1977-2019

Taxon		Jan (n=5)	Feb (n=4)	Mar (n=5)	Apr (n=2)	May (n=3)	Jun (n=2)	Jul (n=2)	Aug (n=2)	Sep (n=3)	Oct (n=4)	Nov (n=8)	Dec (n=3)	Mean	%
American Plaice	*Hippoglossoides platessoides*	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1
Atlantic Cod	*Gadus morhua*	1.0	0.8	3.5	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1
Atlantic Croaker	*Micropogonias undulatus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	<0.1	<0.1
Atlantic Herring	*Clupea harengus*	19.6	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	310.1	27.9	4.6
Atlantic Mackerel	*Scomber scombrus*	0.0	0.0	0.0	0.0	2.2	3.1	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.1
Atlantic Menhaden	*Brevoortia tyrannus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.4	0.1
Butterfish	*Peprilus spp*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	2.1	0.6	0.0	0.0	1.2	0.2
Cunner	*Tautogolabrus adspersus*	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Fish (unidentified)	*Pisces*	132.8	244.6	131.7	0.0	159.4	784.5	1,592.5	2,005.3	283.0	352.9	0.0	258.3	495.4	82.1
Fourbeard Rockling	*Enchelyopus cimbrius*	0.0	0.0	0.0	0.0	0.7	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1	<0.1
Fourspot Flounder	*Hippoglossina oblonga*	0.0	0.0	0.0	0.0	0.0	0.0	0.5	24.6	1.5	1.9	0.0	0.0	2.4	0.4
Frigate tunas	*Auxis spp*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	<0.1	<0.1
Grubby	*Myoxocephalus aenaeus*	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1
Gulf Stream Flounder	*Citharichthys arctifrons*	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	18.3	12.5	0.1	0.0	2.6	0.4
Haddock	*Melanogrammus aeglefinus*	0.0	0.0	0.2	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	<0.1
Hakes	*Urophycis spp*	0.0	0.0	0.0	0.0	0.0	0.0	10.4	275.6	19.1	26.4	4.6	0.0	28.0	4.6
Large-tooth Flounders	*Etropus spp*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	0.0	0.0	0.1	<0.1
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	0.0	0.8	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	<0.1

Taxon		Jan (n=5)	Feb (n=4)	Mar (n=5)	Apr (n=2)	May (n=3)	Jun (n=2)	Jul (n=2)	Aug (n=2)	Sep (n=3)	Oct (n=4)	Nov (n=8)	Dec (n=3)	Mean	%
Monkfish	*Lophius americanus*	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1
Offshore Hake	*Merluccius albidus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.2	<0.1
Pollock	*Pollachius virens*	0.1	1.1	1.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	<0.1
Rock Gunnel	*Pholis gunnellus*	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	<0.1
Sand Lances	*Ammodytes spp*	52.1	99.3	59.3	86.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8	4.1
Sea Robins	*Prionotus spp*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.3	0.0
Silver Hake	*Merluccius bilinearis*	0.2	0.0	0.0	0.0	0.0	0.0	0.0	21.8	6.3	6.9	7.6	0.0	3.6	0.6
Summer Flounder	*Paralichthys dentatus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.0	23.9	17.4	0.8	9.9	1.6
Windowpane	*Scophthalmus aquosus*	0.0	0.0	0.0	0.0	0.4	0.0	0.0	3.3	26.3	2.0	1.7	0.0	2.8	0.5
Winter Flounder	*Pseudopleuronectes americanus*	0.0	0.0	6.3	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.1
Witch Flounder	*Glyptocephalus cynoglossus*	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	<0.1
Yellowtail Flounder	*Limanda ferruginea*	0.0	0.0	0.0	0.0	7.0	3.6	0.5	0.6	0.0	0.0	0.0	0.0	1.0	0.2
	Total	**206.0**	**347.4**	**204.1**	**89.9**	**172.7**	**793.3**	**1,606.5**	**2,347.0**	**433.9**	**429.7**	**39.6**	**569.1**	**603.3**	**100.0**

Note:
n = number of EcoMon samples collected during each month, within a 10-mile (16-km) radius of the Project

Table 8. Monthly mean larval density (n/100m³) of abundant fish taxa collected in the EcoMon program within 10 miles (16 km) of the SouthCoast Wind offshore HVDC converter station during 2010-2019.

Taxon		Mar (n=1)	May (n=1)	Aug (n=1)	Oct (n=1)	Nov (n=4)	Mean	%
Atlantic Croaker	*Micropogonias undulatus*	0.0	0.0	0.0	0.0	0.4	0.1	0.0
Atlantic Herring	*Clupea harengus*	0.0	0.0	0.0	0.0	5.7	1.1	0.1
Atlantic Menhaden	*Brevoortia tyrannus*	0.0	0.0	0.0	0.0	8.8	1.8	0.1
Butterfish	*Peprilus spp*	0.0	0.0	24.2	0.0	0.0	4.8	0.4
Fish (unidentified)	*Pisces*	0.0	0.0	4,010.7	1,336.7	0.0	1,069.5	83.9
Fourbeard Rockling	*Enchelyopus cimbrius*	0.0	2.0	0.0	0.0	0.0	0.4	0.0
Fourspot Flounder	*Hippoglossina oblonga*	0.0	0.0	49.3	7.5	0.0	11.4	0.9
Frigate tunas	*Auxis spp*	0.0	0.0	0.9	0.0	0.0	0.2	0.0
Hakes	*Urophycis spp*	0.0	0.0	546.6	88.6	9.0	128.9	10.1
Offshore Hake	*Merluccius albidus*	0.0	0.0	0.0	7.5	0.0	1.5	0.1
Pollock	*Pollachius virens*	0.8	0.0	0.0	0.0	0.0	0.2	0.0
Sand Lances	*Ammodytes spp*	45.5	0.0	0.0	0.0	0.0	9.1	0.7
Sea Robins	*Prionotus spp*	0.0	0.0	6.5	0.0	0.0	1.3	0.1
Silver Hake	*Merluccius bilinearis*	0.0	0.0	43.7	13.7	13.6	14.2	1.1
Summer Flounder	*Paralichthys dentatus*	0.0	0.0	0.0	92.4	31.0	24.7	1.9
Windowpane	*Scophthalmus aquosus*	0.0	0.0	6.5	2.4	3.4	2.5	0.2
Winter Flounder	*Pseudopleuronectes americanus*	12.3	4.9	0.0	0.0	0.0	3.4	0.3
	Total	**58.6**	**6.9**	**4,688.4**	**1,548.9**	**71.9**	**1,274.9**	**100.0**

Note:
n = number of EcoMon samples collected during each month, within a 10-mile (16-km) radius of the Project

4.2.2 State Trawl Surveys

The Rhode Island Department of Environmental Management (RI DEM) and Massachusetts Division of Marine Fisheries (MA DMF) each conduct bi-annual (spring and fall) inshore adult/juvenile trawl surveys in state waters to characterize fish abundance. Site-specific data for south of Martha's Vineyard and Nantucket were available from the MA DMF survey, but the RI DEM data included all state waters. Both data sets include sites of similar depth (approx. 164 ft [50 m]) in a reasonable proximity to the SouthCoast Wind intake site and the relative abundance data is therefore likely to represent the species composition for adult fish and invertebrates selected by the trawl gear in the area (**Figure 22**).

The most abundant species present in both surveys for the most recent year available (2021) was scup (*Stenotomus chrysops*; RI DEM 2022, MA DMF 2021). RI DEM's publicly available data does not differentiate between spring and fall surveys, but after scup, the top species were longfin squid, bay anchovy (*Anchoa mitchilli*), weakfish (*Cynoscion regalis*), and Atlantic moonfish (*Selene setapinnis*; **Table 9**), and total of 64 species were captured in 2021 (RI DEM 2022).

Table 9. Abundance and relative abundance of top ten species from Rhode Island Department of Environmental Management trawl survey 2021.

Common Name	Scientific Name	Abundance	Relative Abundance
Scup	*Steotomus chrysops*	58,719	28.00%
Longfin Squid	*Doryteuthis pealeii*	35,910	17.62%
Bay Anchovy	*Anchoa mitchilli*	26,865	13.18%
Weakfish	*Cynoscion regalis*	21,677	10.63%
Atlantic Moonfish	*Selene setapinnis*	13,446	6.60%
Butterfish	*Peprilus triacanthus*	12,456	6.11%
Atlantic Silverside	*Menidia menidia*	11,140	5.46%
Atlantic Menhaden	*Brevoortia tyrannus*	10,492	5.15%
Alewife	*Alosa pseudoharengus*	6,375	3.13%
Atlantic Herring	*Clupea harengus*	1,646	0.81%

For the MA DMF adult and juvenile survey, data were obtained for the 12 stations closest to the proposed SouthCoast Wind intake site, in state waters south of Martha's Vineyard and Nantucket (**Table 10**). In the MA DMF spring survey, scup represented 17% of the catch followed by little skate (*Leucoraja erinacea*) and Atlantic cod (*Gadus morhua*; both 16%), and northern sand lance (*Ammodytes dubius*; 14%; **Table 10**). In the MA DMF fall survey, scup made up 73% of the catch, followed by longfin squid (*Loligo pealeii*) at 17% (**Table 10**). The total fish at these stations in the fall survey (4,632) vastly outnumbered the total for spring (2,894), driven by the large catch (32,366) of scup.

Table 10. Abundance and relative abundance of fish and invertebrates from Massachusetts Division of Marine Fisheries spring and fall bottom trawl survey stations closest to the proposed SouthCoast Wind intake for 2018 2019, and 2021.

Species (Common Name)	Abundance		Relative Abundance (%)		Overall Abundance	Overall Relative Abundance (%)
	Spring	Fall	Spring	Fall		
Stenotomus chrysops (Scup)	484	31,882	16.72	73.07	32,366	69.57
Loligo pealeii (Longfin Squid)	168	7,508	5.81	17.21	7,676	16.5
Peprilus triacanthus (Butterfish)	26	2,670	0.9	6.12	2,696	5.79
Ammodytes dubius (Northern Sand Lance)	414	1,156	14.31	2.65	1,570	3.37
Leucoraja erinacea (Little Skate)	472	72	16.31	0.17	544	1.17
Gadus morhua (Atlantic Cod)	461	0	15.93	0	461	0.99
Merluccius bilinearis (Silver Hake)	248	1	8.57	0	249	0.54
Prionotus carolinus (Northern Searobin)	128	44	4.42	0.1	172	0.37
Leucoraja ocellata (Winter Skate)	113	20	3.9	0.05	133	0.29
Cancer irroratus (Atlantic Rock Crab)	86	34	2.97	0.08	120	0.26
Scophthalmus aquosus (Windowpane)	66	9	2.28	0.02	75	0.16
Pseudopleuronectes americanus (Winter Flounder)	60	1	2.07	0	61	0.13
Decapterus punctatus (Round Scad)	0	59	0	0.14	59	0.13

Species (Common Name)	Abundance		Relative Abundance (%)		Overall Abundance	Overall Relative Abundance (%)
	Spring	Fall	Spring	Fall		
Paralichthys dentatus (Summer Flounder)	33	24	1.14	0.06	57	0.12
Urophycis regia (Spotted Hake)	43	2	1.49	0	45	0.1
Centropristis striata (Black Sea Bass)	18	18	0.62	0.04	36	0.08
Ovalipes ocellatus (Lady Crab)	13	19	0.45	0.04	32	0.07
Etropus microstomus (Smallmouth Flounder)	12	12	0.41	0.03	24	0.05
Majidae (unid. spider crab)	1	23	0.03	0.05	24	0.05
Mustelis canis (Smooth Dogfish)	1	21	0.03	0.05	22	0.05
Hippoglossina oblonga (Fourspot Flounder)	15	2	0.52	0	17	0.04
Alosa pseudoharengus (Alewife)	13	2	0.45	0	15	0.03
Selene setapinnis (Atlantic Moonfish)	0	13	0	0.03	13	0.03
Euspira heros (Northern Moonsnail)	5	1	0.17	0	6	0.01
Lagocephalus laevigatus (Smooth Puffer)	0	6	0	0.01	6	0.01
Menticirrhus saxatilis (Northern Kingfish)	0	6	0	0.01	6	0.01
Morone saxatilis (Striped Bass)	0	6	0	0.01	6	0.01
Myoxocephalus octodecemspinosus (Longhorn Sculpin)	6	0	0.21	0	6	0.01
Anchoa mitchilli (Bay Anchovy)	0	5	0	0.01	5	0.01
Decapterus macarellus (Mackerel Scad)	0	3	0	0.01	3	0.01
Arctica islandica (Ocean Quahog)	1	1	0.03	0	2	0
Brevoortia tyrannus (Atlantic Menhaden)	1	1	0.03	0	2	0
Hemitripterus americanus (Sea Raven)	2	0	0.07	0	2	0
Homarus americanus (American Lobster)	1	1	0.03	0	2	0
Selar crumenophthalmus (Bigeye Scad)	0	2	0	0	2	0
Caranx crysos (Blue Runner)	0	1	0	0	1	0
Conger oceanicus (Conger Eel)	1	0	0.03	0	1	0
Cynoscion regalis (Weakfish)	0	1	0	0	1	0
Dasyatis sabina (Atlantic Stingray)	0	1	0	0	1	0
Limulus polyphemus (Horseshoe Crab)	0	1	0	0	1	0
Prionotus evolans (Striped Searobin)	0	1	0	0	1	0
Sphoeroides maculatus (Northern Puffer)	0	1	0	0	1	0
Stephanolepis hispida (Planehead Filefish)	0	1	0	0	1	0
Syngnathus fuscus (Northern Pipefish)	0	1	0	0	1	0
Urophycis chuss (Red Hake)	1	0	0.03	0	1	0
Zoarces americanus (Ocean Pout)	1	0	0.03	0	1	0
Total	**2,894**	**43,632**	**100**	**100**	**46,526**	**100**

4.2.3 NOAA Fisheries EFH Mapper

The NOAA Fisheries Essential Fish Habitat (EFH) Mapper (EFH Mapper) was used to determine EFH species present at the proposed SouthCoast Wind intake site. The EFH Mapper for this location produced a list of 18 species with eggs or larvae (and often additional life stages; NMFS 2021). For the purposes of this report, only species with EFH for eggs and larvae were included because these are the life stages considered to be susceptible to entrainment by the proposed intake operation (**Table 11**). With expected intake velocities of less than or equal to 0.5 ft/s, older life stages and other species are not considered susceptible to impingent by the proposed intake operation, in accordance with EPA (2001). A full list of all fish and macroinvertebrate taxa, regardless of life stage, having EFH within the Project Area identified from the COP (which includes not only this specific location of the OSP, but also the entire Lease Area and Export Cable Routes) is presented in COP Appendix N: Essential Fish Habitat Assessment.

Table 11. List of EFH species, life stage, management council, and fishery management plan (FMP) for EFH species identified using the NOAA Fisheries EFH mapper.

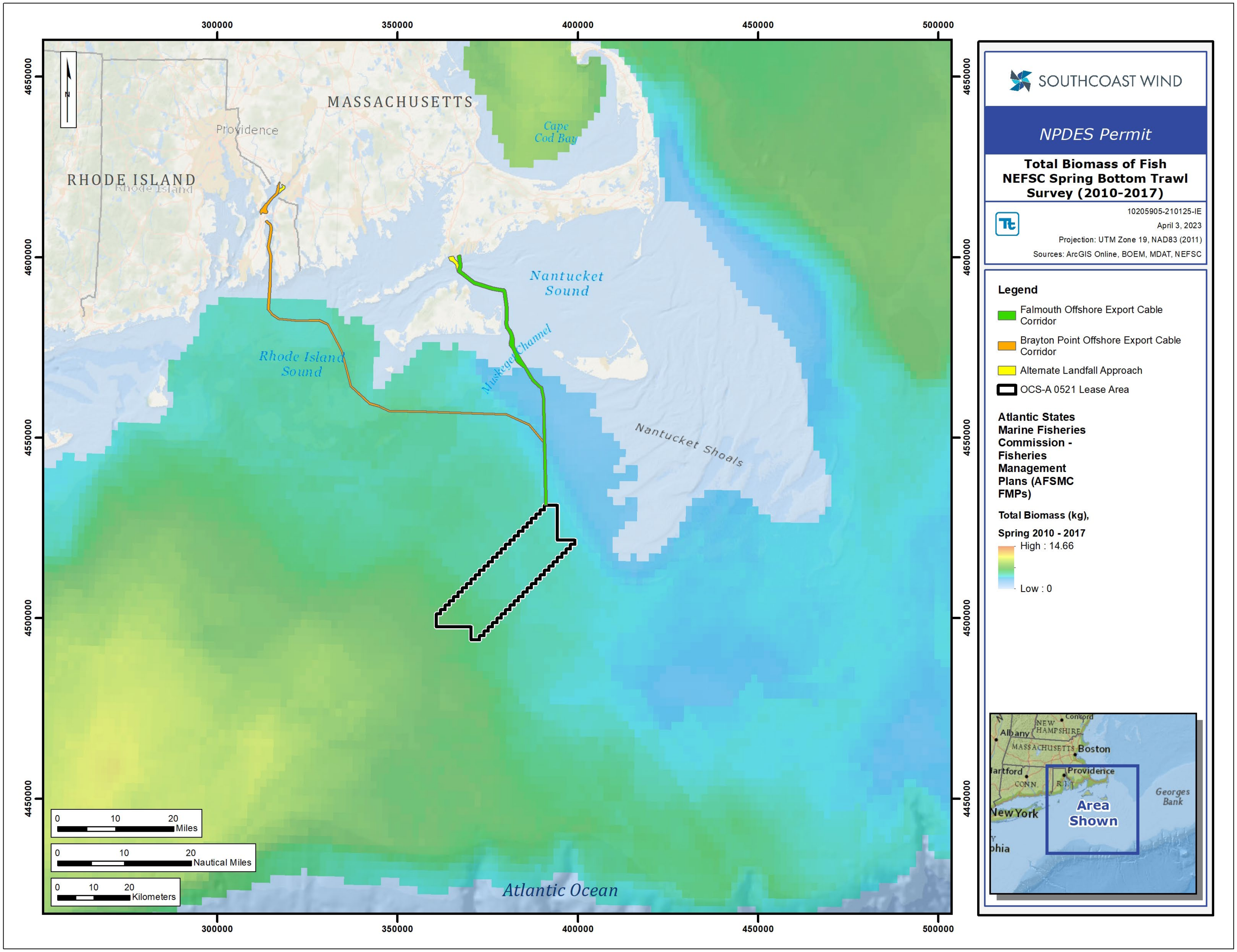
Common Name	Lifestage(s) Found at Location	Management Council	FMP
Atlantic Sea Scallop[1]	ALL	New England	Amendment 14 to the Atlantic Sea Scallop FMP
Haddock[1]	Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
	Adult		
	Larvae		
Ocean Pout[1]	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
	Eggs		
Atlantic Herring[1]	Juvenile	New England	Amendment 3 to the Atlantic Herring FMP
	Larvae		
Atlantic Cod[1]	Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
	Adult		
	Eggs		
Silver Hake[1]	Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
	Eggs/Larvae		
	Adult		
Red Hake[1]	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
	Eggs/Larvae/Juvenile		
Yellowtail Flounder[1]	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
	Juvenile		
	Larvae		
	Eggs		
Monkfish[1]	Adult	New England	Amendment 4 to the Monkfish FMP
	Eggs/Larvae		
	Juvenile		
Windowpane Flounder[1]	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
	Larvae		
	Juvenile		
Witch Flounder[1]	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
	Larvae		
	Eggs		

Common Name	Lifestage(s) Found at Location	Management Council	FMP
Winter Flounder	Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
	Larvae/Adult		
American Plaice[1]	Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
Offshore Hake[1]	Larvae	New England	Amendment 14 to the Northeast Multispecies FMP
Atlantic Pollock[1]	Eggs	New England	Amendment 14 to the Northeast Multispecies FMP
	Larvae		
Atlantic Mackerel[1]	Eggs	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
	Larvae		
	Juvenile		
	Adult		
Atlantic Butterfish[1]	Eggs	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
	Larvae		
	Adult		
	Juvenile		
Summer Flounder[1]	Eggs	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
	Larvae		
	Adult		

Note: *[1]includes egg or larval stage that may be susceptible to entrainment based on spawning habitat/location or stage-specific life history characteristics (non-adhesive egg or pelagic egg/larvae)*
Source: *NOAA Fisheries 2021*

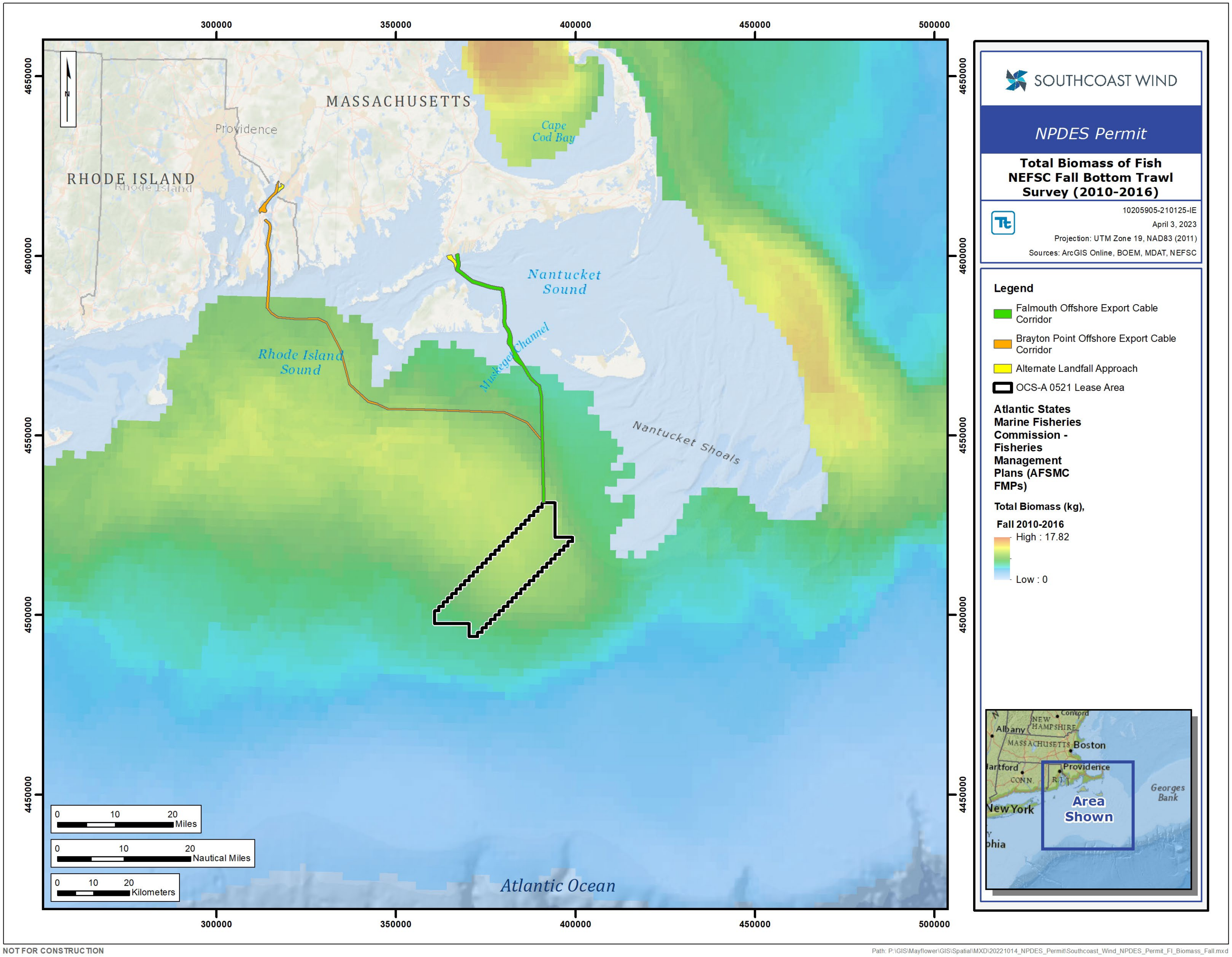
4.2.4 NOAA Fisheries NEFSC Spring and Fall Bottom Trawl Surveys

Since 1963, NOAA Fisheries Northeast Fisheries Science Center (NEFSC) has conducted standardized adult and juvenile bottom trawl surveys during spring (March–April) and fall (September–October) along the US northeastern continental shelf based on a stratified random sampling design. The COP presents spatial information on fish biomass and diversity from recent data collected by the NEFSC trawl surveys, as shown in **Figure 23** through **Figure 26**. The 2010–2017 NEFSC bottom trawl survey data indicate fish biomass during spring was lower in the OCS-A 0521 Lease Area compared to Cape Cod Bay and outer Cape Cod waters. In the fall, when fish move inshore, fish biomass in the Offshore Project Area is less than areas within Cape Cod Bay and Great South Channel, higher than outer Cape Cod waters and similar to other adjacent offshore wind lease areas. During spring, species richness of fish collected in 2010–2017 NEFSC bottom trawl surveys were relatively low in the northeastern half of the Lease Area compared to waters in the other offshore wind areas to the west and waters offshore of Cape Cod, however in the southeastern half of the Lease Area, species richness of fish was relatively high. Species richness of fish in the Lease Area was higher during the fall compared to spring and was similar to adjacent areas during both seasons. The NEFSC survey data is suitable for characterizing spatial distribution and species composition of juvenile and adult fish exposed to impingement. Species present in these surveys during their respective spawning seasons may also be a reasonable surrogate for the species richness associated with ichthyoplankton in the water column that might be subject to entrainment through the OSP.



