EMPIRE OFFSHORE WIND:
EMPIRE WIND PROJECT (EW 1 and EW 2)

CONSTRUCTION AND OPERATIONS PLAN

VOLUME 2b: BIOLOGICAL RESOURCES

Prepared for
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Submitted to
Bureau of Ocean Energy Management

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Photo Credit: Jan Arne Wold/Equinor

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5. BIOLOGICAL RESOURCES AND HABITATS

The following sections provide an assessment of the terrestrial and coastal biological resources and habitats in the vicinity of the Project Area. Terrestrial systems assessed include those areas between the export cable landfalls and each respective POI. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities. This section includes a discussion of the existing vegetation community composition as it relates to the presence and quality of habitat, a review of sensitive habitats including wetlands and waterbodies, and an evaluation of avian and bat species along with other rare or protected species and natural communities. Coastal systems reviewed include those areas located within and adjacent to the Lease Area and the submarine export cable routes, and include a characterization of benthic resources, finfish and invertebrate communities, and designated essential fish habitat (EFH), as well as marine mammals and sea turtles. Along with the characterization of the affected environment, potential Project-related impacts to terrestrial and coastal biological resources and habitats, as a result of the construction, operations, and decommissioning of the Project are also discussed.

Resources reviewed as part of this biological resources and habitats assessment include a combination of publicly available data sources, resource-specific agency consultations, and targeted field surveys. These resources are referenced throughout the following sections.

5.1 Terrestrial Vegetation and Wildlife

This section describes the terrestrial vegetation and wildlife resources that have been observed, or have the potential to occur, in the vicinity of the Project Area. Potential impacts to terrestrial vegetation and wildlife resources resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Empire are also described that are intended to avoid, minimize, and/or mitigate potential impacts to terrestrial vegetation and wildlife.

Other resources related to terrestrial vegetation and wildlife that are discussed in separate sections include:

- Wetlands and Waterbodies (Section 5.2);
- Avian Species (Section 5.3 and Appendix Q);
- Bat Species (Section 5.4, Appendix R, and Appendix S);
- Marine Mammals (Section 5.6); and
- Sea Turtles (Section 5.7).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes up to a 0.5-mi (0.8-km) radius buffer (1 mi [1.6 km] total width) around the EW 1 and EW 2 onshore export and interconnection cable routes and associated onshore substation sites and the O&M Base[1] (**Figure 5.1-1** and **Figure 5.1-2**).[2]

[1] While the O&M Base will serve both EW 1 and EW 2, the facility will be located at SBMT, adjacent to the EW 1 onshore substation, and will therefore be included within the EW 1 Onshore Study Area for the purposes of this analysis.

[2] Based on the information provided by the NYSDEC, as described in **Data Relied Upon and Studies Competed**.

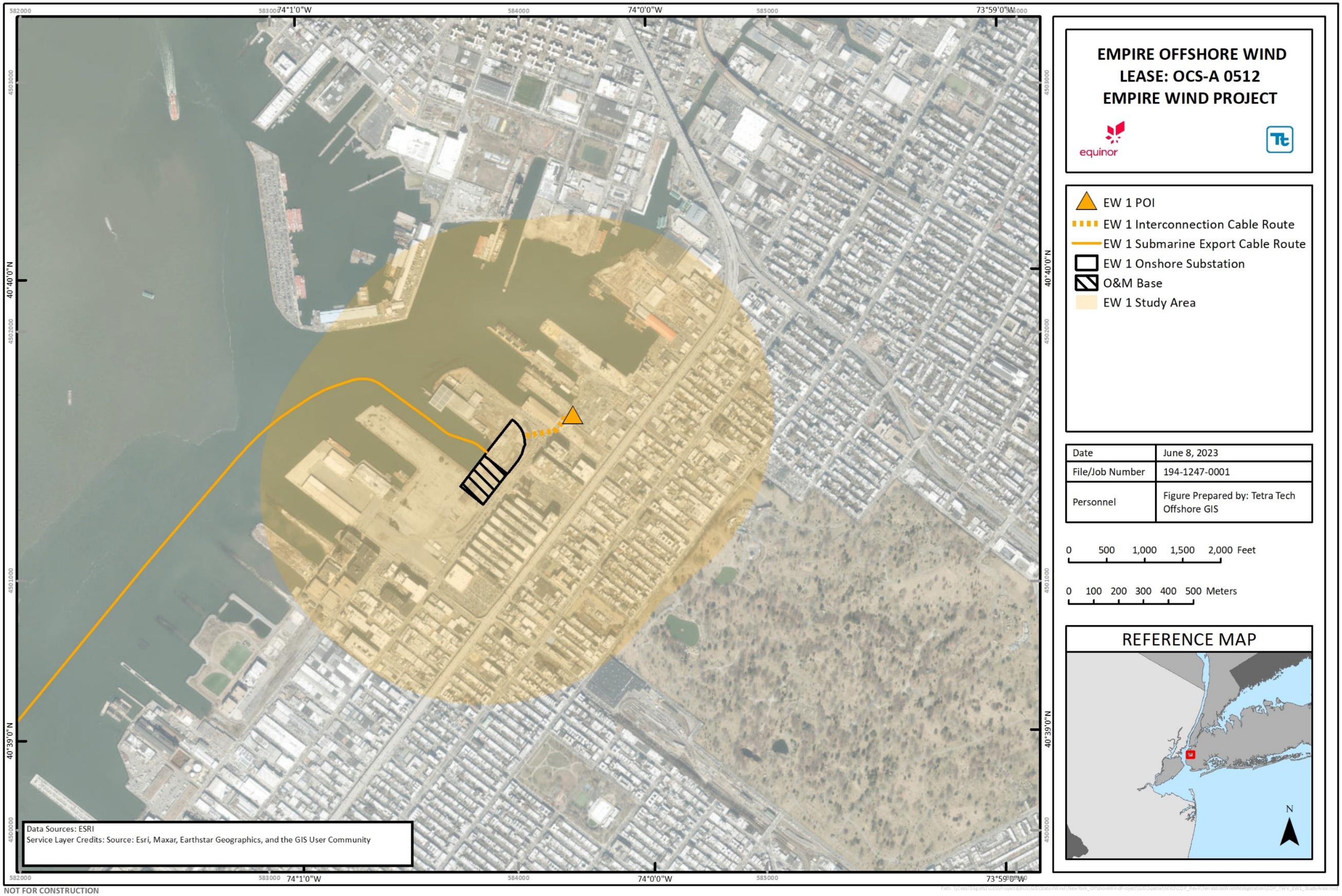


Figure 5.1-1 EW 1 Terrestrial Vegetation and Wildlife Study Area