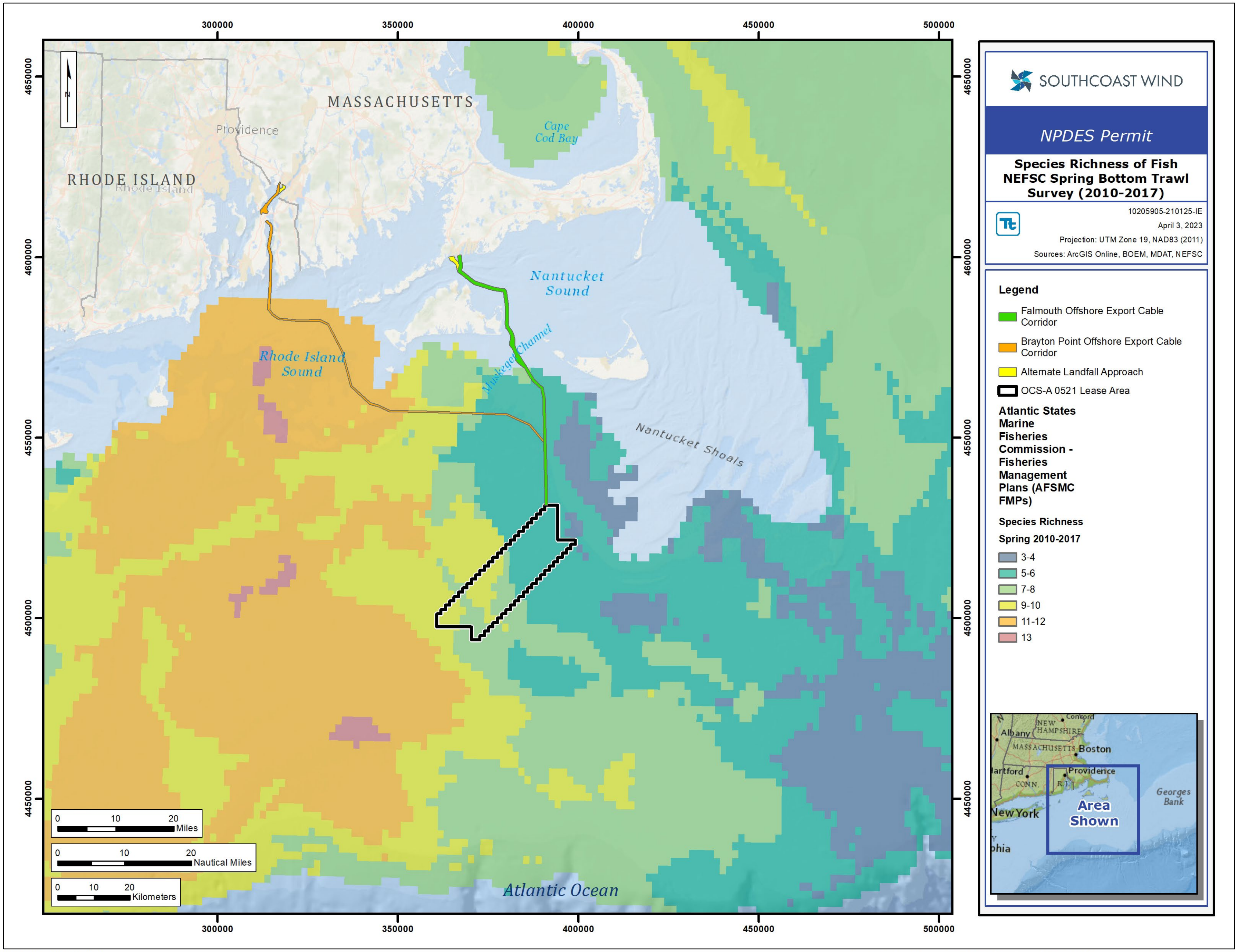
Source: NEFSC 2020b

Figure 23. Total Biomass in kilograms (kg) Results of NEFSC Spring Bottom Trawl Surveys (2010 – 2017)



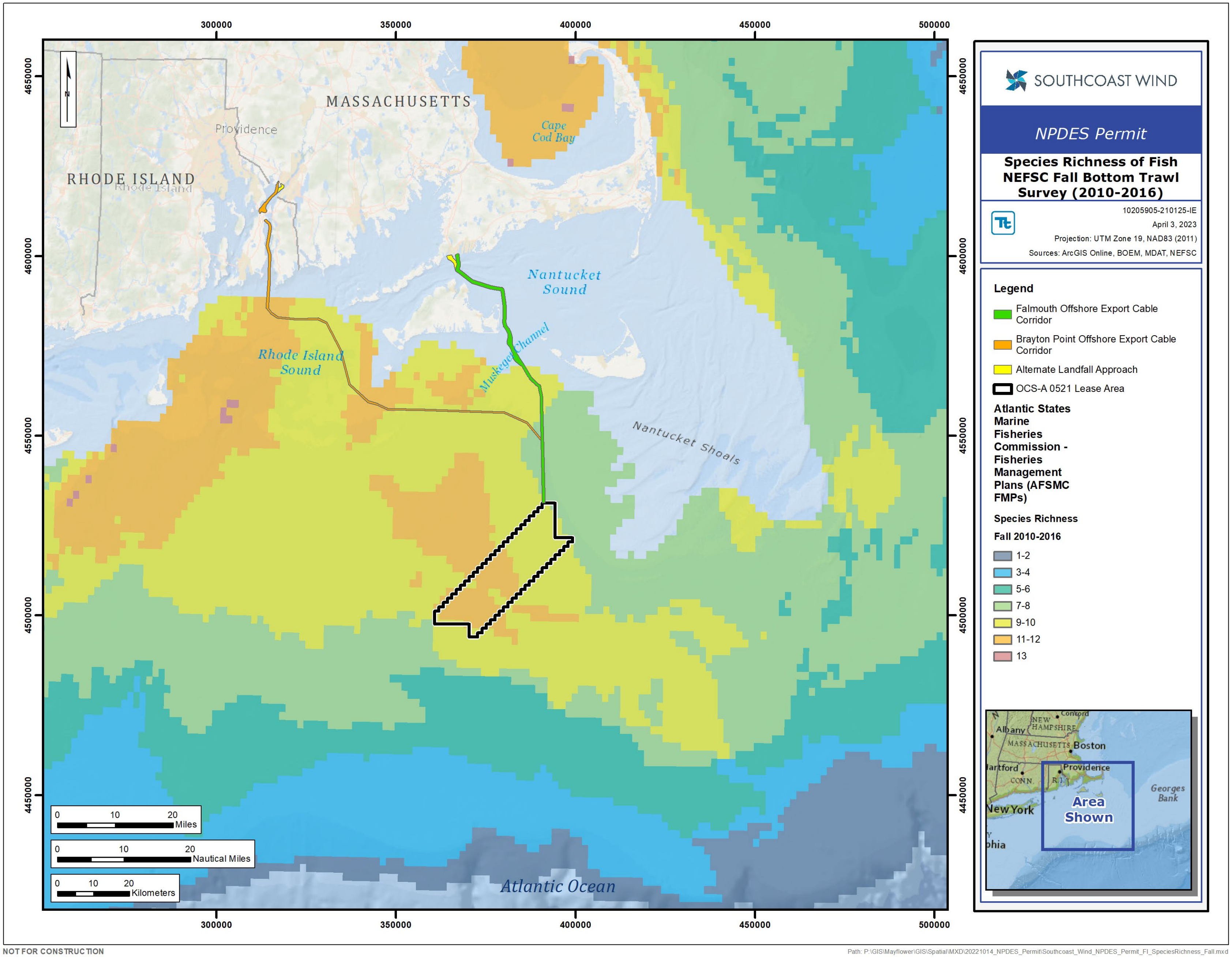
Source: NEFSC 2020b

Figure 24. Total Biomass (kg) Results of NEFSC Fall Bottom Trawl Surveys (2010 – 2016)



Source: NEFSC 2020b

Figure 25. Species Richness Results of NEFSC Spring Bottom Trawl Surveys (2010 – 2017)



Source: NEFSC 2020b

Figure 26. Species Richness Results of NEFSC Fall Bottom Trawl Surveys (2010 – 2016)

4.2.5 Other Sources

The SouthCoast Wind COP included a review of the literature to determine the fish species likely to be present at the Offshore Project Area. It found that the bi-annual resource trawl surveys conducted in Nantucket Sound between 1978 and 2004 included 122 species (ESS Group, Inc. and Battelle 2006). A multiyear fishery independent survey (2009 to 2012) in Rhode Island and Block Island Sounds identified 101 species (Malek et al. 2014). A full list of all fish and macroinvertebrate taxa from these studies and their Endangered Species Status (ESA) is presented in **Table 12**.

Table 12. List of species identified for the Offshore Project Area of SouthCoast Wind in the Construction and Operations Plan.

Group	Common_Name	Species	ESA Status
Marine bony fish	Albacore tuna	*Thunnus alalunga*	none
	American Plaice	*Hippoglossoides platessoides*	none
	Butterfish	*Peprilus triacanthus*	none
	Atlantic Cod	*Gadus morhua*	none
	Atlantic Herring	*Clupea harengus*	none
	Atlantic Mackerel	*Scomber scombrus*	none
	Atlantic Wolffish	*Anarhichas lupus*	none
	Black Sea Bass	*Centropristis striata*	none
	Bluefin Tuna	*Thunnus thynnus*	none
	Bluefish	*Pomatomus saltatrix*	none
	Haddock	*Melanogrammus aeglefinus*	none
	Monkfish	*Lophius americanus*	none
	Ocean Pout	*Macrozoarces americanus*	none
	Offshore Hake	*Merluccius albidus*	none
	Pollock	*Pollachius pollachius and P. virens*	none
	Red Hake	*Urophycis chuss*	none
	Scup	*Stenotomus chrysops*	none
	Silver Hake	*Merluccius bilinearis*	none
	Skipjack Tuna	*Katsuwonus pelamis*	none
	Summer Flounder	*Paralichthys dentatus*	none
	White Hake	*Urophycis tenuis*	none
	Windowpane Flounder	*Scophthalmus aquosus*	none
	Winter Flounder	*Glyptocephalus cynoglossus*	none
	Yellowfin Tuna	*Thunnus albacares*	none
	Yellowtail Flounder	*Pleuronectes ferruginea*	none
Anadromous fish	Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	ESA endangered (NY Bight DPS)
	Shortnose Sturgeon	*Acipenser brevirostrum*	ESA endangered
Elasmobranchs	Barndoor Skate	*Dipturus laevis*	none
	Little Skate	*Leucoraja erinacea*	none
	Winter Skate	*Leucoraja ocellata*	none
	Basking Shark	*Cetorhinus maximus*	none
	Blue Shark	*Prionace glauca*	none

Group	Common_Name	Species	ESA Status
	Common Thresher Shark	*Alopias vulpinus*	none
	Dusky Shark	*Carcharhinus obscurus*	none
	Great White Shark	*Carcharodon carcharias*	none
	Porbeagle Shark	*Lamna nasus*	none
	Sand Tiger Shark	*Carcharias taurus*	none
	Sandbar Shark	*Carcharhinus plumbeus*	none
	Shortfin Mako Shark	*Isurus oxyrinchus*	ESA candidate
	Smoothhound Shark	*Mustelus canis*	none
	Spiny Dogfish	*Squalus acanthias*	none
	Tiger Shark	*Galeocerdo cuvier*	none
Macroinvertebrates	Atlantic Sea Scallop	*Placopecten magellanicus*	none
	Atlantic Surfclam	*Spisula solidissima*	none
	Longfin Inshore Squid	*Doryteuthis pealeii*	none
	Northern Shortfin Squid	*Illex illecebrosus*	none
	Ocean Quahog	*Arctica islandica*	none

Source: AECOM et al. 2021
Note: DPS = Distinct Population Segment.

4.3 Impingement and Entrainment Susceptibility – (r)(4)(iii)

No site-specific studies on impingement or entrainment have been conducted. Impingement and entrainment susceptibility was determined from publicly available data sets and the literature.

The CWIS is expected to withdraw cooling water from the ocean at rate of approximately 9.9 MGD and maintain an intake velocity of 0.5 ft/s or less, as discussed in Section 3. The EPA considers intake velocities of 0.5 ft/s or less a suitable compliance option to minimize impingement impacts. The design calls for a once-through cooling system because closed-cycle cooling is not a feasible option for an unmanned offshore facility. Since impingement compliance is obtained through meeting the 0.5 ft/s velocity requirement, and there are no traveling screens on which a fish could become impinged, therefore impingement impacts should not be considered further.

The species and life stages most susceptible to entrainment are fish eggs and larvae from species that spawn in the proximity of the proposed intake structure. Based on the EFH Mapper results in conjunction with MarMap/EcoMon ichthyoplankton samples and MA DMF trawl surveys, these would include haddock (*Melanogrammus aeglefinus*) larvae, ocean pout (*Zoarces americanus)* eggs, Atlantic herring (*Clupea harengus*) larvae, Atlantic cod (*Gadus morhua*) eggs and larvae, silver hake (*Merluccius bilinearis)* eggs and larvae, red hake (*Urophycis chuss*) eggs and larvae, yellowtail flounder (*Pleuronectes ferruginea)* eggs and larvae, monkfish (*Lophius americanus)* eggs and larvae, windowpane (*Scophthalmus aquosus)* larvae, witch flounder (eggs and larvae), winter flounder (*Pseudopleuronectes americanus)* larvae, American plaice (*Hippoglossoides platessoides*) larvae, silver/offshore hake (*Merluccius bilinearis/albidus*)(larvae), pollock (*Pollachius virens*) eggs and larvae, Atlantic mackerel (*Scomber scombrus)* eggs and larvae, butterfish (*Peprilus triacanthus*) eggs and larvae, and summer flounder (*Paralichthys dentatus*) eggs and larvae. While not all of these species were represented in the data set of fish larvae from MARMAP/EcoMon (Section 4.2.1; **Table 7** and

Table 8), many of them were, leading to further likelihood of their presence near the proposed SouthCoast Wind intake site.

Additional information on EFH species is included in SouthCoast Wind COP Appendix N: EFH Assessment. However, not all EFH species accounted for in that report are included here, since that report includes the larger Lease Area *and* export cable routes, whereas this permit application is focused on the specific CWIS location, at the OSP, within the Lease Area only.

In absence of site-specific ichthyoplankton densities, EcoMon plankton data from 1977–2019 was used to estimate entrainment abundance from cooling water withdrawal by the CWIS at the offshore converter station. Given the limitations of recent data immediately in the vicinity of the intake location, the minimum, mean, and maximum larval densities observed within 10 miles (16 km) of the CWIS location over the full time series were used to extrapolate the range of entrainment abundance assuming a water withdrawal rate of 9.9 MGD. The annual entrainment abundance of fish larvae was estimated to range from 8.3 million to 174.4 million with a mean estimate of 83.2 million (**Table 13**). Based on monthly mean larval densities and excluding unidentified fish (68.4 million), the taxa with the highest estimated larval entrainment annually were hakes (3.9 million), Atlantic herring (3.9 million), sand lances (3.3 million), summer flounder (1.3 million), and silver hake (0.5 million; **Table 14**). Larval density data Excel files from the EcoMon plankton dataset used to generate **Table 8**, **Table 13**, and, **Table 14** are available as part of this permit application. The highest monthly estimated entrainment of fish larvae occurred in June through August; dominated by unidentified fish species, which was the most abundant taxa group (82.2% of all individuals) in the EcoMon dataset, as shown in **Figure 27**, with other notable abundances for Atlantic herring, sand lances, summer flounder, and hakes.

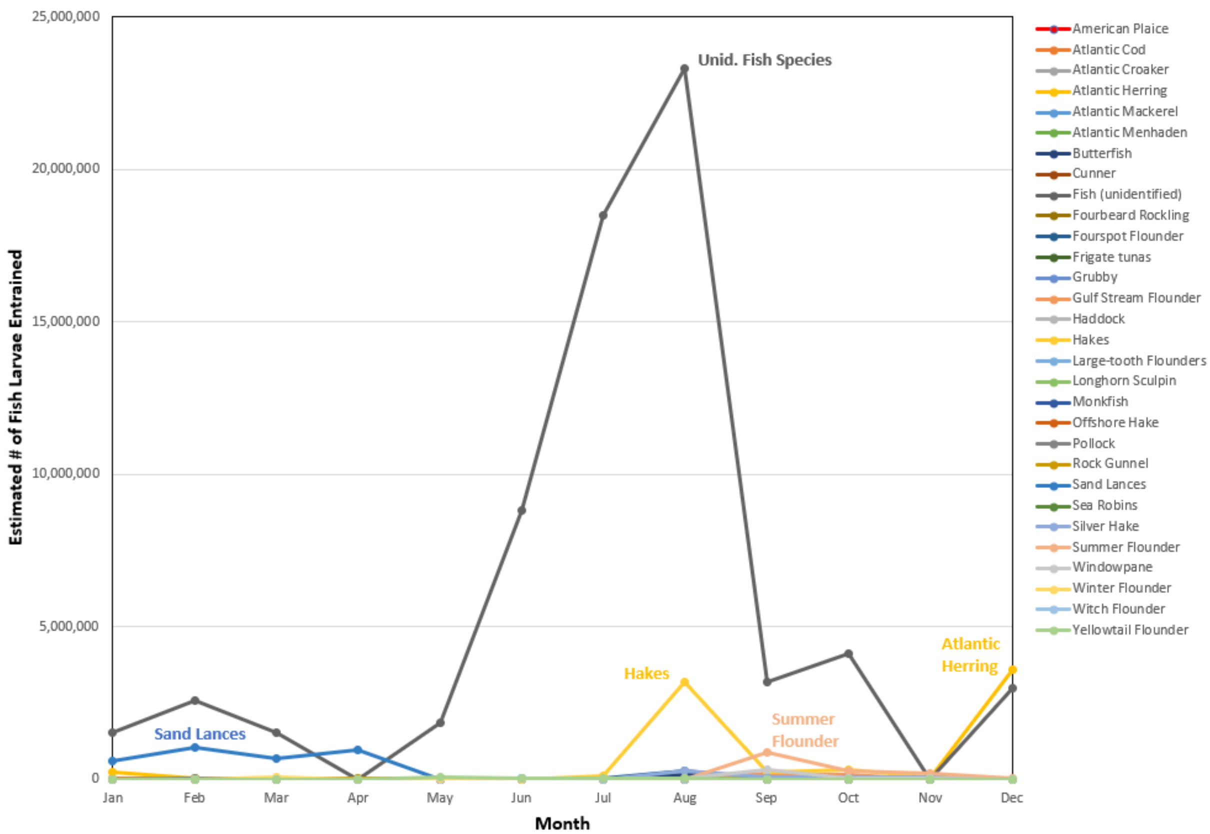


Figure 27. Estimated mean numbers of fish larvae entrained per month, based on 1977-2019 EcoMon density data

These larval entrainment estimates assume the 1977–2019 time series is representative of the current and future species composition. However, the species composition cannot be fully-differentiated, since the majority of individuals in the applicable dataset were not identified beyond 'unidentified fish larvae'. Also, species diversity may be underestimated within the raw annual entrainment of all fish and life stages because publicly available EcoMon data set excludes all fish eggs and larvae of less common fish taxa (although some proportion of that abundance is accounted for in the 'unidentified fish larvae' category). An approximation of potential egg entrainment densities can be assumed based on other entrainment monitoring studies in the open ocean, such as that of existing offshore LNG Facilities in Massachusetts, and similar proposed offshore LNG facilities in the Gulf of Mexico, which report overall egg densities ranging between 3 to 15 times higher than larval densities during the same sampling periods, as would be expected since most fish species are broadcast spawners with pelagic eggs; therefore substantial numbers of eggs do not survive to the larval stage due to exceptionally high natural mortality resulting from predation by marine organisms and other factors (Murua and Saborido-Rey 2003; Helfman et al. 2009). Furthermore, for broadcast-spawning species, a largely unknown but highly variable proportion of spawned eggs in the water column are not fertilized or viable (Lambert et al. 2003), and therefore impacts to entrained unfertilized/unviable eggs cannot be assessed or quantified in the same manner as for fertilized/viable eggs or larval stages, since unfertilized/unviable eggs will not contribute to the recruitment potential of the cohort into which they were spawned. The non-surface 74 ft (22.6 m) depth of withdrawal is expected to be a substantial mitigating factor to minimize the entrainment of fish eggs, regardless of viability, since the eggs of many offshore fish species are buoyant (Sundby and Kristiansen 2015).

Table 13. Estimated (flow-based projections) monthly and annual abundance of fish larvae entrained by cooling water withdrawn at a rate of 9.9 MGD for SouthCoast Wind's Offshore HVDC Converter Station CWIS, based on monthly mean larval densities observed by EcoMon within 10 miles (16 km) during 1977-2019.

Month	Number of Samples	Min	Mean	Max
Jan	5	45,229	2,392,735	7,685,427
Feb	4	124,488	3,645,628	7,009,604
Mar	5	680,822	2,371,345	4,115,157
Apr	2	239,280	1,010,610	1,781,910
May	3	79,732	2,006,661	5,576,745
Jun	2	11,580	8,918,910	17,826,210
Jul	2	2,304,943	18,663,457	35,021,971
Aug	2	65,441	27,266,081	54,466,659
Sep	3	441,900	4,878,420	10,540,020
Oct	4	180,110	4,991,620	17,993,981
Nov	8	10,800	445,770	2,496,090
Dec	3	4,141,166	6,611,556	9,928,990
Annual Total	**43**	**8,325,491**	**83,202,793**	**174,442,764**

Table 14. Estimated (flow-based projections) monthly and annual mean abundance of fish larvae by taxon entrained by cooling water withdrawn at a rate of 9.9 MGD for SouthCoast Wind's Offshore HVDC converter station CWIS, based on monthly mean larval densities observed by EcoMon within 10 miles (16 km) during 1977-2019.

Taxon	Jan (n=5)	Feb (n=4)	Mar (n=5)	Apr (n=2)	May (n=3)	Jun (n=2)	Jul (n=2)	Aug (n=2)	Sep (n=3)	Oct (n=4)	Nov (n=8)	Dec (n=3)	Annual (n=43)
American Plaice	0	0	4,092	0	2,480	0	0	0	0	0	0	0	6,572
Atlantic Cod	11,997	8,652	40,734	23,970	0	0	0	0	0	0	0	0	85,353
Atlantic Croaker	0	0	0	0	0	0	0	0	0	0	2,070	0	2,070
Atlantic Herring	227,695	8,400	4,092	0	0	0	0	0	0	0	40,230	3,602,200	3,882,617
Atlantic Mackerel	0	0	0	0	26,009	34,860	6,045	0	0	0	0	0	66,914
Atlantic Menhaden	0	0	0	0	0	0	0	0	0	0	49,590	0	49,590
Butterfish	0	0	0	0	0	0	0	140,399	23,280	6,727	0	0	170,406
Cunner	0	0	0	0	0	0	11,749	0	0	0	0	0	11,749
Fish (unidentified)	1,543,335	2,566,172	1,529,633	0	1,851,413	8,820,120	18,501,110	23,296,717	3,181,620	4,099,905	0	3,000,521	68,390,546
Fourbeard Rockling	0	0	0	0	7,595	0	6,045	0	0	0	0	0	13,640
Fourspot Flounder	0	0	0	0	0	0	6,045	286,223	16,650	21,917	0	0	330,835
Frigate tunas	0	0	0	0	0	0	0	5,425	0	0	0	0	5,425
Grubby	0	0	2,046	0	0	0	0	0	0	0	0	0	2,046
Gulf Stream Flounder	0	0	0	0	0	0	5,704	0	206,280	145,328	1,350	0	358,662
Haddock	0	0	2,728	0	0	5,790	0	0	0	0	0	0	8,518
Hakes	0	0	0	0	0	0	120,714	3,201,308	215,250	306,652	52,020	0	3,895,944
Large-tooth Flounders	0	0	0	0	0	0	0	0	3,060	9,021	0	0	12,081
Longhorn Sculpin	0	8,316	4,092	5,850	0	0	0	0	0	0	0	0	18,258
Monkfish	0	0	0	0	0	5,790	0	0	0	0	0	0	5,790
Offshore Hake	0	0	0	0	0	0	0	0	0	21,917	0	0	21,917
Pollock	1,705	11,592	20,770	0	3,782	0	0	0	0	0	0	0	37,849
Rock Gunnel	0	0	0	11,760	0	0	0	0	0	0	0	0	11,760
Sand Lances	605,740	1,042,496	689,471	969,030	0	0	0	0	0	0	0	0	3,306,737
Sea Robins	0	0	0	0	0	0	0	37,820	0	0	0	0	37,820
Silver Hake	2,263	0	0	0	0	0	0	253,797	71,010	79,670	85,410	0	492,150
Summer Flounder	0	0	0	0	0	0	0	0	865,170	277,419	195,690	8,835	1,347,114

Taxon	Jan (n=5)	Feb (n=4)	Mar (n=5)	Apr (n=2)	May (n=3)	Jun (n=2)	Jul (n=2)	Aug (n=2)	Sep (n=3)	Oct (n=4)	Nov (n=8)	Dec (n=3)	Annual (n=43)
Windowpane	0	0	0	0	4,960	0	0	37,820	296,100	23,064	19,410	0	381,354
Winter Flounder	0	0	73,687	0	28,861	0	0	0	0	0	0	0	102,548
Witch Flounder	0	0	0	0		11,640	0	0	0	0	0	0	11,640
Yellowtail Flounder	0	0	0	0	81,561	40,710	6,045	6,572	0	0	0	0	134,888
Total	**2,392,735**	**3,645,628**	**2,371,345**	**1,010,610**	**2,006,661**	**8,918,910**	**18,663,457**	**27,266,081**	**4,878,420**	**4,991,620**	**445,770**	**6,611,556**	**83,202,793**

Note:
n = number of EcoMon samples collected during each month, within a 10-mile (16-km) radius of the Project

4.4 Reproduction, Recruitment, and Peak Abundance – (r)(4)(iv)

Relevant taxa were defined as those species with EFH for egg or larval life stages likely to be present at the proposed SouthCoast Wind intake location. This approach was conservative considering the available EcoMon data does not include all of these species actually being present at the sites sampled closest to the proposed intake location. Available information on the primary period of reproduction, recruitment, and peak abundance is included for each species in the following subsections. This information is also summarized in **Table 15**.

Table 15. Period of peak reproduction, recruitment, and abundance for EFH species likely to be present near the proposed intake site for SouthCoast Wind

Species	Reproduction	Recruitment	Abundance a/	Source(s)
Haddock	January–June	February–August	March, June	NOAA 2022a; NEFMC 2017; Laurence 1978; Fahay 1983
Ocean Pout	September–October	N/A	N/A	NOAA 2020a; NEFMC 2017; Clark and Livingstone 1982; Methven and Brown 1991
Atlantic Herring	October–November	Spring	December	NOAA 2022b; NEFMC 2017; Graham et al. 1972
Atlantic Cod	Late winter–early spring	Spring	March	NEFMC 2021; Zemeckis et al. 2014; NEFMC 2017; Fahay 1983; Lough et al. 1989; Colette and Klein-McPhee 2002
Silver/Offshore Hake	May–June	Autumn	August	NOAA 2022d; NEFMC 2017; NEFSC 1999a; NEFSC 1999b; Colette and Klein-McPhee 2002
Red Hake	May–June	October–November	August	NEFMC 2016b; NEFMC 2017; NEFSC 1999c; Collette and Klein-McPhee 2002
Yellowtail Flounder	March–August	Summer–Fall	May	NEFSC 1999d; NEFMC 2016b; Fahay 1983
Monkfish	February–October	Early Summer	June	NOAA 2022f; NEFSC 1999e; NEFMC 2016b; NEFMC 1998; NEFMC 2017; Fahay 1983,
Windowpane	April–May; October–November	July–October	September	NOAA 2022g; NEFSC 1999f; Colette and Klein-McPhee 2002; Morse and Able 1995
Witch Flounder	March–November	June–July	June	NOAA 2020b; NEFSC 1999g; Colette and Klein-McPhee 2002
American Plaice	March–June	Late Summer	March–April	NEFMC 2016b; Morgan 2001; Collette and Klein-McPhee 2002
Atlantic Pollock	November–February	Spring-Summer	March	NOAA 2022h; NEFSC 1999h
Atlantic Mackerel	April–May	Summer-Fall	June	NOAA 2022i; NEFSC 1999i; Collette and Klein-McPhee 2002
Butterfish	June–July	Autumn	August	NOAA 2022j; NEFMC 2017; NEFSC 1999j; Collette and Klein-McPhee 2002
Summer Flounder	September-December	Spring, Summer, Fall	September	NOAA 2022k; NEFSC 1999k; Collette and Klein-McPhee, 2002

Note:
a/ Period of peak abundance taken from MarMap/EcoMon data.

4.4.1 Haddock (*Melanogrammus aeglefinus)*

4.4.1.1 Reproduction

Haddock spawn yearly between January and June in and around the vicinity of Nantucket Shoals where substrates consist of rock, gravel, sand, or mud bottoms (NOAA 2022a; NEFMC 2017). Female haddock can produce between 850,000 to three million eggs per year releasing unfertilized eggs in large batches on the seafloor. After fertilization by males, eggs become buoyant and remain pelagic for approximately two weeks before hatching (NEFSC 2005a). Upon hatching at 2 to 5 millimeters (mm), larvae will remain pelagic for 2 to 3 months drifting with ocean currents both inshore and out to coastal waters before settling to the ocean floor (NOAA 2022a). Haddock eggs and larvae are primarily found at depths ranging from 30 to 150 m (NEFSC 2005a).

4.4.1.2 Recruitment

Haddock larvae metamorphose into juveniles in roughly 30 to 42 days at lengths of 2 to 3 centimeters (cm), making the expected period of larval recruitment from February to August (Fahay 1983; Laurence 1978). Early juveniles remain in the upper water column for several months until reaching lengths around three to 10 cm, when they begin feeding and eventually settling to the ocean floor (NEFSC 2005a; NOAA 2022a).

4.4.1.3 Peak Abundance

Haddock larvae were identified in MarMap/EcoMon bongo net samples from March and June over the 42-year sample period from 1977 to 2019.

4.4.2 Ocean Pout *(Zoarces americanus)*

4.4.2.1 Reproduction

Ocean pout migrate inshore, including to bays and estuaries, in the fall to spawn from September to October (NOAA 2020b; NEFMC 2017). Females deposit and guard their eggs on substrates or rocky crevices for approximately 2 to 3 months until they hatch. Once hatched, ocean pout remain in benthic habitat throughout adulthood (NOAA 2020b).

4.4.2.2 Recruitment

Ocean pout larvae remain on or near the bottom and are not susceptible to capture in ichthyoplankton surveys. They are about 30 mm long at hatching and relatively advanced in development, suggesting a very brief larval phase and no susceptibility to an intake placed in the water column (Clark and Livingstone 1982; Methven and Brown 1991).

4.4.2.3 Peak Abundance

Ocean pout larvae were not identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake between 1977 and 2019.

4.4.3 Atlantic Herring *(Clupea harengus)*

4.4.3.1 Reproduction

Atlantic herring spawn in the fall from October to November (NOAA 2022b). Eggs are deposited on the seafloor at depths of 5 to 90 meters on substrates consisting of rock, gravel, or coarse sand or attached to macrophytes (NEFSC 2005b). Schools of spawning herring create a large, dense carpet of eggs that stick to the benthic substrates, with each female depositing 30,000 to 200,000 eggs (NEFSC 2005b; NOAA 2022b). Egg predation and unfavorable environmental conditions often cause a high rate of egg mortality. Hatching occurs at approximately two weeks, and larvae are found throughout the water column in depths ranging from 10 to 250 m (NEFSC 2005b).

4.4.3.2 Recruitment

Atlantic herring have a very long larval stage lasting 4-8 months. Larvae are transported to inshore and estuarine waters where they metamorphose into early-stage juveniles in the spring (Graham et al. 1972).

4.4.3.3 Peak Abundance

Atlantic herring larvae were identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius during the months of November, December, January, February, and March, with peak abundance in December over the 42-year sample period.

4.4.4 Atlantic Cod *(Gadus morhua)*

4.4.4.1 Reproduction

Atlantic cod spawning occurs year-round, peaking in late winter to early spring, on the ocean floor of rocky inshore habitats and offshore banks (NEFMC 2021; Zemeckis et al. 2014). Females can produce three to nine million eggs and perform broadcast spawning at regular intervals throughout the spawning season (NOAA 2022c; Zemeckis et al. 2014). Eggs are fertilized by males immediately upon release by females, becoming buoyant and pelagic and drifting in ocean currents for 2-3 weeks before hatching (NEFMC 2021; Zemeckis et al. 2014). Larvae are pelagic and occupy the water column from the surface to depths of about 75 m (NEFMC 2021).

Studies on spawning dynamics have identified primary Southern New England spawning areas in the northeastern region of Georges Bank, with some scattered areas across western Georges Bank, Nantucket Shoals, and areas offshore Rhode Island and Southern Massachusetts, such as Cox's Ledge (DeCelles et al. 2017; Zemeckis et al. 2014). There are no known Atlantic cod spawning grounds near the proposed OSP location, though entrainment of cod eggs and larvae may occur as a result of larval transport to the vicinity of the Project Area. Near-surface ocean circulation patterns in New England waters are suspected of transporting cod eggs and larvae from spawning sites in both Georges Bank and the Gulf of Maine to waters near the Project Area (Zemeckis et al 2014).

4.4.4.2 Recruitment

Transformation of Atlantic cod larvae to the juvenile stage occurs at sizes greater than 20 mm, followed by recruitment to bottom habitats at 2 to 6 cm, generally after a pelagic duration of no more than 2 months (Colette and Klein-McPhee 2002; Fahay 1983; Lough et al. 1989).

4.4.4.3 Peak Abundance

Atlantic cod larvae were identified from January through April in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake between 1977 and 2019. The peak abundance was in March.

4.4.5 Silver/Offshore Hake *(Merluccius bilinearis/albidus)*

4.4.5.1 Reproduction

Silver and offshore hake spawn late spring to early summer (May to June) and are considered serial spawners, producing and depositing up to three batches of eggs in a single spawning season (NOAA 2022d). Eggs and larvae from both species are pelagic and are dispersed by ocean currents in coastal and offshore regions of continental shelf (NEFMC 2017). While eggs have been found over large expanses on the continental shelf, silver hake primary spawning grounds occur between Cape Cod and Montauk Point, on the southern regions of Georges Bank, and the region north of Cape Cod to Cape Ann (NEFMC 2016a). Plankton surveys have captured both silver and offshore hake eggs and larvae in depths ranging from 10 to 1250 m, but primarily in depths of 50 to 150 m (NEFSC 1999a; NEFSC 1999b).

4.4.5.2 Recruitment

Silver hake exist as pelagic larvae for about 2 months and at about 17-20 mm long recruit to the benthos as juveniles, generally in the fall (Colette and Klein-McPhee 2002). Growth and recruitment of silver and offshore hake of New England and mid-Atlantic are presumed to be similar (NEFSC 1999b).

4.4.5.3 Peak Abundance

Silver and offshore hake larvae were identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake between 1977 and 2019 in the months of August through November and January, peaking in August.

4.4.6 Red Hake *(Urophycis chuss)*

4.4.6.1 Reproduction

Red hake spawn late spring to fall, peaking in June to July (NEFMC 2016b). Spawning occurs primarily on continental shelf waters of the mid-Atlantic and southern New England, but eggs been found in waters from the Gulf of Maine through offshore Cape Hatteras (NEFMC 2016b). Eggs, larvae, and ripe adult females have also been found in higher salinity regions of coastal bays, primarily in New England states (NEFMC 2016b). Eggs and larval red hake are buoyant and found in the upper water column, mainly in surface waters (NEFSC 1999c).

4.4.6.2 Recruitment

Transformed juveniles remain pelagic until reaching lengths of around 25 to 30 mm total length (TL). Red hake begin recruitment to the benthos at lengths of approximately 35 to 40 mm in September through December, with the peak in October-November (Collette and Klein-McPhee 2002; NEFSC 1999c).

4.4.6.3 Peak Abundance

The MarMap/EcoMon data did not distinguish between red hake and spotted hake (*Urophycis regalis*). Larvae for *Urophycis spp* were present in July through November with the peak abundance in August between 1977 and 2019.

4.4.7 Yellowtail Flounder *(Pleuronectes ferruginea)*

4.4.7.1 Reproduction

Yellowtail flounder spawn in the spring and summer (March to August) (NEFSC 1999d). Eggs are deposited on the ocean floor and float to the surface upon fertilization (NOAA 2022e). Eggs are primarily found in the upper water column and towards the surface—from 30 to 90 m—in waters of Georges Bank, Cape Cod Bay, and the continental shelf of southern New England south to Delaware Bay (NEFMC 2016b; NEFSC 1999d). Larvae are also pelagic and drift in surface waters from 10 to 90 m, though have been found as deep as 1250 m (NEFSC 1999d).

4.4.7.2 Recruitment

Yellowtail flounder larvae begin to inhabit benthic habitats once they transform to the juvenile stage at 11.6-16 mm standard length (SL) (Fahay 1983; NEFSC 1999d).

4.4.7.3 Peak Abundance

The subset MarMap/EcoMon data from 1977 to 2019 identified yellowtail flounder larvae in samples from May through August, with a peak in May.

4.4.8 Monkfish *(Lophius americanus)*

4.4.8.1 Reproduction

Monkfish spawn between February to October, peaking in late spring to early summer months, in waters across the continental shelf throughout New England and the mid-Atlantic (NOAA 2022f; NEFMC 2016b; NEFMC 1998). Females deposit eggs in large, buoyant mucoidal egg “veils” which can contain more than one million eggs (NOAA 2022f). Egg veils float near the surface and are dispersed by ocean currents and wind for a few weeks until they disintegrate and larvae hatch (NEFMC 2016a; NEFMC 1998). Larvae are pelagic and found at a wide range of depths from 25 to over 1000 m, though most abundantly from 30 to 90 m (NEFMC 2016b; NEFSC 1999e).

4.4.8.2 Recruitment

Larval recruitment of monkfish occurs at 5-10 cm TL when the elongate fins and body gradually assume the adult form and generally peaks in early summer (NEFSC 1999e; Fahay 1983).

4.4.8.3 Peak Abundance

Monkfish larva was only identified in June in samples from the subset MarMap/EcoMon data from 1977 to 2019.

4.4.9 Windowpane *(Scophthalmus aquosus)*

4.4.9.1 Reproduction

Windowpane spawn in the spring (April to May) and fall (October to November) with peak spawning occurring in the fall (NOAA 2022g). Eggs are pelagic and occur throughout the water column, primarily at depths of less than 70 m (NEFSC 1999f). Eggs hatch within approximately 8 days and larvae remain pelagic, drifting in surface waters (NOAA 2022g; NEFSC 1999f). Peak densities of recently spawned larvae (2-4 mm TL) occur in the southern Mid-Atlantic Bight in May and November, and on Georges Bank in July-October (Morse and Able 1995).

4.4.9.2 Recruitment

Windowpane larvae settle to the bottom at approximately 10 mm TL, though planktonic larval specimens have been collected on Georges Bank up 20 mm in length (Colette and Klein-McPhee 2002; NEFSC 1999f). Spring-spawned windowpane larvae settle in both estuaries and on the continental shelf and grow more rapidly, reaching 11 to 19 cm TL by September (NEFSC 1999f). Fall-spawned fish only settle on the continental shelf and have slower growth rates, reaching an estimated 18 to 21 cm TL by the following fall (Morse and Able 1995; NEFSC 1999f). Juveniles and adults generally occur in shallower water habitats of less than 110 m (NEFSC 1999f).

4.4.9.3 Peak Abundance

Windowpane larvae were identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake between 1977 and 2019 in the months of May and August through November, peaking in September.

4.4.10 Witch Flounder *(Glyptocephalus cynoglossus)*

4.4.10.1 Reproduction

Witch flounder gather in dense aggregations to spawn in areas of cold water at or near the ocean floor during March through November, with peak spawning occurring during the summer months (NOAA 2020c). Witch flounder are typically found in deep waters, down to approximately 1500 m (NEFSC 1999g). Eggs are pelagic and found water column, most commonly observed from 30 to 150 m, but as deep as 1250 m (NEFSC 1999g).

4.4.10.2 Recruitment

The pelagic larval stage is lengthy, lasting 4–6 months, potentially up to one year (Colette and Klein-McPhee 2002; NEFSC 1999g). Recruitment to the benthos peaks around mid-winter (presuming a peak spawning period of June to July). The size at which larvae transform to juveniles and begin to inhabitant the bottom can vary greatly, ranging from 20-68 mm (NEFSC 1999g).

4.4.10.3 Peak Abundance

Witch flounder larvae were identified only June in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake site between 1977 and 2019.

4.4.11 American Plaice *(Hippoglossoides platessoides)*

4.4.11.1 Reproduction

American plaice are batch spawners, depositing eggs every few days during the spawning season, which lasts from around March through June and peaking in April and May in the Gulf of Maine and Georges Bank (Morgan 2001; NEFMC, 2016b). Eggs are deposited on the ocean floor by females typically at depths greater than 56 m, down to over 165 m (NEFSC 2004). Once fertilized the eggs float towards surface waters where they remain pelagic (30 to 90 m) for approximately 2 weeks until hatching (NOAA 2021a; NEFSC 2004; NEFMC 2016b). Larvae are also pelagic and are dispersed by ocean currents in surface waters (NEFSC 2004). Surveys have indicated that high abundance of American plaice larvae occurs in the spring throughout Georges Bank and the Great South Channel at 50 to 110 m depths (NEFSC 2004).

4.4.11.2 Recruitment

Metamorphosis of American plaice larvae is complete by 30 to 40 mm TL, and they drift deeper as they grow until they find suitable habitat on the seafloor. This period of recruitment generally peaks in late summer (Collette and Klein-McPhee 2002).

4.4.11.3 Peak Abundance

American plaice were identified in samples from MarMap/EcoMon subset for station within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake site between 1977 and 2019 in March and April.

4.4.12 Atlantic Pollock *(Pollachius virens)*

4.4.12.1 Reproduction

Atlantic pollock spawn over hard, stony, or rocky benthic substrates multiple times per season, generally peaking in late fall through winter (November through February) (NOAA 2022h; NEFSC 1999h). Spawning grounds span throughout the Gulf of Maine and western Georges Bank (NEFMC 2016b). Fertilized eggs and larvae are both buoyant and pelagic and found at depths ranging from 20 to 270 m and deeper, though most have been observed in the 50 to 90 m range (NEFMC 2016b; NEFSC 1999h).

4.4.12.2 Recruitment

Pollock reach juvenile stages after 3 to 4 months; at which time they inhabit pelagic and benthic habitats from intertidal inshore waters in Long Island Sound and Narraganset Bay to 180 m or deeper on the continental shelf in the Gulf of Maine and Georges Bank (NEFMC 2016b; NEFSC 1999h).

4.4.12.3 Peak Abundance

Pollock larvae were identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake site between 1977 and 2019 in December through May, peaking in March.

4.4.13 Atlantic Mackerel *(Scomber scombrus)*

4.4.13.1 Reproduction

Atlantic mackerel are batch spawners, spawning around five to seven times per season and exhibiting fecundity of between 285,000 to almost two million eggs (NOAA 2022i). Spawning peaks in the spring (April to May) in the Mid-Atlantic Bight, approximately 10 to 30 miles offshore, and progressively later through June and early July moving north (NEFSC 1999i). Eggs hatch within five to seven days, and larvae are pelagic, found throughout the water column from 10 to 130 m (NEFSC 1999i).

4.4.13.2 Recruitment

Larvae transform to swimming juvenile stage fish within 2 months (during Summer and Fall) at lengths around 50 mm, when schooling behavior begins (Collette and Klein-McPhee 2002; NEFSC 1999i). Juveniles are generally present in depths ranging from 20 to 70 m down to 340 m, depending on season (NEFSC 1999i).

4.4.13.3 Peak Abundance

Atlantic mackerel larvae were identified in the MarMap/EcoMon subset data in May through July, peaking in June between 1977 and 2019.

4.4.14 Butterfish *(Peprilus triacanthus)*

4.4.14.1 Reproduction

Butterfish spawn in the summer months, mainly June and July (NOAA 202022j). Eggs and larvae are buoyant and pelagic, occurring over wide expanses of the Mid-Atlantic Bight from high salinity areas of estuaries to the outer continental shelf. Eggs and larvae are dispersed by ocean currents as they generally occur in the upper 200 m of the water column in deeper waters, and throughout the water column in waters shallower than 200 m (NEFSC 1999j). Larvae may undergo diel vertical migrations, as survey catches have showing increased abundance in the upper 4 m of the water column at night (NEFSC 1999j). Larvae and juveniles are also commonly associated with jellyfish, *Sargassum*, and other flotsam in the open ocean (NEFSC 1999j).

4.4.14.2 Recruitment

Larvae reaching sizes of 10 to 15 mm are able to swim, often associating with patches of flotsam (NEFSC 1999j). Larval butterfish may undergo diel vertical migrations, potentially congregating near the surface at night (NEFSC 1999j). Butterfish grow rapidly, and reach juvenile stage at approximately 16 mm, and assume adult schooling behavior at about 60 mm, generally by Fall (Collette and Klein-McPhee 2002).

4.4.14.3 Peak Abundance

Butterfish larvae were identified in samples from MarMap/EcoMon subset for stations within a 10-mile (16-km) radius of the proposed SouthCoast Wind intake site in August through October, peaking in August between 1977 and 2019.

4.4.15 Summer Flounder (*Paralichthys dentatus*)

4.4.15.1 Reproduction

Summer flounder spawning occurs during offshore migration to wintering grounds on southern New England and mid-Atlantic continental shelf from September through December (NEFSC 1999k). Spawning occurs later into the winter and spring in southern mid-Atlantic regions (NEFSC 1999k). Fecundity is size-dependent, females can produce between 460,000 to more than four million eggs (NOAA 2022k). Eggs are buoyant and pelagic and occur at various depths depending on season: 30 to 70 m in the fall, over 100 m in the winter, and 10 to 30 m in the spring. When hatched, larvae drift with currents towards coastal areas, occurring most abundantly within 85 km from shore and in depths around 10 to 70 m (NEFSC 1999k).

4.4.15.2 Recruitment

Summer flounder post-larvae migrate inshore during metamorphosis and settle in estuaries, generally in spring, fall, and summer; with many juveniles overwintering in estuaries, as well (Collette and Klein-McPhee 2002; NEFSC 1999k).

4.4.15.3 Peak Abundance

Summer flounder larvae were identified in the MarMap/EcoMon subset near the proposed SouthCoast Wind intake site in September through December, peaking in September between 1977 and 2019.

4.5 Seasonal and Diel Patterns – (r)(4)(v)

Seasonal and diel patterns in biological organisms in the vicinity of the CWIS were determined from publicly available data and the literature, in lieu of site-specific ichthyoplankton data.

Seasonality of biological organisms in the neritic zone is generally determined by species life history, including migrations for spawning and feeding. Similarly, zooplankton like the copepods prevalent in this area (see Section 4.2.1) exhibit seasonal fluctuations due to the availability of phytoplankton and other nutrients (e.g., Head and Pepin 2010).

During the winter months, finfish biodiversity in the area near the intake location is expected to decrease. In the spring anadromous species passing through the area on their way to the coastal zone increases diversity (Mattocks et al. 2017; Schtickzelle and Quinn 2007). Additionally, seasonal and highly migratory finfish species that use the Offshore Project Area for spawning and foraging in the spring and summer months. Seasonal patterns of fish larvae and eggs are based on spawning season, which varies by species (see Section 4.4.), and diel patterns of larvae may include vertical migrations to feed at night.

4.6 Threatened, Endangered, and Protected Species – (r)(4)(vi)

4.6.1 Fishes

There are two bony fish species listed in the federal ESA that are known to occur in the Offshore Project Area: Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) and Shortnose Sturgeon (*Acipenser brevirostrum*) (Greater Atlantic Regional Fisheries Office 2019). With exception of the Atlantic Sturgeon from Gulf of Maine Distinct Population Segment (DPS) which are threatened, all other subpopulations or DPSs are listed as endangered. The Shortnose Sturgeon is listed as threatened. Both species spawn in freshwater rivers throughout the Northeast where larvae remain until they reach the subadult life stage (Bain 1997), and therefore they are not susceptible to entrainment at an intake structure located offshore. Impingement of these sturgeon species at an offshore facility is improbable given the expected intake configuration and operation at SouthCoast Wind's offshore HVDC converter station.

Other threatened or endangered species that may be present around the SouthCoast Wind's CWIS include the Oceanic Whitetip Shark (*Carcharhinus longimanus*; threatened), Giant Manta Ray (*Manta birostris*; threatened) and Shortfin Mako Shark (*Isurus oxyrinchus*; ESA candidate for listing, NOAA 2021b). These species also employ reproductive or other life history strategies (gives birth to live young, highly migratory; Castro 2010) that make them unsusceptible to impingement and entrainment.

4.6.2 Marine Mammal Forage Species

The SouthCoast Wind CWIS would entrain various planktonic organisms, some of which may be prey species (e.g., copepods [*Calanus* spp. and *Pseudocalanus* spp] and other zooplankton) important to the foraging base of marine mammals, such as the endangered North Atlantic right whale (*Eubalaena glacialis*) within the Project Area.

Laboratory experiments carried out to determine the effects of chlorine treatment associated with cooling water intakes on entrained copepod species found that the entrainment processes typically resulted in copepod mortality due to not only the biocide treatment, but also thermal stress influenced by exposure time (Ershath et al. 2019). Melton and Serviss (2000) suggested that longer exposure durations were associated with higher mortality rates and shorter exposure durations associated with lower mortality rates. Once dead, the copepod carcass becomes less dense as it decomposes, retaining its buoyancy before slowly falling to the sea floor (NSF 2011). Within the Great South Channel off New England, a large dense patch of copepods was investigated (Wishner et al. 1988), where an area of accumulated copepod exoskeletons and partially decomposed copepods was attributed to predation of right whales feeding on an adjacent live patch of copepods. In the York

River estuary, Virginia, copepod carcasses were analyzed to determine how long they remained suspended in the water column before sinking to the sea floor (Elliot et al. 2011). Turbulent mixing kept carcasses suspended in the water column as microbial decomposition reduced the dry weight of the carcasses within the first eight hours after death. Presumably, if copepods from a prey patch overlapping with the CWIS remain floating in the water column following entrainment through the CWIS and discharge back to the source water, they may still be available as North Atlantic right whale prey consumed within the live patch of copepods.

EPA assumes 100 percent mortality of all early life-stage organisms that are entrained through a CWIS, without site-specific verification studies (EPA 2001; 2014). However, as demonstrated in site-specific studies at various facilities, actual entrainment mortality may be substantially less than 100 percent for certain taxonomic groups and under certain operational parameters (e.g., discharge temperature, physical abrasion, chlorination levels, etc.), particularly for some species of marine planktonic crustaceans (Bamber & Seaby 2004; EPRI 2009; EPA 2004). Due to the wide range of responses and tolerance to these stressors across taxa and differences across source water bodies and cooling water systems, it is challenging to study and broadly predict how individuals of certain species may be impacted, especially considering confounding effects of entrainment stressors occurring simultaneously and within a discrete location (EPRI 2005).

Assessing the magnitude of copepod entrainment impacts on whales may be achieved by comparison to assessments completed by other facilities that use seawater cooling systems in the region. The Northeast Gateway Offshore LNG Terminal Project offshore of Massachusetts has comparatively similar types of entrainment impacts as those that are anticipated by the SouthCoast Wind CWIS. As part of the Environmental Assessment for the Northeast Gateway facility, Dr. Robert Kenney developed a bioenergetic model to address the impacts of the removal of zooplankton and small fish on marine mammals and whether cooling water system entrainment would remove excessive biomass of prey beyond natural variability and recovery rates. Based on whale metabolism research by Kenney et al. (1985) and Trites and Pauly (1998), the estimated daily and annual prey consumption rates for an individual North Atlantic right whale are from 518 to 774 kilograms per day and 46,587 to 69,985 kilograms per year while present off the coast of Massachusetts (Northeast Gateway 2012). The Northeast Gateway Project operations were estimated to potentially remove approximately 1,700 kilograms per year of zooplankton and small fish (while utilizing up to 56 MGD); which was considered a negligible volume of prey items relative to individual and population requirements of whales occurring in the region (Northeast Gateway 2012). Therefore, the SouthCoast Wind CWIS operations, which has a considerably lower DIF of 9.9 MGD, compared to 56 MGD at Northeast Gateway, would be expected to entrain proportionally lower numbers of prey and would therefore also be considered a negligible impact.

4.7 Agency Consultation – (r)(4)(vii)

As part of the development of the COP for this Project, SouthCoast Wind has participated in numerous agency consultations and public participation activities, which are documented in COP Section 1.6, containing a description of SouthCoast Wind's approach to agency/stakeholder engagement. COP Appendix A (Agency Correspondence) contains a full list of SouthCoast Wind's correspondences with federal, state, and local agencies to-date.

In addition, specific to this NPDES Application, SouthCoast Wind also held an initial consultation meeting with EPA Region 1 on May 23, 2022, and a follow-up consultation meeting with EPA Region 1 on July 11, 2023. Additional NPDES-specific consultations are expected with EPA Region 1, Bureau of Ocean Energy Management (BOEM), NOAA Fisheries, and other agencies/stakeholders during application review and development of the Draft/Final NPDES Permit for this Project.

5.0 OCEAN DISCHARGE CRITERIA – SECTION §125, SUBPART M

Under §125 Criteria and Standards for the NPDES, Subpart M guidelines for issuance of NPDES permits are established for the discharge of pollutants from a point source into the territorial seas, the contiguous zone, and the oceans. It is required under §125.122(a) that the director determine whether a discharge will cause unreasonable degradation of the marine environment, and that discharges in compliance with section 301(g), 301(h), or 316(a) variance requirements or state water quality standards shall be presumed not to cause unreasonable degradation of the marine environment, for any specific pollutants or conditions specified in the variance or the standard. Under §125, Subpart M, the director shall determine whether a discharge will cause unreasonable degradation of the marine environment based on consideration of the parameters and criteria listed in **Table 16**, which includes a cross-walk of where that information can be found in this application and supporting materials, such as the SouthCoast Wind COP. Each of these criteria are addressed within this permit application or within the COP (and related assessments) submitted separately as part of the federal permitting dashboard[3] associated with this Project, with the resulting assessment that no reasonable alternatives to ocean discharge exist, and that ocean discharge will not result in unreasonable degradation of the marine environment.

3 https://www.permits.performance.gov/permitting-project/southcoast-wind-energy-llc-southcoast-wind

Table 16. Ocean Discharge Criteria and Applicability

Ocean Discharge Criteria	Applicability to the SouthCoast Wind OSP	Location of Information
The quantities, composition and potential for bioaccumulation or persistence of the pollutants to be discharged	The OSP will not discharge any bioaccumulating pollutants. All pollutants to be discharged are documented in the application.	NPDES Application, Form 2E NPDES Application, Appendix A: Thermal Plume Modeling
The potential transport of such pollutants by biological, physical or chemical processes		
The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain	Biological communities are characterized, per §122.21(r)(4), with additional information in the COP	NPDES Application Narrative, Section 4 COP – Volume 2: Section 6.6 through 6.9
The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism		
The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs	None of these features are proximate to the OSP	COP Appendix L1 – Offshore Designated Protected Areas Report
The potential impacts on human health through direct and indirect pathways	No impacts to human health anticipated	COP – Volume 2: Section 15 – Public Health and Safety
Existing or potential recreational and commercial fishing, including finfishing and shellfishing	Impacts to fish and shellfish are characterized, per §122.21(r)(4)	COP – Volume 2: Section 11 – Commercial and Recreational Fisheries and Fishing Activity COP – Appendix V – Commercial and Recreational Fisheries and Fishing Activity Technical Report
Any applicable requirements of an approved Coastal Zone Management plan	Applicability of Coastal Zone Management Act Consistency are documented	COP – Appendix D1 – Massachusetts Coastal Zone Management Act Consistency Certification – Falmouth POI COP – Appendix D2 – Massachusetts Coastal Zone Management Act Consistency Certification – Brayton Point POI COP – Appendix D3 – Rhode Island Coastal Zone Management Act Consistency Certification – Brayton Point POI
Such other factors relating to the effects of the discharge as may be appropriate	Documentation of the extent of the thermal plume/mixing zone	NPDES Application, Appendix A: Thermal Plume Modeling
Marine water quality criteria developed pursuant to section 304(a)(1)	No site-specific water quality criteria	NPDES Application Narrative, Section 2.2.2 COP – Volume 2: Section 5.2 - Water Quality

6.0 COMPLIANCE WITH TRACK I REQUIREMENTS – SECTION §125, SUBPART I

Although the offshore converter station CWIS facility proposed by SouthCoast Wind is not itself considered to be a new power generating facility, it is operationally part of a new power generating facility. Despite this type of converter station facility not being specifically identified in the Phase I Rule, it is assumed to be subject to this subpart since it meets the following criteria in §125.81:

- It is a point source that uses or proposes to use a cooling water intake structure;
- It has at least one cooling water intake structure that uses at least 25 percent of the water it withdraws for cooling purposes as specified in paragraph (c) of this section; and
- It has a design intake flow greater than two (2) MGD.

The SouthCoast Wind offshore converter station CWIS is a new facility and may choose to comply with Track I or Track II requirements. Based on anticipated flow requirements (DIF less than 10 MGD) and intake configuration, SouthCoast Wind expects to comply with a maximum design intake velocity of 0.5 ft/s, and chooses to comply with Track I requirements, as outlined below.

6.1 Intake Flow – Section §125.84(b)(1)

The CWIS described in Section 3 is designed to withdraw a maximum design intake flow of 9.9 MGD of once-through non-contact cooling water. As an unmanned facility, the OSP is not equipped to accommodate closed-cycle recirculating cooling water system (e.g., cooling towers), and there is currently no market-availability for this technology on unmanned OSPs, therefore it is not feasible to reduce flow to a level commensurate with that of a closed-cycle recirculating cooling water system. For this reason, a closed-cycle recirculating cooling water system is not considered for further evaluation, as further evaluated in Middleton and Barnhart (2022).

Since closed-cycle recirculating cooling is not an available option for this unmanned facility, SouthCoast Wind did not conduct a detailed analysis. However, three OSP suppliers were queried as to whether a closed cycle-cooling system would be possible and all three responded that while some developers have shown interest in the concept, they had not designed one before. The SouthCoast Wind team is therefore proceeding with the existing options from OSP suppliers, with the intent of selecting a proven existing system design. A newly-developed and unproven closed-cycle cooling option (even if feasible) introduces unacceptable risk, with a concern that new design solution may lead to a reduction in reliability and availability for the unmanned facility, given the critical nature of the cooling system.

6.2 Intake Velocity – Section §125.84(b)(2)

The CWIS described in Section 3 is designed to withdraw a maximum design intake flow (DIF) of 9.9 MGD. Each of the three intake caissons would have a maximum operational capacity of 4.95 MGD and will each be in compliance with a maximum intake velocity of 0.5 ft/s. Since each intake caisson operates independently, intake velocity is calculated at the end (bell mouth opening) of each intake caisson. This intake velocity is supported by the following parameters, incorporated into the calculation of velocity within a pipe (**V** = **Q** ÷ **A**), where **V**=velocity; **Q**=flow rate; **A**=cross-sectional open-area of pipe (adjusted for reduction of cross-sectional area, due to the bar rack dimensions):

- Maximum intake flow rate per caisson = 780 m^3/h (3,434 gpm). Each operating independently.
- Inside diameter of bell mouth opening = 1.445 m (4.74 ft)
  - Each bar in the bar rack is approx. 20 mm (0.8 in) wide x 1445 mm (56.9 in) long = 0.029 m^2 x 3 (# of bars) = 0.087 m^2 (0.936 ft^2)
- Cross-sectional open area of caisson inlet = 1.640 m^2 (17.65 ft^2), adjusted for the area occupied by the bar rack (0.087 m^2 (0.936 ft^2) = 1.553 m^2 (16.72 ft^2)
- The bar rack accounts for approximately 5 percent reduction in open area of the intake caisson bell mouth opening, compared to an open-pipe

Maximum through-screen intake velocity, based on the above parameters:

V = 780 m^3/h ÷ 1.553 m^2 = 502.25 m/h ÷ 3,600 s = 0.1395 m/s **= 0.458 ft/s** (with clean grid)

To be within the 0.5 ft/s velocity requirement, the free open area must be at least 1.400 m^2, and in this case is 1.553 m^2. However, this open area is assumed to be partially reduced over time due to fouling/marine growth. With the caisson/bell mouth dimensions above, this leaves approximately 0.153 m^2 as a reasonable fouling margin, which equals about 10 percent of the total open area when the grid is clean. If an additional fouling margin is warranted, an engineering solution may be to increase the size of the bell mouth opening, during the final design stage. Alternatively, a maintenance schedule to ensure that biofouling does not result in the intake velocity exceeding 0.5 ft/s may be implemented. The inline flowmeter at each of the intake caissons would be a reasonable method to quantify and track this during operations. SouthCoast Wind is open to either of these solutions (or a combination of), to ensure the 0.5 ft/s intake velocity limit is not exceeded.

6.3 Tidal Prism – Section §125.84(b)(3)

Although the offshore converter station facility is located in a tidal system, the Atlantic Ocean, it is not located in an estuary or tidal river. The open-ocean nature of the source waterbody, rather than an enclosed estuary or tidal river, results in the total design intake flow over one tidal cycle of ebb and flow of far less than 1 percent of the volume of the water column during one tidal excursion at the mean low water level. Since this type of calculation is applicable only to ocean inlets, estuaries, rivers, lagoons, etc. (USACE 1976) it is not considered for this facility.

6.4 Select and Implement Design and Construction Technologies for Minimizing Impingement Mortality and Entrainment – Section §125.84(b)(4) and (5)

A preliminary screening of design and construction technologies or operational measures has been conducted as part of this Application to determine which alternatives offer the greatest potential for minimizing impingement mortality or entrainment impacts at the proposed converter station facility and therefore may warrant further discussion in this section (**Table 17**). Technologies and operational measures were screened based upon feasibility for implementation at the facility, biological effectiveness (i.e., ability to achieve reductions in either impingement mortality or entrainment), and cost of implementation (including capital, installation, and annual operations and maintenance costs). The information included in this section is applicable to the Best Technology Available (BTA) for reducing impingement mortality or entrainment impacts at the SouthCoast Wind converter station facility. Such technologies and operational measures are further described with extensive detail on feasibility (including examples of case studies) by the Electric Power Research Institute's *Fish Protection Technology Manual* (EPRI 2012) and EPA's support documents for the Phase I Cooling Water Intake Rule (EPA 2001). An evaluation of the feasibility of closed-cycle cooling systems (e.g., cooling towers, subsea coolers, air cooling, etc.) for offshore HVDC converter stations by BOEM determined that as of 2022, innovations in cooling systems are being studied and developed, but so far, no new systems are tested and available for use on a commercial scale (Middleton and Barnhart 2022). Therefore, closed-cycle cooling should not be considered BTA for this type of facility.

Table 17. Technology, Operation, or Design Features Considered for the SouthCoast Wind OSP Converter Station

Category	Technology, Operation, or Design Feature	Status at SouthCoast Wind OSP	Fish Protection Potential		Feasible for Consideration
			Impingement Mortality	Entrainment	
Flow Reduction, from design intake flow (DIF)	Single pump operation or dual-pump operation at reduced capacity	Part of design	MAYBE	YES	YES – referenced in text
	Closed cycle re-circulating cooling (cooling towers)	Not part of the design	MAYBE	YES	NO – Closed-cycle cooling designs for use in unmanned offshore applications are not commercially viable and, based on current evaluations, would not be commercially feasible for the Project. Unlike oil and gas platforms, this offshore substation will be an unmanned facility. Given the high cooling loads and critical nature of the reliability of the CWIS for unmanned operations, closed-cycle cooling system (cooling tower, or air cooled), or closed-loop cooling system (subsea cooled heat exchangers) are not available technologies for this type of unmanned offshore facilities, based on existing supplier and engineering capabilities for HVDC converter stations of this type (Middleton and Barnhart 2022). Closed-cycle systems would also require large cooling tower equipment or extensive fan arrays. Space and weight constraints on the offshore substation, based on the amount of electrical substation and converter station equipment required as well as safety and operability requirements would not be compatible with this unmanned facility. As an unmanned facility, the OSP is not equipped to accommodate closed-cycle recirculating cooling water system (e.g., cooling towers), and there is currently no market-availability for this technology on unmanned OSPs, therefore not considered for further evaluation.
	Subsea coolers[1]	Not part of the design	YES	YES	NO – Subsea heat exchangers are not an available technology for unmanned offshore facilities, based on existing supplier and engineering capabilities for HVDC converter stations of this type. Additionally, subsea heat exchange systems are typically located directly on the seafloor and would create space conflicts with the inter-array cables and submarine export cables approaching the offshore substation as well as the need for separate vessel work area during installation and decommissioning. Configuration of facility not equipped for subsea heat exchangers, and there is currently no market-availability for this technology on unmanned offshore substations, therefore not considered for further evaluation (Middleton and Barnhart 2022).
	Seawater lift pumps with variable frequency drives	Part of the design	MAYBE	YES	YES – referenced in text

Category	Technology, Operation, or Design Feature	Status at SouthCoast Wind OSP	Fish Protection Potential		Feasible for Consideration
			Impingement Mortality	Entrainment	
	The use of fresh water or grey water for cooling	Not part of the design	MAYBE	YES	NO – adequate fresh or grey water supply does not exist, therefore not considered for further evaluation.
	Scheduled Outages during periods of peak impingement mortality & entrainment	Not part of the design	MAYBE	YES	NO – seasonal outages not anticipated, therefore not considered for further evaluation.
	The use of air cooling	Not part of the design	YES	YES	NO – Air cooling with fan arrays may be theoretically implemented on an offshore substation but would require a substantial additional area and would require moving critical equipment outside thus exposing it to the marine atmosphere. This would result in unacceptable failure rates of the equipment used in this technology is therefore not feasible from an engineering perspective for this unmanned installation. Configuration of facility not equipped for air cooling from an engineering or structural perspective, therefore not considered for further evaluation (Middleton and Barnhart 2022).
Physical Barriers	Depth of withdrawal (intake caisson depth)	Part of the design	MAYBE	YES	YES – referenced in text
	Barrier Net/Marine life exclusion system	Not part of the design	YES	YES	NO – not a proven technology in open ocean settings, therefore not considered for further evaluation.
Behavioral Barriers	Velocity cap intake	Not part of the design	YES	NO	NO – A velocity cap intake can be an effective means of minimizing impingement (by redirecting the vertical flow into a horizontal flow, which some fish species can more easily avoid), but applications are limited to coastal facilities within a few miles of shore. The complex structural components associated with the substation platform would inhibit a horizontal flow-path at the CWIS, limiting the utility of a velocity cap intake for this type of facility. Not a proven technology in OSP applications, therefore not considered for further evaluation. Furthermore, the low intake velocity of 0.5 ft/s meets impingement mortality compliance standards.
	Strobe light, acoustic deterrents, air bubble curtains (only effective for certain target species)	Not part of the design	MAYBE	NO	NO – not a proven technology in open ocean settings, therefore not considered for further evaluation.

Category	Technology, Operation, or Design Feature	Status at SouthCoast Wind OSP	Fish Protection Potential		Feasible for Consideration
			Impingement Mortality	Entrainment	
Collection/ Diversion Systems	Modified traveling screens with standard mesh, slot mesh or fine mesh (including Ristroph features [e.g., buckets, fish return, etc.])	Not part of the design	YES	MAYBE	NO – configuration of facility not equipped for traveling screens. The low intake velocity of 0.5 ft/s meets impingement mortality compliance standards.
	Cylindrical wedge wire screens	Not part of the design	YES	YES	NO – Wedgewire screens are not a typical installation for this type of offshore unmanned substation in a marine environment – a 'crash-bar' rack or grid type of debris screen, as proposed here is typical. Additional engineering challenges/constraints exist for installing wedgewire screens at the bottom of a pump caisson. Furthermore, biofouling of a wedgewire screen would introduce a maintenance concern that could not be overcome at an unmanned facility. Wedgewire screens have been utilized in limited applications, typically in freshwater systems, with very limited use in the marine environment (and none at an unmanned facility). A bar rack on the bottom of the intake caisson will be designed to provide sufficient open-area, to limit the velocity through the openings to 0.5 ft/s. Not a proven technology on this type of unmanned offshore platform, with engineering constraints, biofouling, and maintenance as primary concerns (as described in EPRI 2012), therefore not considered for further evaluation.

Note:
Technologies/operational measures presented does not imply that a particular technology/operational measure will be implemented at the SouthCoast Wind offshore converter station facility. 'MAYBE' refers to impingement mortality or entrainment reduction potential under certain conditions.

[1]Includes passive non-contact cooling via "subsea cooler," which has been considered but is not currently commercially or technically viable. No full-scale systems with similar service are in operation and would therefore present a high operational risk. Technology qualification of this alternative system would need to be carried out, including testing and accepted engineering standards met. Also, the replacement and retrieval method of subsea cooler modules is still immature and current supply chain is not sufficiently developed.

As summarized in **Table 17**, there are several technologies or operational measures that are capable of reducing impingement mortality or entrainment at a conventional power generating station or manufacturing facility, where implementation is appropriate. Many of these technologies or operational measures however, are not available for implementation at the SouthCoast Wind offshore converter station CWIS facility due to the configuration of the facility, limited space at the facility's footprint, unproven implementation in open ocean applications, unproven implementation at unmanned OSPs, and other reasons. Also, some of the technologies or operational measures may reduce impingement mortality, but SouthCoast Wind is choosing to comply with impingement mortality standards by maintaining a maximum intake velocity of 0.5 ft/s. Several of the technologies or operational measures listed in **Table 17** (e.g., closed-cycle cooling, air cooling, fresh/grey water, seasonal outages, barrier net, traveling screens, velocity cap, behavioral barriers) were not considered feasible for the SouthCoast Wind offshore converter station CWIS facility primarily due to the engineering constraints of these measures and space limitations on the limited footprint of an un-manned offshore platform. Furthermore, in developing the Phase I Rule, EPA recognized that the total estimated annualized compliance costs of the Phase I Rule is $48 million for up to 121 new facilities estimated to begin operation between 2001 and 2020 (EPA 2001), but these estimates did not consider the compliance cost for the type of facility being proposed by SouthCoast Wind.

At this stage of Project, SouthCoast Wind has limited front-end engineering design for the OSP that will be used to inform the design and construction technologies or operational measures for minimizing impingement mortality and entrainment. All values related to the design and configuration of the converter station are conservative, in order to provide sufficient detail for permitting-level requirements of this application; additional precision to those values may emerge during the detailed engineering design stage. SouthCoast Wind intends to comply with Track I requirements for new facilities in §125.84(c), with the converter station withdrawing less than 10 MGD.

Technologies or operational measures in the following sections are considered feasible for further consideration into the design and operation of the cooling water intake/discharge for the SouthCoast Wind offshore converter station facility.

6.4.1 Flow Reduction from DIF - Single Seawater Lift Pump Operation

The SouthCoast Wind offshore converter station facility is designed to operate at maximum efficiency during typical operating conditions using two seawater lift pumps, each operating at up to 780 m^3/h (see

Table 6). However, the system is also capable of operating using only one pump at a daily flow rate up to 4.95 MGD, which would equate to a 50 percent flow reduction from maximum DIF. From an engineering basis, a 50 percent flow reduction potential from DIF would be achieved by using a single pump when the required cooling for the dissipated heat load is halved (e.g., instead of two transformers operating, only one transformer is operating due to maintenance or operational issues). Consequently, in this scenario, one seawater lift pump flow can fulfill the HVDC converter station equipment cooling requirement. However, at this time, SouthCoast Wind cannot determine the frequency of such operating conditions that would result in a 50 percent flow reduction from DIF.

6.4.2 Flow Reduction from DIF - Seawater Lift Pumps with 3-Way Valve Operation

To provide additional perspective on pump capacities vs. operational requirements and DIF, each seawater lift pump's rated nameplate design capacity is 900 m^3/h, but continuous operation at this maximum capacity is not recommended by pump manufacturers for efficiency, cost, maintenance, and other factors to consider at this unmanned OSP. Therefore, during normal operating conditions, each of the two seawater lift pumps are designed to operate at up to 780 m^3/h each, for a total DIF of up to 9.9 MGD.

Under this maximum DIF, each pump caisson intake flow would be designed to maintain an intake velocity of 0.5 ft/s or less. The pump caisson does not have a common inlet (or gateway) as seen in a typical cooling water intake structure of an onshore power plant. Therefore, the intake velocity does not change whether one or two pumps are running at the same time. The intake velocity is determined based on the face velocity of each pump caisson. Therefore, utilizing a single pump instead of two pumps at full capacity results in no change in the intake velocity reduction. A real reduction in intake velocity will happen when each pump is operated at a reduced flow, with an equivalent reduction in entrainment expected since entrainment is directly proportional to intake flow volume. However, for system operational redundancy and reliability, two pumps running at 50 percent capacity would be a more likely scenario than a single pump operation.

Total intake flow could be reduced by reducing flow when the full design intake flow is not needed to meet the NPDES discharge temperature limits (most likely during non-peak load conditions, lower than average ambient seawater temperatures at the intake, maintenance of one of the transformers, etc.). This flow reduction could be accomplished by reducing the flowrate of operating pumps, by means of a 3-way valve operation, or through the use of VFDs (described below).

6.4.3 Flow Reduction from DIF – Seawater Lift Pumps with Variable Frequency Drives

The SouthCoast Wind offshore converter station CWIS facility is designed to incorporate variable frequency drives on the seawater lift pumps. Variable frequency drives are sometimes used on the pump motors in cooling water intake systems as a means to control flow or minimize the total flow volume required. As such, safe operational parameters are still maintained and a proportional flow volume reduction may result, similar to that described for single pump or reduced pump capacity operation in Section 6.4.1 and Section 6.4.2. Variable frequency drives for the seawater lift pumps may allow efficient reduction in seawater flow during periods when the facility is not operating at full-rated operational capacity. Installation of variable frequency drive controls for each seawater lift pump motor may allow for flow reductions at lower capacities. This would result in reduction of entrainment due to reduction in cooling water flow. With this technology it may be possible to vary the speed of the motor across a range within the safe operating capabilities of the seawater lift pump. However, pump operational characteristics may limit the achievable pump motor set speed range and the reduction in flow that could be achieved using variable frequency drive controls.

The configuration of the intake structure will be designed to utilize variable frequency drives on the pump motor. Each seawater lift pump has a VFD motor which allows it to speed up and down, with proportional increases/decreases in flow, allowing for control of intake velocity. The primary purpose of the VFDs is the control of the temperature differential across the seawater/cooling water heat exchangers. Therefore, as cooling demand increases and more flow is required to satisfy the cooling water system (within the limits of the 9.9 MGD DIF), the VFD would ramp up the pump flow to match the demand. The pump's rated capacity is intentionally selected to limit the intake velocity. The pump's rated capacity is constrained by the pump's speed motor. The high flow alarm on the flowmeter at each seawater pump discharge can be set at appropriate flow levels to allow for operators to intercede remotely if the velocity through the screen approaches 0.5 ft/s. Even though the intake speed into the seawater pump caisson cannot exceed 0.5 ft/s due to the pump's rated capacity, the flow alarm is actually to prevent the pump from running inefficiently (i.e., away from its Best Efficiency Point (BEP) and preventing a potential breakdown of the pump.

The combination of dual-pump operation at reduced capacity via three-way valve and VFD would result in a continuously regulated actual intake flow (AIF), currently estimated at approximately 8.18 MGD or less, to correspond with actual cooling needs and ambient source seawater temperatures at any given point in time (**Table 6**). The absolute minimum flow, adjusted with VFDs based on cooling demand and source seawater temperature, is expected to be approximately 200 m^3/hr, or 1.3 MGD (**Table 6**).

6.4.4 Depth of Withdrawal

The SouthCoast Wind offshore converter station CWIS facility is designed to withdraw water from the middle portion of the water column at a depth of approximately 74 ft (22.6 m) below the surface and approximately 81 ft (24.7 m) above the seafloor. This is a favorable location for avoiding the higher concentrations of entrainable ichthyoplankton closer to the surface (Sundby and Kristiansen 2015), as well as avoiding entrainable plankton taxa associated with benthic habitats (Kendall and Naplan 1981), particularly for buoyant egg and larval stages (Hare et al. 2006). Studies have shown that the majority of ichthyoplankton occurs within the top 200 m of the ocean (Ahlstrom 1959; Sassa et al. 2002), with observations of decreased species diversity and richness with increased depth (Wang et al. 2021). Even with observed behaviors such as diel vertical migration or varying depth preferences based on seasonal temperature differences or different horizontal transport mechanisms, the majority of ichthyoplankton species maintain a depth range located within the upper layers of the ocean (Huebert et al. 2010; Hare and Govoni 2005). The results of studies designed to specifically explore how depth relates to ichthyoplankton presence indicate that catches dramatically decrease with increased depths (Wang et al. 2021).

Depth of withdrawal has been suggested as a factor that may influence ichthyoplankton entrainment potential at conventional generation facilities located in coastal marine environments. At Mystic Station in Boston Harbor, Shaw Environmental (2006) observed ichthyoplankton densities at the intake withdrawal depth of 2.1 m (7 ft) below the surface (17.4 ±34.52 eggs per 100 m^3) were substantially higher than ichthyoplankton densities at the surface (139.3 ±334.49 eggs per 100 m^3), primarily due to buoyant eggs at the surface which exhibited substantially lower levels of entrainment. This observation was primarily influenced by seasonal patterns of high densities of buoyant eggs such as tautog and cunner (Labridae).

While data is limited for direct comparison of water withdrawal depths on entrainment densities, in general a non-surface water intake withdrawing water from the middle portion of the water column is more favorable to minimize entrainment impacts, compared to a surface withdrawal.

6.4.5 Hydraulic Zone of Influence

The Area of Influence (40 CFR 122.21(r)(2)(ii)), also referred to as the Hydraulic Zone of Influence (HZI), is the portion of a source water body that is hydraulically influenced by the withdrawal of source water by a CWIS. Outside of the HZI, water flow is no longer influenced by the CWIS, but rather driven by ambient factors such as ocean currents, winds, and other factors not associated with the CWIS.

For the original NPDES permit application (submitted December 2022), the HZI was calculated using a model derived from shoreline intakes (see Wiegel 1964; Golder Associates 2008). However that did not account for the specific conditions associated with an open-ocean intake caisson, such as this. Therefore, for this revised NPDES permit application, a more robust method/calculation (stream function theory) was used to gain a better understanding of the influence of intake on ocean currents, incorporating the fundamentals of fluid dynamics in three-dimensional flows. This analysis incorporated the following key inputs:

- a depth-averaged current speed (µ),
- the radial component of the intake velocity (μ_r) in the horizontal and vertical direction using radial distance and depth of the water from the intake.
- Using µ and μ_r, a combined current speed was used to calculate combined velocity of current and intake, allowing for a percent change in velocity to be determined using the combined current speed and µ

The maximum downstream distance to the stagnation point limit of the HZI is determined using stream function theory (by equating the ambient current velocity to the velocity that would be induced by the intake).

$$u_r = \frac{Q}{4\pi r^2} \quad (1)$$

$$u_{rh} = u_r \cos arctan\left(\frac{z}{r}\right) \quad (2)$$

$$u_{rv} = u_r \sin arctan\left(\frac{z}{r}\right) \quad (3)$$

where:

	r	Radius of hydraulic zone of influence (meters)
	Q	Design Intake Flow (cubic feet per second)
	h	Constant; total water depth (feet)
	V	Ambient mean velocity (feet per second)
	μ_r	radial component of the intake velocity, where: $r = \sqrt{x^2 + y^2 + z^2}$
	z	location in the water column (e.g., intake = 0 ft, seafloor = 81 ft [below intake])

(all equations used, calculations, and results are included in the submitted data with this permit application)

Conceptually, the HZI-line is the dividing streamline between water that flows into the intake and water that flows past the intake. The impact of transverse diffusion is accommodated by making the probability transition zone perpendicular to the HZI line and the local direction of flow wider in the upstream direction. Far up-current or up-wind, the probability of hydraulically influencing organisms becomes uniform throughout the water column cross-section; this probability equals the ratio of the intake flow to the ocean current discharge.

Since this HZI calculation is typically done using historical data, which is not available for this proposed OSP facility, the available data from the SouthCoast Wind Metocean buoy were used. The input values and resulting calculations from the above equations are available as part of this permit application. The dimensions of the HZI (radial distance from intake, depth from intake, depth above bottom, and area) were calculated for the maximum DIF flow across four seasonal scenarios, with results shown in**Table 18**.

Table 18. Extent of Hydraulic Zone of Influence

Scenario Category	Season	Radial Distance from intake (feet)	Depth from intake (feet)	Minimum depth above bottom (feet)	Area (feet^2)
Maximum DIF (9.9 MGD)	Fall	8.0	5	73	201
	Winter	4.0	2	76	50
	Spring	5.5	3	75	95
	Summer	8.5	5	73	227

Under all ocean current and intake flow conditions, the entire 360° area surrounding the intake caisson (on the horizontal and vertical axis) is assumed to be within the HZI. The location and extent of the HZI within the Atlantic Ocean is bound by the lateral distance, vertical distance, and area shown for each of the scenarios modeled. Within those boundaries, the dimensions will change with ocean current flow and intake flow, and therefore, with time. The exact location/dimensions of the HZI at any time will depend on the ratio of the intake flow to the current flow. Under low-flow hydrologic conditions (in this case the minimum annual current flow conditions), the HZI will extend further away from the intake. Consequently, the HZI for the SouthCoast Wind OSP intake with a maximum design intake flow of 9.9 MGD represents an approximate area inclusive of the dimensions defined above, and shown in **Figure 28**.

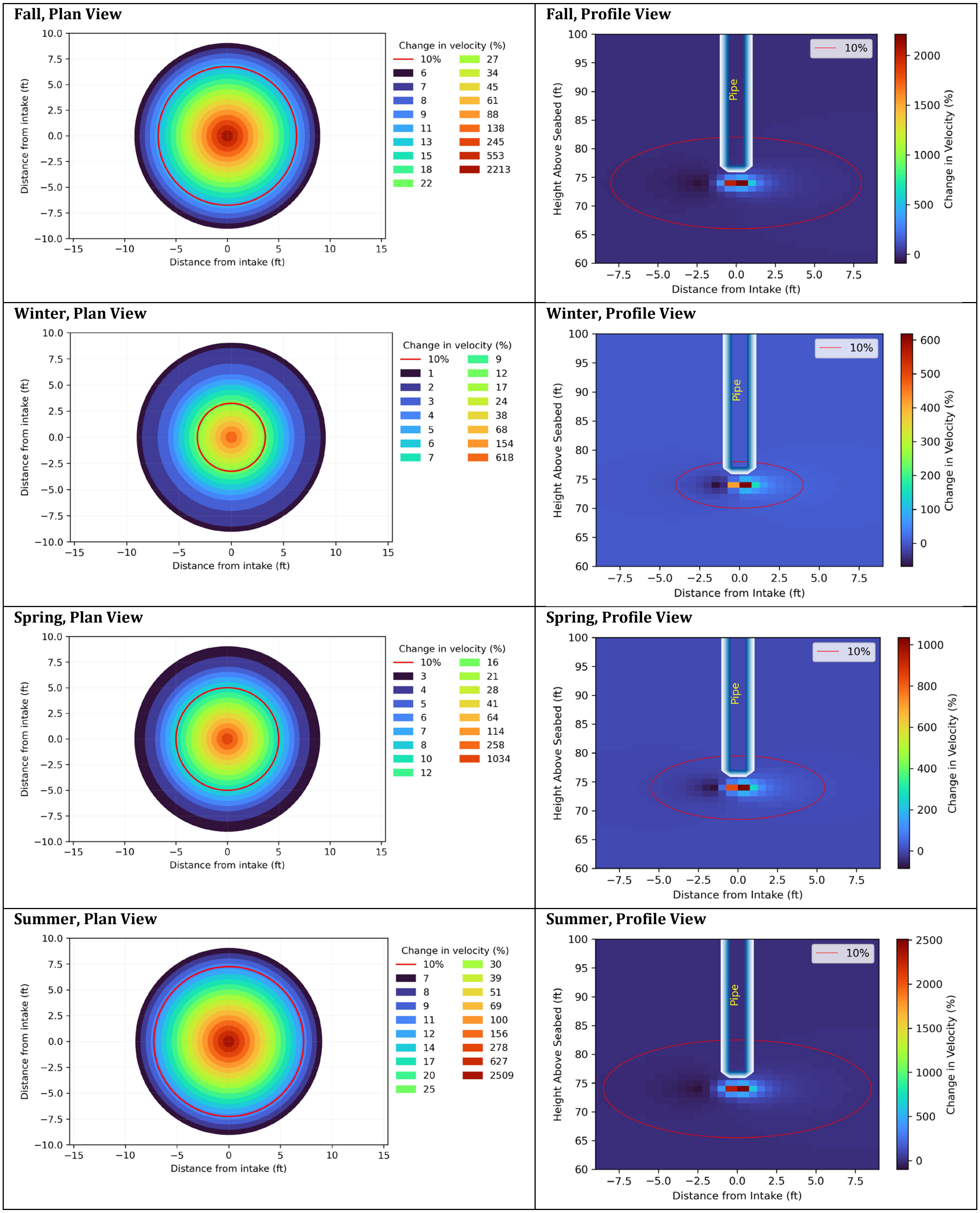


Figure 28. Hydraulic Zone of Influence Dimensions for Maximum DIF (9.9 MGD)

6.5 Section §125.84(b)(6) through (8)

As part of this application, SouthCoast Wind is submitting the relevant application information required in §122.21(r) and §125.84(b). The required information is located in the following sections in this document:

- **§122.21(r)(2) (except (r)(2)(iv)), (3), and (4)** – see Section 2, Section 3, and Section 4 of this document.
- **§125.86(b)** – see Section 6.1 for flow reduction information; see Sections 6.2 and 3.0 for intake velocity information; see Section 2.0 for source waterbody flow information (although, note that the facility is not located in a freshwater stream, lake/reservoir, estuary, or tidal river.
- **§125.87** – not included in this application, as monitoring requirements will be determined by the Director and implemented accordingly, pending receipt of the Final NPDES Permit.
- **§125.88** – not included in this application, as recordkeeping requirements will be implemented pending receipt of the Final NPDES Permit.

7.0 REFERENCES

AECOM, Tetra Tech, Inc., and DNV Energy USA, Inc. 2021. *Construction and Operations Plan, SouthCoast Wind Energy LLC*. Submitted to the Bureau of Ocean Energy Management. October 2021.

Ahlstrom, E. H. 1959. “Vertical distribution of pelagic fish eggs and larvae off California and Baja California.” *Fish. Bull.* 60, 107–146. Available online at: https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/fish-bull/ahlstrom.pdf

Bain, M. B. 1997. “Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes.” *Environmental Biology of Fishes* 78:347–358.

Bamber, R. N. and R. M. H. Seab. 2004. The effects of power station entrainment passage on three species of marine planktonic crustacean, *Acartia tonsa* (Copepoda), *Crangon crangon* (Decapoda) and *Gammarus gammarus* (Decapoda). Marine Environmental Research 57(4): 281-294

Barlow, J., M. Kahru, and B.G. Mitchell. 2008. “Cetacean biomass, prey consumption and primary production requirements in the California Current ecosystem.” *Marine Ecology Progress Series* 371: 285-295

BOEM (Bureau of Ocean Energy Management). 2018. Vi*neyard Wind Offshore Wind Energy Project Draft Environmental Impact Statement*. December 2018

Castro, J. I. 2010. *The Sharks of North America*. Oxford University Press.

Clark, S.H. and R. Livingstone, Jr. 1982. “Ocean pout Macrozoarces americanus.” In Grosslein, M.D. and T.R. Azarovitz eds. *Fish distribution*. p. 76-79. MESA New York Bight Atlas Monograph 15, N.Y. Sea Grant Institute, Albany, NY.

Collette, B., and G. Klein-MacPhee. 2002. *Bigelow and Schroeder’s Fishes of the Gulf of Maine, 3rd edition*. Smithsonian Institution Press, Washington, D.C.

DeCelles, G. R., D. Martins, D.R. Zemeckis, S.X. Cadrin, and B. Neis. 2017. “Using Fishermen’s Ecological Knowledge to map Atlantic cod spawning grounds on Georges Bank.” *ICES Journal of Marine Science*, 74(6), 1587-1601. doi:10.1093/icesjms/fsx031

DHI (Danish Hydraulic Institute). 2020. *SouthCoast Pre-FEED and FEED Metocean Conditions.*

Elliot, D.T., Harris, C.K., Tang, K.W., 2010. Dead in the water: The fate of Copepod carcasses in the York River estuary, Virginia. Limnol. Oceanogr., 55(5): 1821-1834

EPA (U.S. Environmental Protection Agency). 2001a. *Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities.* EPA-821-R-01-036. Washington, DC. November 2001. Available online at: https://www.epa.gov/sites/default/files/2015-04/documents/cooling-water_phase-1_tdd_2001.pdf

EPA. 2015. *National Coastal Condition Assessment 2010*. Office of Water and Office of Research and Development. EPA 841-R-15-006. Available online at: https://www.epa.gov/national-aquatic-resourcesurveys/ncca.

EPRI (Electric Power Research Institute). 2012. *Fish Protection Technology Manual*. Product ID #3002000231. 618 pp. Available online at: https://www.epri.com/research/products/000000003002000231

Epsilon Associates, Inc. 2018. *Vineyard Wind Draft Construction and Operations Plan, Volume III.* March 15, 2018.

Ershath, M.M., Namazi, M.A., Saeed, M.O., 2019. Effect of cooling water chlorination on entrained selected copepods species. Biocatalysis and Agricultural Biotechnology. 17:129-134. https://doi.org/10.1016/j.bcab.2018.11.010

ESS Group, Inc. and Battelle. 2006. *Cape Wind Energy Project. Appendix 3.8-B: Draft Fisheries Report*. Prepared for Cape Wind Associates, LLC. September 2006.

Fahay, M.P. 1983. "Guide to the early stages of marine fishes occurring in the western North Atlantic Ocean, Cape Hatteras to the southern Scotian Shelf." *J. Northwest Atl. Sci.* 4: 1-423.

Gleen, D.H. 1992. "Measurement of long-period, low amplitude Swell in the Western North Atlantic." *Journal of Atmospheric and Oceanic Technology*, vol. 9, pp. 645-658

Golder Associates. 2008. *Source Water and Cooling Water Data and Impingement Mortality and Entrainment Characterization for Monroe Power Plant.* Submitted to Detroit Edison. July 2008. Available online at: https://www.nrc.gov/docs/ML1101/ML110130664.pdf

Graham, J.J., S.B. Chenoweth, and C.W. Davis. 1972. "Abundance, distribution, movements, and lengths of larval herring along the western coast of the Gulf of Maine." *Fish. Bull.*, U.S. 70:307–321.

Greater Atlantic Regional Fisheries Office. 2019. *The Greater Atlantic Region ESA Section 7 Mapper (vers. 2.0).* Retrieved October 2020 from: https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=1bc332edc5204e03b250ac11f9914a27.

Hare, J.A. and J.J. Govoni. 2005. "Comparison of average larval fish vertical distributions among species exhibiting different transport pathways on the southeast Unites States continental shelf." *Fishery Bulletin* 103(4): 728-736. Available online at: https://aquadocs.org/bitstream/handle/1834/26210/hare.pdf?sequence=1&isAllowed=y Hare, J.A., H.J. Walsh, and M.J. Wuenschel. 2006. "Sinking rates of late-stage fish larvae: Implications for larval ingress into estuarine nursery habitats." *Journal of Experimental Marine Biology and Ecology* 330(2): 493–504. Available online at: https://doi.org/10.1016/j.jembe.2005.09.011.

Head, E. J. H., and P. Pepin. 2010. "Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006)." *Journal of Plankton Research* 32(12):1633–1648.

Helfman, G. S., Collette, B. B., Facey, D. E., & Bowen, B. W. (2009). The Diversity of Fishes: Biology, Evolution, and Ecology (2nd ed., pp. 528). Malden, MA: Wiley-Blackwell

Huebert, K.B., S. Sponaugle, and R.K. Cowen. 2010. "Predicting the vertical distributions of reef fish larvae in the Straits of Florida from environmental factors." *Canadian Journal of Fisheries and Aquatic Science*. 67: 1755-1767. DOI:10.1139/F10-116.

HYCOM 2022. Hybrid Coordinate Ocean Model (HYCOM) User's Manual, Code Version 2.0.01, Manual Version 2.0.01, March 4, 2002

R.L. Doneker and G.H. Jirka. 2021. *CORMIX User Manual. A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters*. EPA-823-K-07-001 December 2007 (Updated July 2021).

Kendall, A.W. and N.A. Naplin. 1981. "Diel-depth distribution of summer ichthyoplankton in the middle Atlantic Bight." *Fishery Bulletin*. 79 (4): 705-725.

Kenney, R.D., M.A.M. Hyman, and H.E. Winn. 1985. *Calculation of Standing Stocks and Energetic Requirements of the Cetaceans of the Northeast United States Outer Continental Shelf*. NOAA Technical Memorandum NMFS-F/NEC-41. Woods Hole, MA: National Marine Fisheries Service. iv + 99 pp.

Kenney, R.D., M.A.M. Hyman, R.E. Owen, G.P. Scott, and H.E. Winn. 1986. "Estimation of prey densities required by western North Atlantic right whales." *Marine Mammal Science* 2: 1–13

Kenney, R.D., G.P. Scott, T.J. Thompson, and H.E. Winn. 1997. "Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem." *Journal of Northwest Atlantic Fisheries Science* 22: 155–171

Kleiber, M. 1975. *The Fire of Life: An Introduction to Animal Energetics, third edition.* Huntington, NY: R.E. Kreiger Publishing Co. 478 pp

Lambert, Y., N. Yaragina, G. Kraus, G. Marteinssdottir, and P. J. Wright. 2003. Using environmental and biological indices as proxies for egg and larval production of marine fish. Journal of Northwest Atlantic Fishery Science, 33, 115-159.

Laran, S., C. Joiris, A. Gannier, and R.D. Kenney. 2010. "Seasonal estimates of densities and predation rates of cetaceans in the Ligurian Sea, northwestern Mediterranean Sea: an initial examination." *Journal of Cetacean Research and Management* 11(1): 31-40.

Laurence, G.C. 1974. "Growth and survival of haddock (*Melanogrammus aeglefinus*) larvae in relation to planktonic prey concentration." *J. Fish. Res. Board Can.* 31: 1415-1419.

Long, D. 2006. *BGS detailed explanation of seabed sediment modified Folk classification.* Available online at: https://www.researchgate.net/publication/284511408_BGS_detailed_explanation_of_seabed_sediment_modified_folk_classification.

Lough, R.G., P.C. Valentine, D.C. Potter, P.J. Auditore, G. R. Bolz, J.D. Neilson, and R.I. Perry. 1989. "Ecology and distribution of juvenile cod and haddock in relation to sediment type and bottom currents on eastern Georges Bank." *Mar. Ecol. Prog. Ser.* 56: 1-12

MA DMF (Massachusetts Division of Marine Fisheries). 2021. *Massachusetts Fishery Resource Assessment*. 2019 Annual Performance Report.

Malek, A.J., J.S. Colllie, and J. Gartland. 2014. "Fine-scale spatial patterns in the demersal fish and invertebrate community in a northwest Atlantic ecosystem." *Estuarine and Coastal Shelf Science,* 147,1-10.

Mattocks, S., C.J. Hall, and A. Jordaan. 2017. "Damming, Lost Connectivity, and the Historical Role of Anadromous Fish in Freshwater Ecosystem Dynamics." *BioScience* 67 (8). 713–728. DOI: 10.1093/biosci/bix069

Melton, B.R., Serviss, G.M., 2000. Florida power Corporation-Anclote power plant entrainment survival of Zooplankton. Environ. Sci. Policy 3, 233–248

Methven, D.A. and J.A. Brown. 1991. "Time of hatching affects development, size, yolk volume, and mortality of newly hatched Macrozoarces americanus (Pisces: Zoarcidae)." *Can. J. Zool*. 69: 2161-2167.

Middleton, P., Barnhart, B. 2022. Supporting National Environmental Policy Act Documentation for Offshore Wind Energy Development Related to High Voltage Direct Current Cooling Systems. Washington (DC): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2022-023. 13 p. Available at: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/HVDC%20Cooling%20Systems%20White%20Paper.pdf

Morgan, M.J. 2001. "Time and location of spawning of American plaice in NAFO Divisions 3LNO." *Journal of Northwest Atlantic Fishery Science*, *29*.

Morse , W.W. and K.W. Able. 1995. "Distribution and life history of windowpane, *Scophthalmus aquosus*, off the northeastern United States." *Fish. Bull. (U.S.)* 93:675-693.

Murua, H. and F. Saborido-Rey. 2003. Female reproductive strategies of marine fish species and their classification in the North Atlantic. Journal of Northwest Atlantic Fishery Science. 33:23-31.

NEFMC (New England Fishery Management Council). 1998. *Monkfish Fishery Management Plan*. Available online at: https://s3.us-east-1.amazonaws.com/nefmc.org/MonkForPDF.FMP.pdf.

NEFMC. 2016a. *Omnibus Habitat Amendment 2, Vol I.* Available online at: https://s3.us-east-1.amazonaws.com/nefmc.org/OA2-FEIS_Vol_1_FINAL_161208.pdf.

NEFMC. 2016b. *Omnibus Habitat Amendment 2, Vol II.* Available online at: https://s3.us-east-1.amazonaws.com/nefmc.org/OA2-FEIS_Vol_2_FINAL_171025.pdf.

NEFMC. 2017. *Final Omnibus Essential Fish Habitat Amendment 2 Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts*. Available online at: https://www.habitat.noaa.gov/protection/efh/efhmapper/oa2_efh_hapc.pdf

NEFMC. 2021. *Northeast Multispecies Fishery Management Plan, Amendment 23.* Available online at: https://s3.us-east-1.amazonaws.com/nefmc.org/210809_Groundfish_A23_FEIS_final_submission_corrected_220107_220113_124340.pdf

NEFSC (Northeast Fisheries Science Center). 1999a. *Essential fish habitat source document. Silver hake, Merluccius bilinearis, life history and habitat characteristics*. Available online at: https://repository.library.noaa.gov/view/noaa/3125

NEFSC. 1999b. *Essential fish habitat source document. Offshore hake, Merluccius albidus, life history and habitat characteristics*. Available online at: https://repository.library.noaa.gov/view/noaa/3116

NEFSC. 1999c. *Essential fish habitat source document. Red hake, Urophycis chuss, life history and habitat characteristics*. Available online at: https://repository.library.noaa.gov/view/noaa/3119

NEFSC. 1999d. *Essential fish habitat source document. Yellowtail flounder, Limanda ferruginea, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE;140. Available online at: https://repository.library.noaa.gov/view/noaa/3137

NEFSC. 1999e. *Essential fish habitat source document. Goosefish, Lophius americanus, life history and habitat characteristics.* NOAA technical memorandum NMFS-NE ; 127. Available online at: https://repository.library.noaa.gov/view/noaa/3104

NEFSC. 1999f. *Essential fish habitat source document. Windowpane, Scophthalmus aquosus, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 137. Available online at: https://repository.library.noaa.gov/view/noaa/3127

NEFSC. 1999g. *Essential fish habitat source document. Witch flounder, Glyptocephalus cynoglossus, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 139. Available online at: https://repository.library.noaa.gov/view/noaa/3136

NEFSC. 1999h. *Essential fish habitat source document. Pollock, Pollachius virens, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 131. Available online at: https://repository.library.noaa.gov/view/noaa/3117

NEFSC. 1999i. *Essential fish habitat source document. Atlantic mackerel, Scomber scombrus, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 141. Available online at: https://repository.library.noaa.gov/view/noaa/3138

NEFSC. 1999j. *Essential fish habitat source document. Butterfish, Peprilus triacanthus, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 145. Available online at: https://repository.library.noaa.gov/view/noaa/3146

NEFSC. 1999k. *Essential fish habitat source document. Summer flounder, Paralichthys dentatus, life history and habitat characteristics*. NOAA technical memorandum NMFS-NE ; 151. Available online at: https://repository.library.noaa.gov/view/noaa/3149

NEFSC. 2004. *Essential fish habitat source document. American plaice, Hippoglossoides platessoides, life history and habitat characteristics, Second edition*. NOAA technical memorandum NMFS-NE ; 187. Available online at: https://repository.library.noaa.gov/view/noaa/4041

NEFSC. 2005a. *Essential fish habitat source document. Haddock, Melanogrammus aeglefinus, life history and habitat characteristics, Second edition.* NOAA technical memorandum NMFS-NE ; 196. Available online at: https://repository.library.noaa.gov/view/noaa/4036.

NEFSC. 2005b. *Essential fish habitat source document. Atlantic herring, Clupea harengus, life history and habitat characteristics, Second edition.* NOAA technical memorandum NMFS-NE ; 192. Available online at: https://repository.library.noaa.gov/view/noaa/4034

NEFSC. 2020a. *Multispecies bottom trawl survey.* Water quality monitoring data files. Available online at: https://catalog.data.gov/dataset/fall-bottom-trawl-survey.

NEFSC. 2020b. *Bottom Trawl Surveys*. Available online at: https://www.fisheries.noaa.gov/inport/item/22557.

NOAA (National Oceanic and Atmospheric Administration). 2020a. *Deep Sea Coral Database*. NOAA Deep Sea Coral Research and Technology Program. Available online at: https://deepseacoraldata.noaa.gov/

NOAA . 2020b. *Ocean Pout*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/ocean-pout#seafood

NOAA. 2020c. *Witch Flounder*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/winter-flounder#seafood

NOAA. 2021a. *American Plaice*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/american-plaice#seafood

NOAA. 2021b. *Endangered and Threatened Wildlife; 90-Day Finding on a Petition to List the Shortfin Mako Shark as Threatened or Endangered Under the Endangered Species Act*. 86 FR 19863.

NOAA. 2022a. *Haddock*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/haddock

NOAA. 2022b. *Atlantic Herring*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/atlantic-herring#seafood

NOAA. 2022c. *Atlantic Cod*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/atlantic-cod#seafood

NOAA. 2022d. *Silver Hake*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/silver-hake#seafood

NOAA. 2022e. *Yellowtail Flounder*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/yellowtail-flounder#seafood

NOAA 2022f. *Monkfish*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/monkfish#seafood

NOAA. 2022g. *Windowpane Flounder*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/windowpane-flounder#overview

NOAA. 2022h. *Atlantic Pollock*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/atlantic-pollock#seafood

NOAA. 2022i. *Atlantic Mackerel*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/atlantic-mackerel

NOAA. 2022j. *Butterfish*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/butterfish#overview

NOAA. 2022k. *Summer Flounder*. NOAA Fisheries. Available online at: https://www.fisheries.noaa.gov/species/summer-flounder#seafood

NOAA Fisheries (National Marine Fisheries Service). 2021. *EFH Mapper*. Available online at: https://www.habitat.noaa.gov/apps/efhmapper/

NOAA NDBC (National Oceanic Atmospheric Administration National Data Buoy Center. 2020. *Water quality monitoring data file*. Available online at: https://www.ndbc.noaa.gov/historical_data.shtml.

Northeast Gateway (Northeast Gateway Energy Bridge, L.P.). 2012. *Environmental Impact Assessment for the Northeast Gateway Deepwater Port*. Prepared by Tetra Tech, Inc. March 2012. 129 pp.

National Science Foundation (NSF). 2011. "Death—Not just Life—Important Link in Marine Ecosystem. Available online at: https://www.nsf.gov/news/news_summ.jsp?cntn_id=119181

Richardson, D.E., L. Carter, K.L. Curti, K.E. Maranik, and M. Castonguay. 2020. "Changes in the spawning distribution and biomass of Atlantic mackerel (*Scomber scombrus*) in the western Atlantic Ocean over 4 decades." *Fishery Bulletin*, 188, 120-134.

RI DEM (Rhode Island Department of Environmental Management). 2022. *Coastal Fishery Resource Assessment Trawl Survey 2021.* Annual Performance Report.

Sassa, C., H.G. Moser, and K. Kawaguchi. 2002. "Horizontal and vertical distribution patterns of larval myctophid fishes in the Kuroshio Current region." *Fish. Oceanogr*. 11, 1–10. DOI: 10.1046/j.1365-2419.2002.00182.x

Schtickzelle, N. and T.P. Quinn. 2007. "A metapopulation perspective for salmon and other anadromous fish." *Fish and Fisheries* 8, 297-314.

Shaw Environmental. 2006*. Mystic I, LLC 306(b) Biomonitoring: Fish Impingement, Fish Entrainment, and Discharge Temperature Monitoring of Unit-7.* Submitted to US EPA Region 1 by Boston Generating, LLC. 105 pp.

Sundby, S. and T. Kristiansen. 2015. The Principles of Buoyancy in Marine Fish Eggs and their Vertical Distributions Across the World's Oceans. PLoS ONE 10(10): e0138821. https://doi.org/10.1371/journal.pone.0138821

Trites, A.W. and D. Pauly. 1998. "Estimating mean body masses of marine mammals from maximum body lengths." *Canadian Journal of Zoology* 76: 886-896

USACE (U.S. Army Corps of Engineers). 1976. *Tidal Prism – Inlet Area Relationships.* James T. Jarrett. General Investigation of Tidal Inlets (GITI) Report #3. February 1976. Available online at: https://usace.contentdm.oclc.org/digital/api/collection/p266001coll1/id/7466/download

US DOC/NOAA/NMFS Northeast Fisheries Science Center. 2019. *Zooplankton and ichthyoplankton abundance and distribution in the North Atlantic collected by the Ecosystem Monitoring (EcoMon) Project from 1977-02-13 to 2019-11-11* (NCEI Accession 0187513). Version 2.2. NOAA National Centers for Environmental Information. Data set. Available online at: https://www.ncei.noaa.gov/archive/accession/0187513.

Walsh, H.J., D.E. Richardson, K.E. Marancik, and J.A. Hare. 2015. "Long-term changes in the distributions of larval and adult fish in the Northeast U.S. Shelf Ecosystem." *PLoS ONE* 10(9):e0137382.

Wang, V.H., C.R. Zapfe, and F.J. Hernandez. 2021. "Assemblage Structure of Larval Fishes in Epipelagic and Mesopelagic Waters of the Northern Gulf of Mexico." *Frontiers in Marine Science.* Available online at: https://www.frontiersin.org/articles/10.3389/fmars.2021.766369/full

Wiegel, R.L. 1964. *Oceanographic Engineering*. Prentice-Hall, Inc, Englewood Cliffs, N.J.

Wishner, K., Durbin, E., Durbin, A., Macaulay, M., Winn, H., Kenney, R. 1988. Copepod Patches and Right Whales in the Great South Channel Off New England. Bulletin of Marine Science, 43(3): 825-844.

Zemeckis, D.R., M.J. Dean, and S.X. Cadrin. 2014. "Spawning dynamics and associated management implications for Atlantic cod." *North American Journal of Fisheries Management* 34(2): 424-442. DOI: 10.1080/02755947.2014.882456.

APPENDIX A: THERMAL PLUME MODELING

TETRA TECH

MEMO

To:	SouthCoast Wind
From:	Erin Lincoln, PH; Tetra Tech Madhu Akasapu-Smith, PE, CFM; Tetra Tech
cc:	Brian Dresser, Tetra Tech
Date:	July 31, 2023
Subject:	SouthCoast Wind CORMIX Mixing Zone Results – revised July 2023

INTRODUCTION

SouthCoast Wind LLC (SouthCoast Wind) is evaluating the effects of the thermal plume caused by the cooling water from the offshore converter. The facility is in the Atlantic Ocean inside the lease area that is located more than 30 miles south of Martha's Vineyard and 20 miles south of Nantucket. SouthCoast Wind requested that Tetra Tech conduct a mixing zone thermal impact study of their effluent plume using Cornell Mixing Zone Expert System (CORMIX).

CORMIX is a comprehensive software system for the analysis, prediction, and design of outfall mixing zones from the discharge of pollutants into diverse water bodies (Doneker 2021). CORMIX serves as a recommended analysis tool in key guidance documents for the permitting of industrial, municipal, thermal, and other point source discharges to receiving waters (Doneker 2021). The program can be used to predict the characteristics of the geometry and dilution of the initial mixing zone to ensure compliance with the water quality regulatory constraints. The program can also be used to study and predict the response of the plumes from the effluent discharges at larger distances (Doneker 2021).

A thermal mixing zone analysis was performed using CORMIX v12.0GTD Advanced Tools (Design) for the SouthCoast Wind effluent discharge to predict and analyze the temperature changes in the Atlantic Ocean during highest temperature delta between ambient and effluent conditions for the four seasons were evaluated. The fall months were defined from September through November, winter months were defined from December through February, spring months were defined from March through May, and summer months were defined from June through August. This memorandum outlines the CORMIX setup and the mixing zone results for the different scenarios evaluated for the thermal impact study.

According to Fact Sheet for the U.S. Environmental Protection Agency (USEPA) Offshore Oil and Gas National Pollutant Discharge Elimination System (NPDES) directive dated June 2023, for ocean discharge regulations at 40 Code of Federal Regulations (CFR) 125.121(c), in the absence of water quality standards, a 100-meter (330-feet) radius mixing zone for initial dilution of discharges is allowed. Recognizing this is for a different industry, in lieu of offshore wind-specific directives, this was reviewed as a surrogate for mixing zones in offshore environments. Marine water quality criteria can be met at the edge of mixing zone, however, with no temperature water quality criterion established for the receiving water body a maximum increase in weekly average temperature by 1.8°F (1°C) suggested by USEPA's Quality Criteria for Water 1986 "Gold Book" was applied (USEPA 1986). This value was used to assess compliance at the edge of the mixing zone.

CORMIX MODEL RESULTS

SOUTHCOAST WIND OUTFALL CONFIGURATION

The effluent from the offshore converter discharges through a submerged pipe into the Atlantic Ocean. Tetra Tech used the CORMIX1 module to represent a system for single port discharges. CORMIX1 is for the analysis of single port sources submerged or above the water surface (Doneker 2021).

The offshore converter outfall was set at 42.7 feet (13 meters) from the water surface (SouthCoast Wind 2023). The outfall was fully submerged and perpendicular to the water surface. The outfall was an open pipe with a diameter of 36 inches as shown in Figure 1.

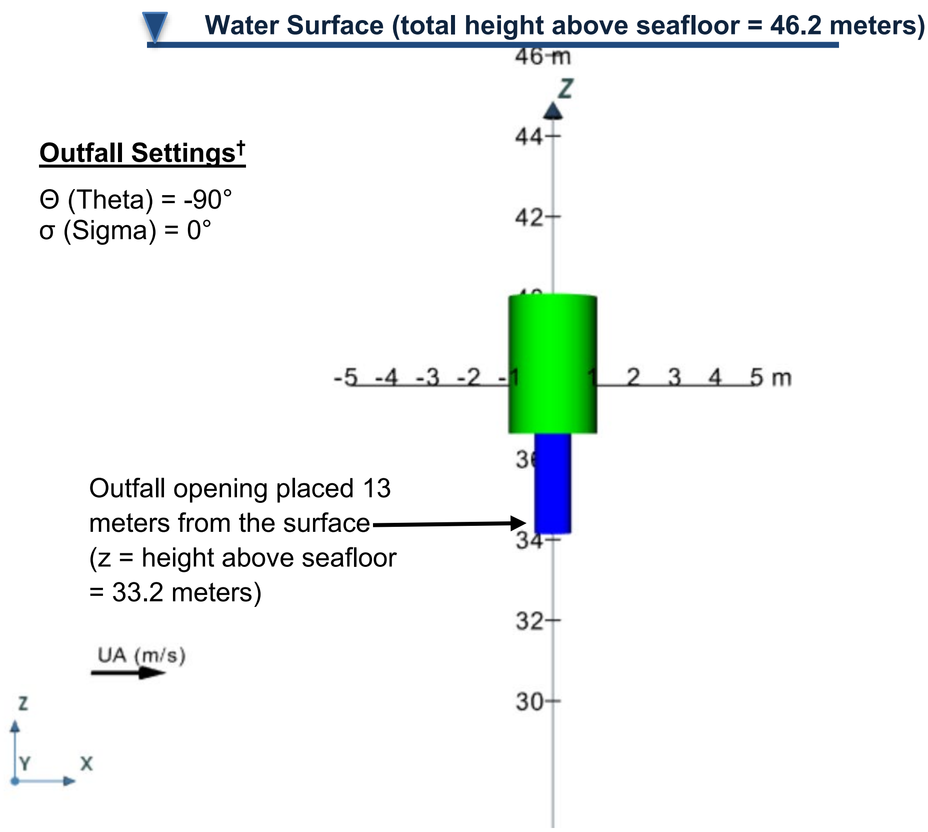


Figure 1: Outfall configuration for the SouthCoast Wind offshore converter

†**θ (Theta)**: Vertical discharge angle, the angle between the port centerline and the horizontal plane.

σ (Sigma): Horizontal angle, the angle measured counterclockwise from the ambient current direction to the plane projection of the port centerline.

EFFLUENT CONDITIONS

A maximum effluent temperature of 86°F (30°C) as provided by SouthCoast Wind was used in the thermal impact study. A total effluent discharge estimated at 9.9 million gallons per day (MGD) by SouthCoast Wind was used in the study. The effluent was assumed to be non-freshwater and the same salinity level was applied as the salinity at the intake structure for each scenario.

AMBIENT CONDITIONS

Tetra Tech used the site-specific metocean data provided by SouthCoast Wind to identify and calculate the velocity, temperature, and salinity model input parameters for the CORMIX mixing zone model. A summary of the metocean dataset and the years it was available is provided below:

- Hourly surface water temperature and hourly salinity from January 23, 2020, through January 22, 2022
- Hourly water level from January 1, 1979, through December 31, 2021
- Depth averaged hourly current speed and direction from January 1, 2000, through December 31, 2017

Data outputs from the data-assimilative hybrid isopycnal-sigma-pressure (generalized) coordinate ocean model (called Hybrid Coordinate Ocean Model or HYCOM) were also used to help support defining the ambient condition and hydrodynamic characteristics for each season. The 41-layer model outputs were available from January 1, 1994, through present and were paired with the measured hourly temperature, and salinity data because of the overlapping time periods.

HYCOM evolved from the Miami Isopycnic-Coordinate Ocean Model (MICOM) and is a primitive equation ocean general circulation model (HYCOM 2002). MICOM has undergone multiple validation studies and is one of the premier ocean circulation models (HYCOM 2002). The model provides mixing throughout the entire water column with smooth transition between the vigorous mixing in the surface boundary layer and the relatively weak diapycnal mixing in the ocean interior (HYCOM 2002).

Although the facility is in a tidally influenced area, CORMIX can only represent steady state conditions. Therefore, Tetra Tech evaluated the temperature plume for the highest seasonal temperature deltas during four separate seasons to represent potential zones of mixing during those periods. Based on the water level and depth averaged current velocity data received from SouthCoast Wind at the facility location, the current speed ranges from 1.5 meters per second (m/sec) to 2 m/sec in all directions with no periods of slack tides (Figure 2).

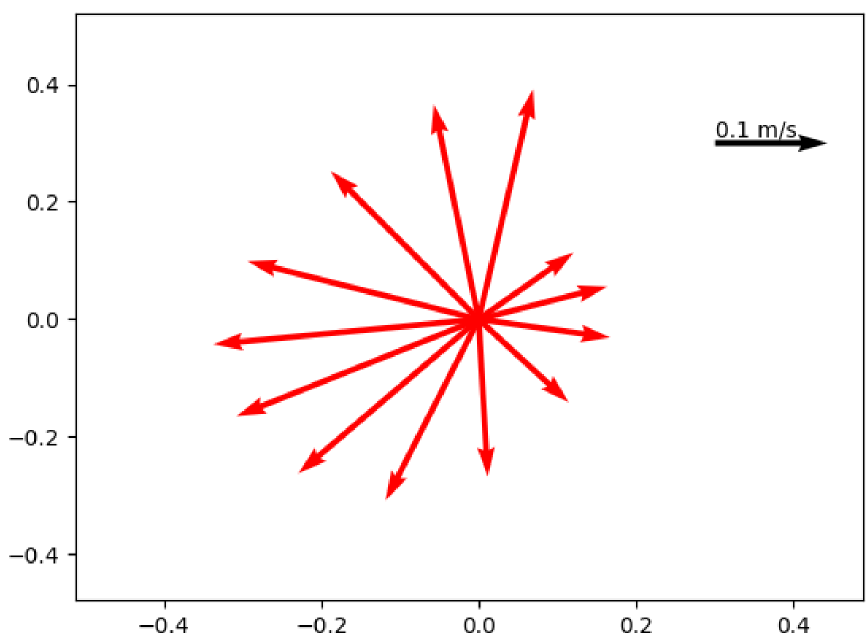


Figure 2: Tidal signature at the discharge location for the SouthCoast Wind

MIXING ZONE ANALYSIS

A mixing zone analysis was performed at the discharge location of SouthCoast Wind into the Atlantic Ocean under a variety of conditions to evaluate the rise in ocean temperatures in the vicinity of the discharge.

CORMIX SCENARIOS AND INPUT PARAMETERS

In the original (December 2022) and revised (April 2023) CORMIX modeling runs, Tetra Tech utilized twelve (12) total scenarios, based on ***critical tidal conditions*** (8 scenarios) and ***maximum temperature delta*** (4 scenarios). The critical tidal scenarios were based on observed minimum and maximum current speeds during 4 seasons with average ocean temperature and salinity at the depth of outfall when the observed current speeds were observed. The maximum temperature delta scenarios were based on maximum temperature deltas during the 4 seasons paired with minimum current speed and salinity at the outfall depth. Upon further evaluation, during this revision (July 2023), the ***critical tidal conditions*** scenarios were dropped from the analysis, based on the following rationale:

- According to the metocean depth averaged hourly current speed from January 1, 2000, through December 31, 2017, an ambient minimum current speed of 0.03 miles/hr [0.015 m/sec] occurred for only 4 total hours (0.0038%) of that entire 17-year period, in the spring and winter months, so the occurrence of these scenarios is exceptionally rare. Therefore, such scenarios are not representative of recurring min/max ambient conditions to better capture the variability in current speeds and to model regular and more realistic current conditions, representative of 99.62% of ambient conditions, the current speed averaged over depths was used.
- Salinity at the intake location was used to calculate density of the effluent, instead of using salinity at the outfall location for better representation of salinity concentration from the source water.
- Wind speed was not included in the revised modeling because the WQ standard of 1.8°F (1°C) was met before the plume reached the surface and was still in near-field mixing zone, therefore had no influence on the behavior of the thermal plume.

The resulting four-scenarios based on maximum temperature delta are consistent with the approach used in recent CORMIX modeling for another offshore wind project in the RI-MA Wind Energy Areas (Woods Hole Group 2022), for which a Draft NPDES Permit has been issued. In this revision, Tetra Tech ran four (4) scenarios with the maximum seasonal temperature delta between ambient and the thermal effluent during the four seasons (fall, winter, spring, and summer) at the outfall location. Table 1 provides a summary of the data assumptions for ambient and effluent conditions for the CORMIX thermal impact study for each scenario.

Site-specific metocean data was used to determine the lowest ambient temperature for each season. Only surface ambient temperature was available from metocean data. The water column at the discharge location is 46.2 meters deep, and the outfall was located approximately 13 meters from the surface. Site-specific metocean data at the surface were compared to the HYCOM outputs at the depth of the outfall, and were available at a 3-hour timestep. Differences in temperatures were low overall (0% to 24%), and the metocean surface temperatures were consistently *lower than* the HYCOM simulated temperatures at 12 meters depth. This indicates that using the measured surface metocean temperature data will result in a more conservative CORMIX analysis compared to using the HYCOM temperature data outputs at the outfall depth, because that lower temperature would result in a greater difference in temperature deltas. Since measured current data were not collected when temperature and salinity data were collected, the HYCOM outputs were used to determine the depth-averaged current speeds on the days when the maximum seasonal temperature delta occurred.

Table 1: Ambient and effluent input parameters for the CORMIX1 model for the four maximum temperature delta scenarios

Model Input	Scenario 1: Fall	Scenario 2: Winter	Scenario 3: Spring	Scenario 4: Summer
Effluent discharge (MGD)	9.9	9.9	9.9	9.9
Effluent water temperature, °F (°C)	86 (30)	86 (30)	86 (30)	86 (30)
Average water depth at Atlantic Ocean[1], feet (meter)	151.6 (46.2)	151.6 (46.2)	151.6 (46.2)	151.6 (46.2)
Wind speed, average, mi/hr	0.0	0.0	0.0	0.0
Average Atlantic Ocean current speed, m/sec	0.1	0.3	0.2	0.10
Date when lowest ambient temperature was recorded	11/30/2021	2/2/2021	3/15/2021	6/1/2021
Atlantic Ocean water temperature, °F (°C)	54.1 (12.3)	39.6 (4.2)	38.6 (3.7)	51.3 (10.7)
Temperature delta,°F (°C)	31.9 (17.7)	46.4 (25.8)	47.4 (26.3)	34.7 (19.3)

[1] The surveyed water depth at BG44

CORMIX RESULTS

Table 2 summarizes the numerical results of each CORMIX scenario, including the Atlantic Ocean temperature and the location and dimensions of the plume when the temperature delta is 1.8°F (1°C).The edge of the plume when the temperature delta reached 1.8°F (1°C) ranged between 42 feet and 85 feet for the maximum temperature delta scenarios (Table 2, Figure 3 through Figure 6). These results indicate that impacts to the ocean temperature are minimal when the maximum temperature deltas occur and the water quality standard will be met within the 100 meters (330 feet) radius mixing zone for initial dilution of discharges which is allowed for the marine waters. The plan and profile views of the excess temperature from Scenarios 1 through 4 can be found in the Thermal Plume Figures. The figures are created in the CORMIX CorVue package.

Table 2: CORMIX results for maximum temperature delta scenarios where temperature delta is 1.8°F (1°C) for SouthCoast Wind

Parameter	Scenario 1: Fall	Scenario 2: Winter	Scenario 3: Spring	Scenario 4: Summer
Atlantic Ocean temperature at the edge of the plume, °F (°C)	55.9 (13.3)	41.4 (5.2)	40.4 (4.7)	53.1 (11.7)
Dilution ratio at the edge of the plume	17.8	25.8	26.3	19.7
Plume Length[1], feet (meter)	41.9 (12.8)	84.9 (25.9)	67.5 (20.6)	46.6 (14.2)
Plume Width (maximum), feet (meter)	11.8 (3.6)	11.1 (3.4)	12.8 (3.9)	28.7 (8.7)
Plume Area, ft^2 (m^2)	407.0 (37.8)	792.1 (73.6)	721.2 (67.0)	657.1 (61.0)

[1]: Distance from the outfall

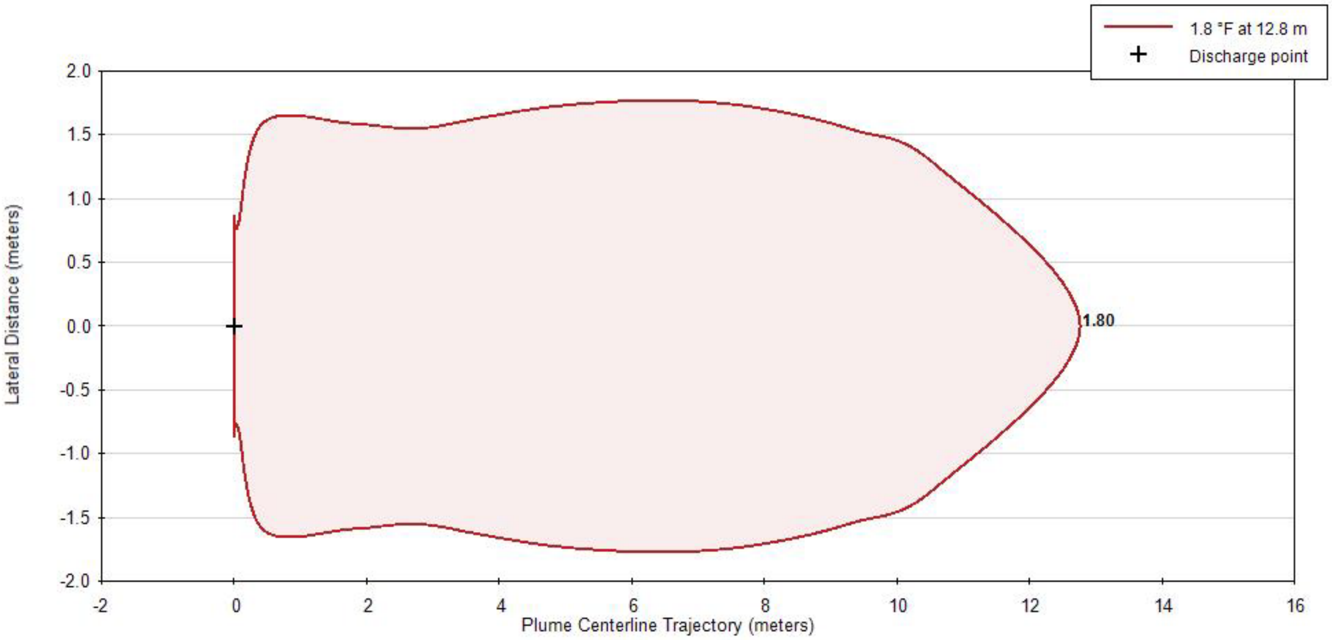


Figure 3: 1.8°F (1°C) temperature delta isoline for Scenario 1: Fall

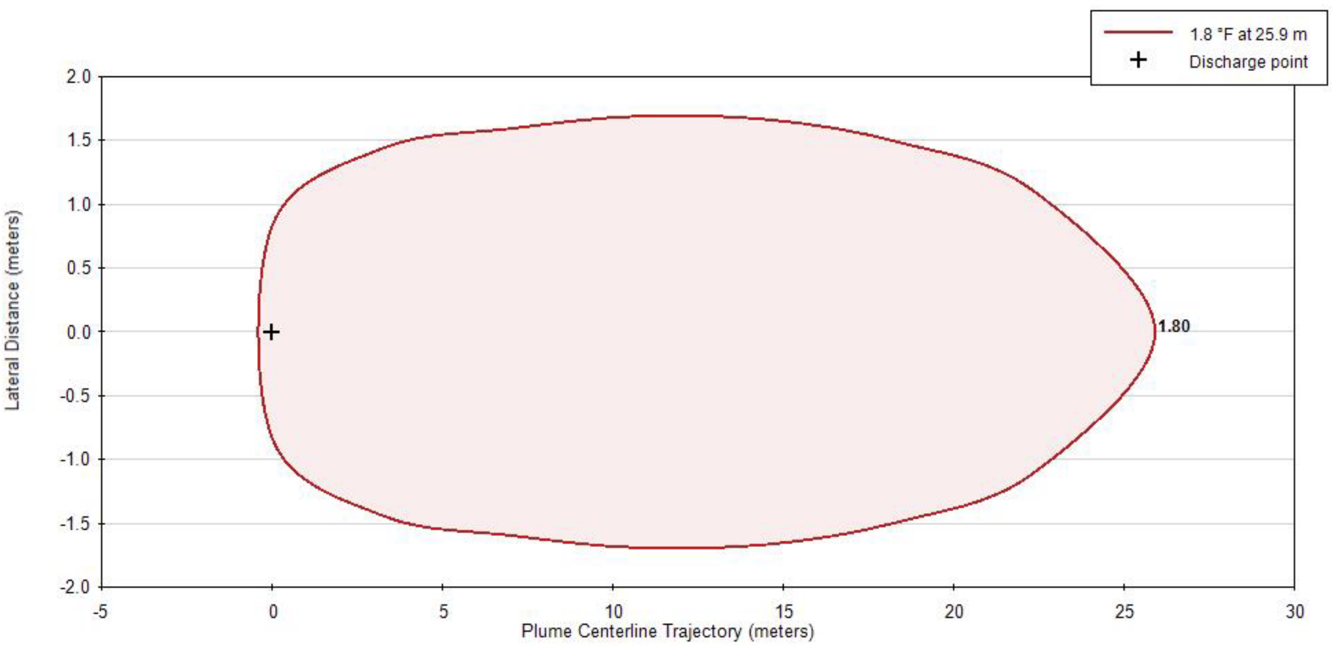


Figure 4: 1.8°F (1°C) temperature delta isoline for Scenario 2: Winter

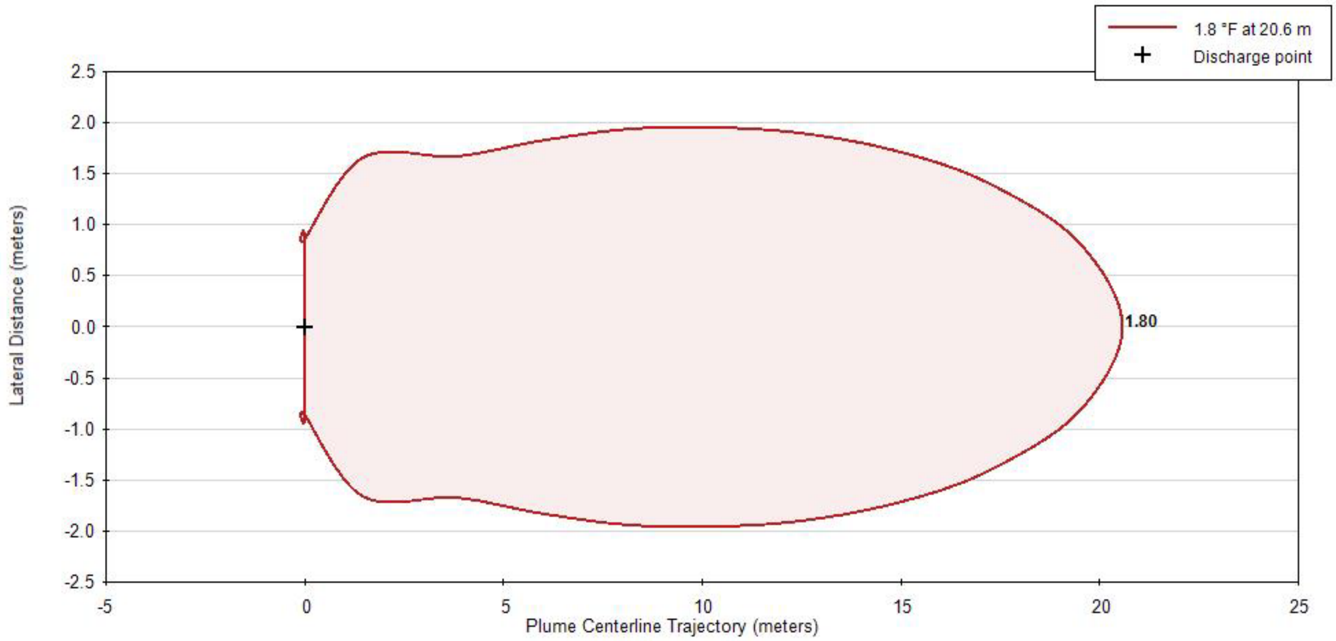


Figure 5: 1.8°F (1°C) temperature delta isoline for Scenario 3: Spring

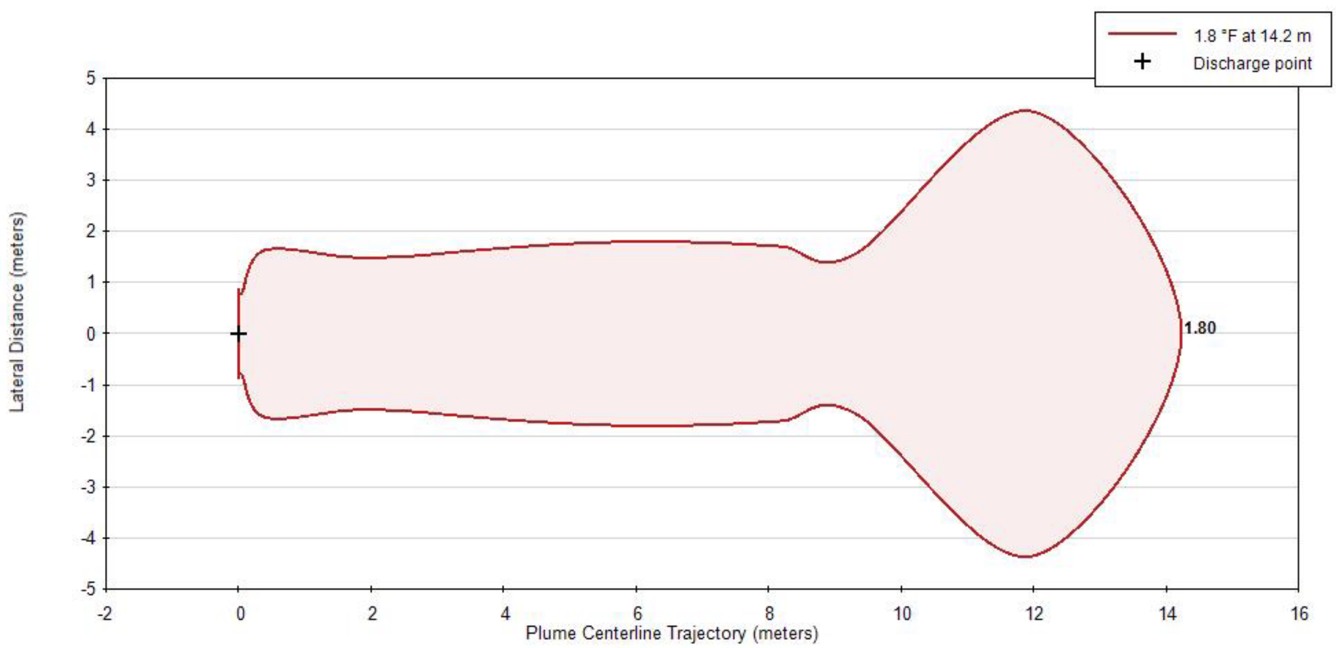


Figure 6: 1.8°F (1°C) temperature delta isoline for Scenario 4: Summer

REFERENCES

Doneker L. Robert and Jirka, H. Gerhard. 2021. CORMIX User's Manual. A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. EPA-823-K-07-001 December 2007 (Updated July 2021).

HYCOM 2022. Hybrid Coordinate Ocean Model (HYCOM) User's Manual, Code Version 2.0.01, Manual Version 2.0.01, March 4, 2002.

SouthCoast Wind 2023. Email exchange between SouthCoast Wind and Tetra Tech on July 14, 2023 (Re updated NPDES Application parameters.msg).

USEPA 1986. Quality Criteria for Water 440/5-86-001. Office of Water Regulations and Standards. Washington, DC.

Woods Hole Group. 2022. Sunrise Wind Farm Converter Station Intake Zone of Influence & Thermal Discharge Modeling Report. Appendix BB to the Sunrise Wind Construction and Operations Plan. 40 pp. Available at: https://www.boem.gov/renewable-energy/state-activities/srw01copappbbhzithermal-discharge2022-04-08508

THERMAL PLUME FIGURES

The CCC stands for Criterion Continuous Concentration and is set at 1.8°F (1°C). The water surface is at 46.2 meters and the outfall is at 33.2 meters, 13 meters below the water surface.

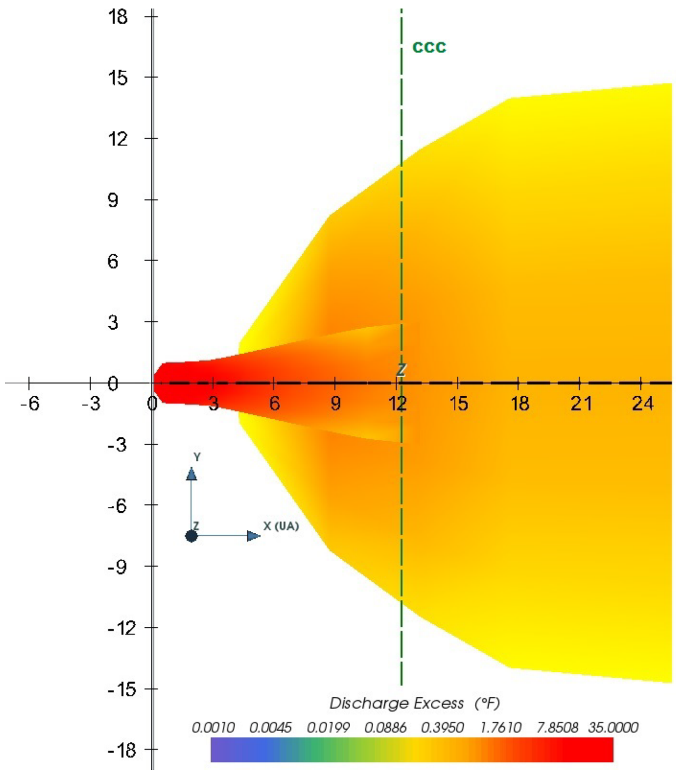


Figure 7: Plan view of the plume for Scenario 1: Fall

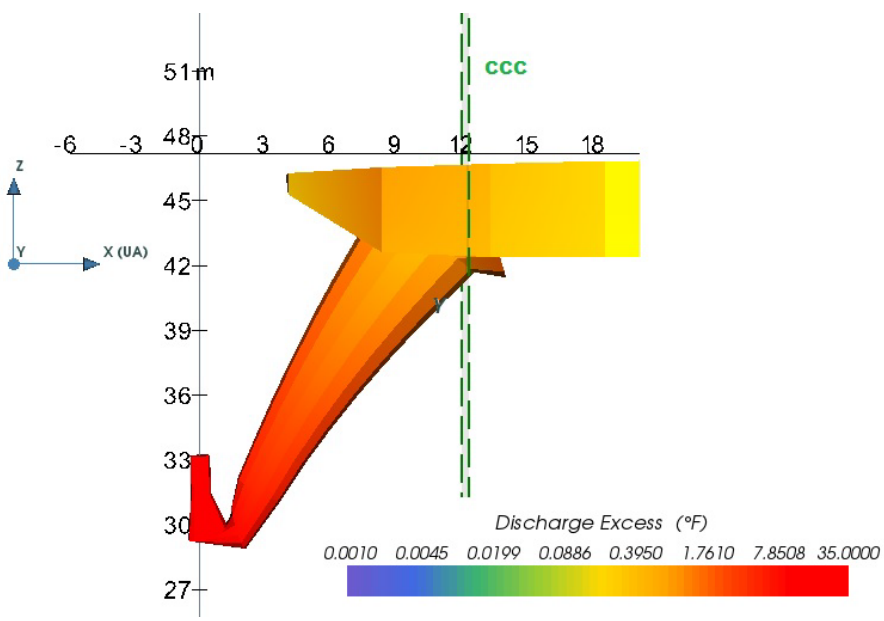


Figure 8: Profile view of the plume for Scenario 1: Fall

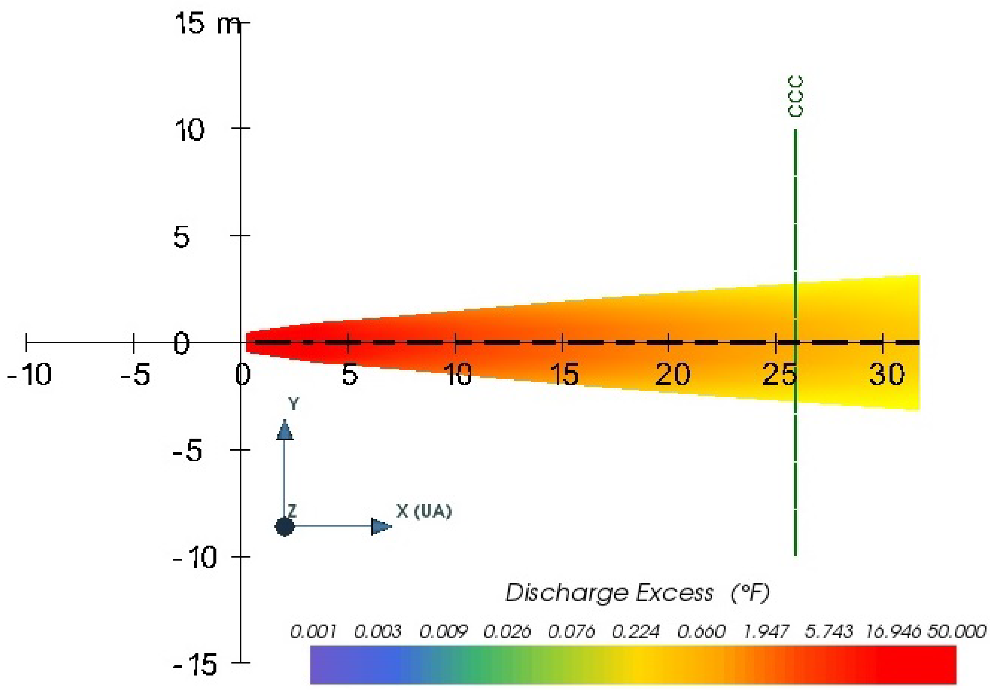


Figure 9: Plan view of the plume for Scenario 2: Winter

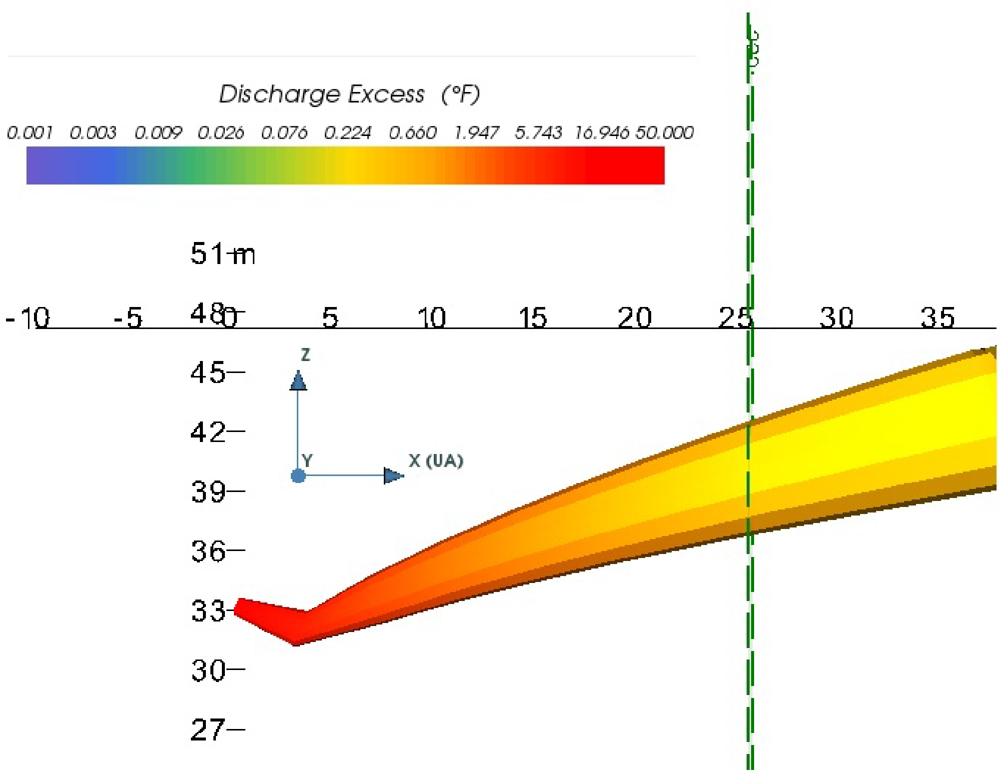


Figure 10: Profile view of the plume for Scenario 2: Winter

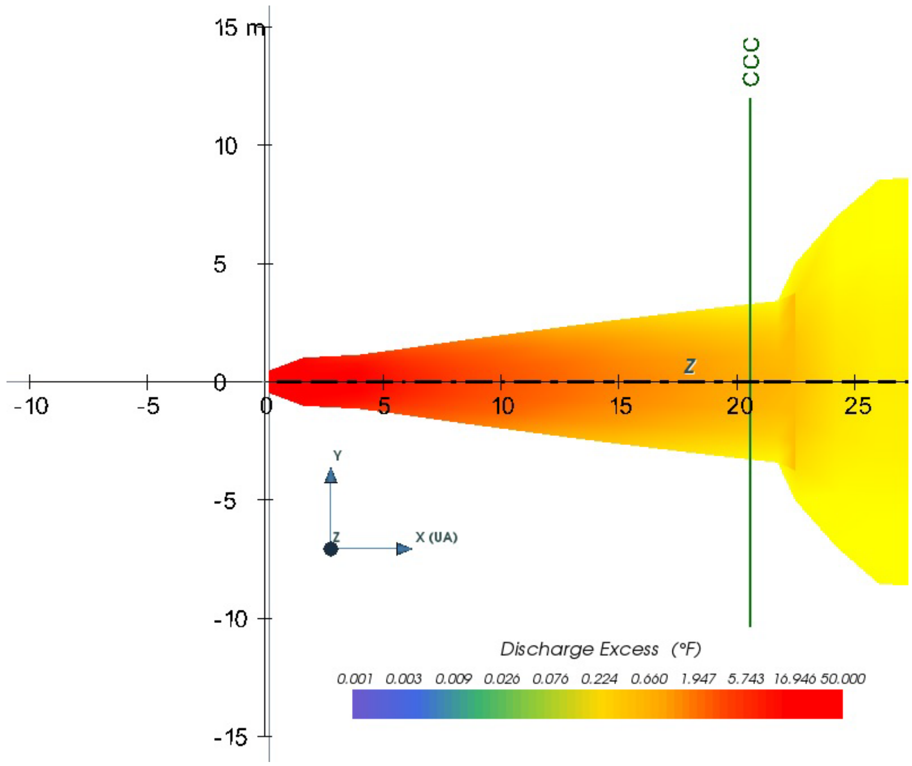


Figure 11: Plan view of the plume for Scenario 3: Spring

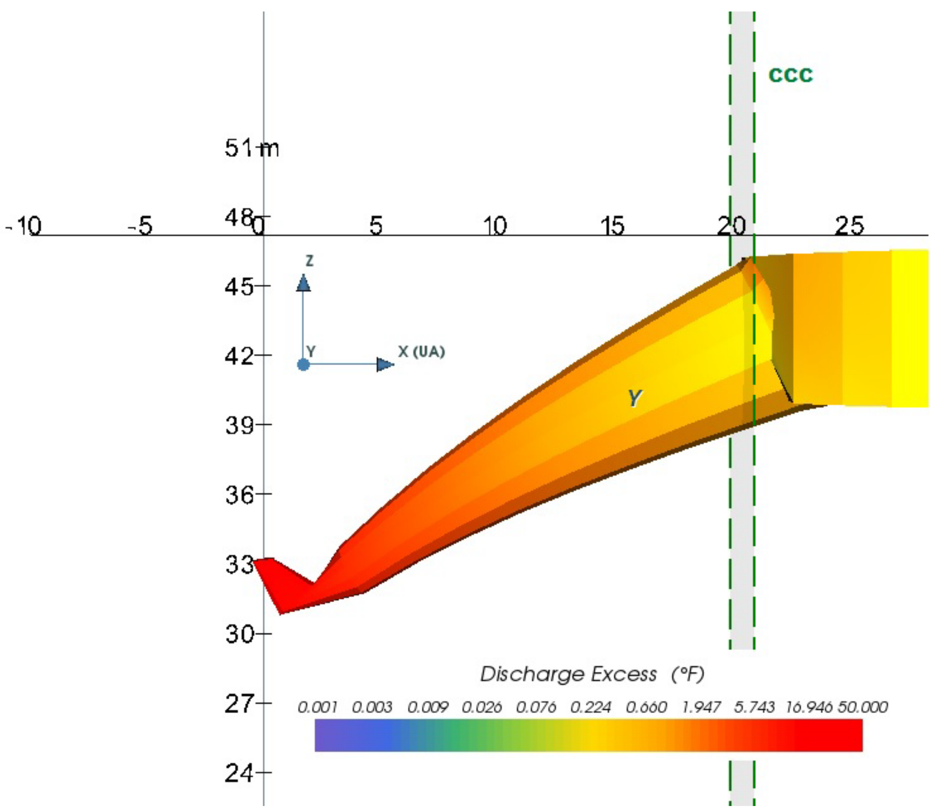


Figure 12: Profile view of the plume for Scenario 3: Spring

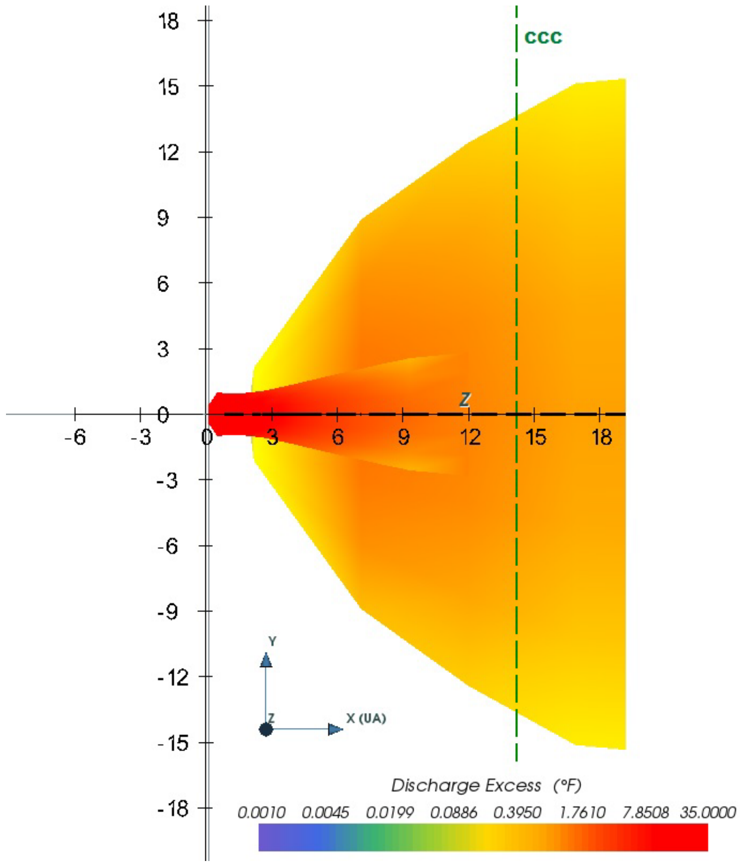


Figure 13: Plan view of the plume for Scenario 4: Summer

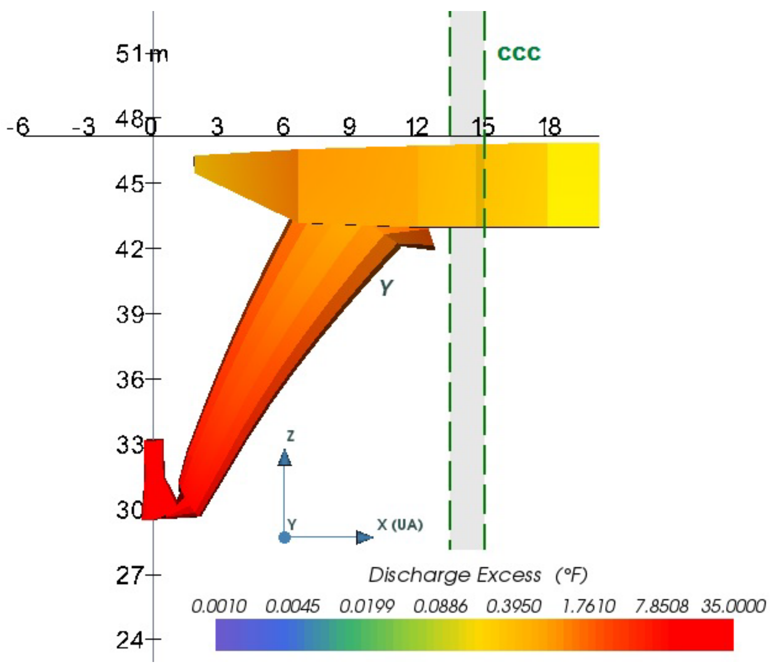


Figure 14: Profile view of the plume for Scenario 4: Summer

APPENDIX B: CONSTRUCTION AND OPERATIONS PLAN (COP) REFERENCES

The following COP Sections and Appendices are incorporated by reference, using verbatim text where appropriate in this document, and are available at the following links:

- SouthCoast Wind COP Volume I
  - Section 1: Introduction
  - Section 2: Project Siting and Design Development
  - Section 3: Description of Proposed Activities
- SouthCoast Wind COP Volume II
  - Section 4.1: Site Geology
  - Section 4.3: Physical Oceanography and Meteorology
  - Section 5.2: Water Quality
  - Section 6.6: Benthic and Shellfish
  - Section 6.7: Finfish and Invertebrates
  - Section 6.8: Marine Mammals
  - Section 6.9: Sea Turtles
  - Section 11: Commercial and Recreational Fisheries and Fishing Activity
- SouthCoast Wind COP Appendix A – Agency Correspondence
- SouthCoast Wind COP Appendix H – Water Quality Report
- SouthCoast Wind COP Appendix M – Benthic and Shellfish Resources Characterization Report
- SouthCoast Wind COP Appendix N – Essential Fish Habitat and Protected Fish Species Assessment
- SouthCoast Wind COP Appendix V – Commercial and Recreational Fisheries and Fishing Activity Technical Report

APPENDIX C: SOUTHCOAST WIND NPDES APPLICATION FORM 1 AND FORM 2E

NPDES Application Form 1 and Form 2E are provided on the EPA website (https://www.epa.gov/npdes/npdes-application-forms) for use in jurisdictions, such as Massachusetts, in which an EPA regional office administers the NPDES permit program. Form 1 and Form 2E were completed for the Project and are included as Appendix C to this NPDES Permit Application.

United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA Form 3510-1 Revised March 2019

Water Permits Division

Application Form 1

General Information

NPDES Permitting Program

Note: All applicants to the National Pollutant Discharge Elimination System (NPDES) permits program, with the exception of publicly owned treatment works and other treatment works treating domestic sewage, must complete Form 1. Additionally, all applicants must complete one or more of the following forms: 2B, 2C, 2D, 2E, or 2F. To determine the specific forms you must complete, consult the "General Instructions" for this form.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
N/A - New Facility	N/A	SouthCoast Wind	

Form 1 NPDES EPA

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

GENERAL INFORMATION

SECTION 1. ACTIVITIES REQUIRING AN NPDES PERMIT (40 CFR 122.21(f) and (f)(1))

Activities Requiring an NPDES Permit

1.1	**Applicants *Not Required* to Submit Form 1**		
1.1.1	Is the facility a new or existing **publicly owned treatment works**? If yes, STOP. Do NOT complete Form 1. Complete Form 2A. ☑ No	1.1.2	Is the facility a new or existing **treatment works treating domestic sewage**? If yes, STOP. Do NOT complete Form 1. Complete Form 2S. ☑ No
1.2	**Applicants *Required* to Submit Form 1**		
1.2.1	Is the facility a **concentrated animal feeding operation** or a **concentrated aquatic animal production facility?** ☐ Yes ➔ Complete Form 1 ***and*** Form 2B. ☑ No	1.2.2	Is the facility an **existing** manufacturing, commercial, mining, or silvicultural **facility** that **is currently discharging process wastewater**? ☐ Yes ➔ Complete Form 1 ***and*** Form 2C. ☑ No
1.2.3	Is the facility a **new** manufacturing, commercial, mining, or silvicultural **facility** that has **not yet commenced to discharge**? ☐ Yes ➔ Complete Form 1 ***and*** Form 2D. ☑ No	1.2.4	Is the facility a **new or existing** manufacturing, commercial, mining, or silvicultural **facility** that **discharges only nonprocess wastewater**? ☑ Yes ➔ Complete Form 1 ***and*** Form 2E. ☐ No
1.2.5	Is the facility a **new or existing facility** whose discharge is composed entirely of **stormwater associated with industrial activity** or whose discharge is composed of **both stormwater and non-stormwater**? ☐ Yes ➔ Complete Form 1 ***and*** Form 2F unless exempted by 40 CFR 122.26(b)(14)(x) or (b)(15). ☑ No		

SECTION 2. NAME, MAILING ADDRESS, AND LOCATION (40 CFR 122.21(f)(2))

Name, Mailing Address, and Location

2.1	**Facility Name**		
	SouthCoast Wind Energy Project		
2.2	**EPA Identification Number**		
	N/A		
2.3	**Facility Contact**		
	Name (first and last) Enrique Alvarez Cordobes	Title Project Director	Phone number (617) 519-3122
	Email address enrique.alvarez@southcoastwind.com		
2.4	**Facility Mailing Address**		
	Street or P.O. box 101 Federal St., Suite 1900		
	City or town Boston	State MA	ZIP code 02110

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
N/A - New Facility	N/A	SouthCoast Wind	

Name, Mailing Address, and Location Continued

2.5	**Facility Location**			
	Street, route number, or other specific identifier Atlantic Ocean; approximately 26 nm(48km) south of Martha's Vineyard and 20 nm (37 km) south of Nantucket			
	County name	County code (if known)		
	City or town	State	ZIP code	

SECTION 3. SIC AND NAICS CODES (40 CFR 122.21(f)(3))

SIC and NAICS Codes

3.1	**SIC Code(s)**	**Description** (optional)
	4911	Electric Power Generation & Transmission
3.2	**NAICS Code(s)**	**Description** (optional)
	221115	Electric Power Generation, Wind

SECTION 4. OPERATOR INFORMATION (40 CFR 122.21(f)(4))

Operator Information

4.1 **Name of Operator**

SouthCoast Wind Energy LLC

4.2 Is the name you listed in Item 4.1 also the owner?

☑ Yes ☐ No

4.3 **Operator Status**

☐ Public—federal ☐ Public—state ☐ Other public (specify)_______________

☑ Private ☐ Other (specify) _______________

4.4 **Phone Number of Operator**

(617) 519-3122

Operator Information Continued

4.5 **Operator Address**

Street or P.O. Box 101 Federal St., Suite 1900		
City or town Boston	State MA	ZIP code 02210
Email address of operator enrique.alvarez@southcoastwind.com		

SECTION 5. INDIAN LAND (40 CFR 122.21(f)(5))

Indian Land

5.1 Is the facility located on Indian Land?

☐ Yes ☑ No

SECTION 6. EXISTING ENVIRONMENTAL PERMITS (40 CFR 122.21(f)(6))

Existing Environmental Permits

6.1 **Existing Environmental Permits** (check all that apply and print or type the corresponding permit number for each)

☑ NPDES (discharges to surface water) NPDES-permitted discharge planned during operations. No NPDES-permitted discharge planned during construction	☐ RCRA (hazardous wastes)	☐ UIC (underground injection of fluids)
☐ PSD (air emissions)	☐ Nonattainment program (CAA)	☐ NESHAPs (CAA)
☐ Ocean dumping (MPRSA)	☑ Dredge or fill (CWA Section 404) See COP for list of anticipated permits required, see also: www.permits.performance.gov/permitting-project/southcoast-wind-energy-llc-southcoast-wind	☑ Other (specify) See COP for list of anticipated permits required, see also: www.permits.performance.gov/permitting-project/southcoast-wind-energy-llc-southcoast-wind

SECTION 7. MAP (40 CFR 122.21(f)(7))

Map

7.1 Have you attached a topographic map containing all required information to this application? (See instructions for specific requirements.)

☑ Yes ☐ No ☐ CAFO—Not Applicable (See requirements in Form 2B.)

SECTION 8. NATURE OF BUSINESS (40 CFR 122.21(f)(8))

Nature of Business

8.1 Describe the nature of your business.

SouthCoast Wind draws from the deep experience and skills of its sponsor companies in successfully permitting, financing, constructing and operating offshore energy production facilities. SouthCoast Wind is developing an offshore lease area that has the potential to generate over 2,400 megawatts (MW) of low-cost clean energy, or enough to power over one million homes. The project will occupy the 199 square-mile (or 127,000 acre) lease area, which was awarded through a competitive auction by the US Bureau of Ocean Energy Management. We expect to deliver clean energy from the project by the end of the 2020s.

See the attached Project Narrative for more detailed information.

SECTION 9. COOLING WATER INTAKE STRUCTURES (40 CFR 122.21(f)(9))

Cooling Water Intake Structures

9.1 Does your facility use cooling water?

☑ Yes ☐ No ➔ SKIP to Item 10.1.

9.2 Identify the source of cooling water. (Note that facilities that use a cooling water intake structure as described at 40 CFR 125, Subparts I and J may have additional application requirements at 40 CFR 122.21(r). Consult with your NPDES permitting authority to determine what specific information needs to be submitted and when.)

Atlantic Ocean.
See Project Narrative for additional information related to the source water, intake structure, and thermal modeling associated with the discharge.

SECTION 10. VARIANCE REQUESTS (40 CFR 122.21(f)(10))

Variance Requests

10.1 Do you intend to request or renew one or more of the variances authorized at 40 CFR 122.21(m)? (Check all that apply. Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)

☐ Fundamentally different factors (CWA Section 301(n))
☐ Water quality related effluent limitations (CWA Section 302(b)(2))
☐ Non-conventional pollutants (CWA Section 301(c) and (g))
☐ Thermal discharges (CWA Section 316(a))
☐ Not applicable

EPA Identification Number	NPDES Permit Number	Facility Name
N/A - New Facility	N/A	SouthCoast Wind

Form Approved 03/05/19
OMB No. 2040-0004

SECTION 11. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

Checklist and Certification Statement

11.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.

Column 1	Column 2
☑ Section 1: Activities Requiring an NPDES Permit	☐ w/ attachments
☑ Section 2: Name, Mailing Address, and Location	☐ w/ attachments
☑ Section 3: SIC Codes	☐ w/ attachments
☑ Section 4: Operator Information	☐ w/ attachments
☐ Section 5: Indian Land	☐ w/ attachments
☐ Section 6: Existing Environmental Permits	☐ w/ attachments
☑ Section 7: Map	☑ w/ topographic map ☑ w/ additional attachments
☑ Section 8: Nature of Business	☐ w/ attachments
☑ Section 9: Cooling Water Intake Structures	☑ w/ attachments
☑ Section 10: Variance Requests	☑ w/ attachments
☑ Section 11: Checklist and Certification Statement	☐ w/ attachments

11.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Francis Slingsby	Chief Executive Officer
Signature	Date signed
[signature]	8/21/2023

United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA Form 3510-2E Revised March 2019

Water Permits Division

EPA

Application Form 2E

Manufacturing, Commercial, Mining, and Silvicultural Facilities Which Discharge Only Nonprocess Wastewater

NPDES Permitting Program

Note: Complete this form ***and*** Form 1 if your facility is a new or existing manufacturing, commercial, mining, and silvicultural facility that discharges only nonprocess wastewater.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
N/A - New Facility	N/A	SouthCoast Wind	

FORM 2E NPDES

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURAL FACILITIES WHICH DISCHARGE ONLY NONPROCESS WASTEWATER

SECTION 1. OUTFALL LOCATION (40 CFR 122.21(h)(1))

Outfall Location

1.1 Provide information on each of the facility's outfalls in the table below.

Outfall Number	Receiving Water Name	Latitude	Longitude
001	Atlantic Ocean	40° 48′ 18.16″ N	-70° 19′ 29.41″ W
		° ′ ″	° ′ ″
		° ′ ″	° ′ ″

SECTION 2. DISCHARGE DATE (40 CFR 122.21(h)(2))

Discharge Date

2.1 Are you a new or existing discharger? (Check only one response.)

☑ New discharger ☐ Existing discharger ➔ SKIP to Section 3.

2.2 Specify your anticipated discharge date: 06/30/2027

SECTION 3. WASTE TYPES (40 CFR 122.21(h)(3))

Waste Types

3.1 What types of wastes are currently being discharged if you are an existing discharger or will be discharged if you are a new discharger? (Check all that apply.)

☐ Sanitary wastes
☐ Restaurant or cafeteria waste
☑ Non-contact cooling water
☐ Other nonprocess wastewater (describe/explain directly below)

3.2 Does the facility use cooling water additives?

☑ Yes ☐ No ➔ SKIP to Section 4.

3.3 List the cooling water additives used and describe their composition.

Cooling Water Additives (list)	Composition of Additives (if available to you)
Sodium Hypochlorite; via electrolysis system	Chlorine

SECTION 4. EFFLUENT CHARACTERISTICS (40 CFR 122.21(h)(4))

Effluent Characteristics

4.1 Have you completed monitoring for all parameters in the table below at each of your outfalls and attached the results to this application package?

☐ Yes ☑ No; a waiver has been requested from my NPDES permitting authority (attach waiver request and additional information) ➔ SKIP to Section 5.

4.2 Provide data as requested in the table below.[1] (See instructions for specifics.)

Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)
		Mass	Conc.	Mass	Conc.	
Biochemical oxygen demand (BOD_5)						
Total suspended solids (TSS)						
Oil and grease						
Ammonia (as N)						
Discharge flow						
pH (report as range)						
Temperature (winter)						
Temperature (summer)						

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
N/A - New Facility	N/A	SouthCoast Wind	

Effluent Characteristics Continued

4.3 Is fecal coliform believed present, or is sanitary waste discharged (or will it be discharged)?

☐ Yes ☑ No ➔ SKIP to Item 4.5.

4.4 Provide data as requested in the table below.[1] (See instructions for specifics.)

Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (Use codes per Instructions.)
		Mass	Conc.	Mass	Conc.	
Fecal coliform						
E. coli						
Enterococci						

4.5 Is chlorine used (or will it be used)?

☑ Yes ☐ No ➔ SKIP to Item 4.7.

4.6 Provide data as requested in the table below.[1] (See instructions for specifics.)

Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)
		Mass	Conc.	Mass	Conc.	
Total Residual Chlorine	N/A					4

4.7 Is non-contact cooling water discharged (or will it be discharged)?

☑ Yes ☐ No ➔ SKIP to Section 5.

4.8 Provide data as requested in the table below.[1] (See instructions for specifics.)

Parameter or Pollutant	Number of Analyses (if actual data reported)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Source (use codes per instructions)
		Mass	Conc.	Mass	Conc.	
Chemical oxygen demand (COD)						
Total organic carbon (TOC)						

SECTION 5. FLOW (40 CFR 122.21(h)(5))

Flow

5.1 Except for stormwater water runoff, leaks, or spills, are any of the discharges you described in Sections 1 and 3 of this application intermittent or seasonal?

☐ Yes ➔ Complete this section. ☑ No ➔ SKIP to Section 6.

5.2 Briefly describe the frequency and duration of flow.

The CWIS providing non-contact once-through cooling water to the converter station will be operated 24 hours per day, 365 days per year, with the exception of maintenance periods. Typical operations will utilize two seawater lift pumps, each operating at 780 cubic meters per hour, for a maximum DIF of 9.9 MGD. At any time, either one or two seawater lift pumps would be expected to be in operation, with the third seawater lift pump serving only as a backup.

SECTION 6. TREATMENT SYSTEM (40 CFR 122.21(h)(6))

Treatment System

6.1 Briefly describe any treatment system(s) used (or to be used).

Each seawater intake caisson is equipped with a pump strainer with a typical outer screen size of 9.5 mm intended to protect the seawater lift pump from debris in the water column. The strainers are retractable on the seawater lift pump for cleaning. Each pump flowline is also equipped with a 250 µm filter, intended to protect the equipment and ensure reliable operation of the CWIS. An automated backwash cleaning system is used, with no added chemicals.

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
N/A - New Facility	N/A	SouthCoast Wind	

SECTION 7. OTHER INFORMATION (40 CFR 122.21(h)(7))

Other Information

7.1 Use the space below to expand upon any of the above items. Use this space to provide any information you believe the reviewer should consider in establishing permit limitations. Attach additional sheets as needed.

The CWIS is equipped with an anti-fouling system to prevent marine growth in the pump caissons and the Seawater System, which consists of Hypochlorite Generator Packages. The Hypochlorite Generator Packages produces Sodium Hypochlorite (NaOCl) by seawater electrolysis. The hypochlorite is injected into the pump caissons near the suction level of the Seawater Lift Pumps. Hypochlorite Generator Packages are designed to achieve a hypochlorite solution flow rate of sufficient concentration, corresponding with a 0 to 2 ppm equivalent free chlorine concentration in the seawater intake lines. This method of continuous injection into the pump caisson is preferred because at a low dosage of NaOCl (i.e., 2 mg/l, 95 kg/day), the residual free chlorine at the outlet would be negligible and oxidized in the water with no negative impact.

SECTION 8. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

Checklist and Certification Statement

8.1 In Column 1 below, mark the sections of Form 2E that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.

Column 1	Column 2	
☑ Section 1: Outfall Location	☑ w/ attachments (e.g., responses for additional outfalls)	
☑ Section 2: Discharge Date	☐ w/ attachments	
☑ Section 3: Waste Types	☐ w/ attachments	
☑ Section 4: Effluent Characteristics	☑ w/ attachments	
☑ Section 5: Flow	☑ w/ attachments	See the attached Project Narrative for more detailed information.
☑ Section 6: Treatment System	☑ w/ attachments	
☑ Section 7: Other Information	☑ w/ attachments	
☑ Section 8: Checklist and Certification Statement	☐ w/ attachments	

8.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Francis Slingsby	Chief Executive Officer
Signature [signature]	Date signed 8/21/2023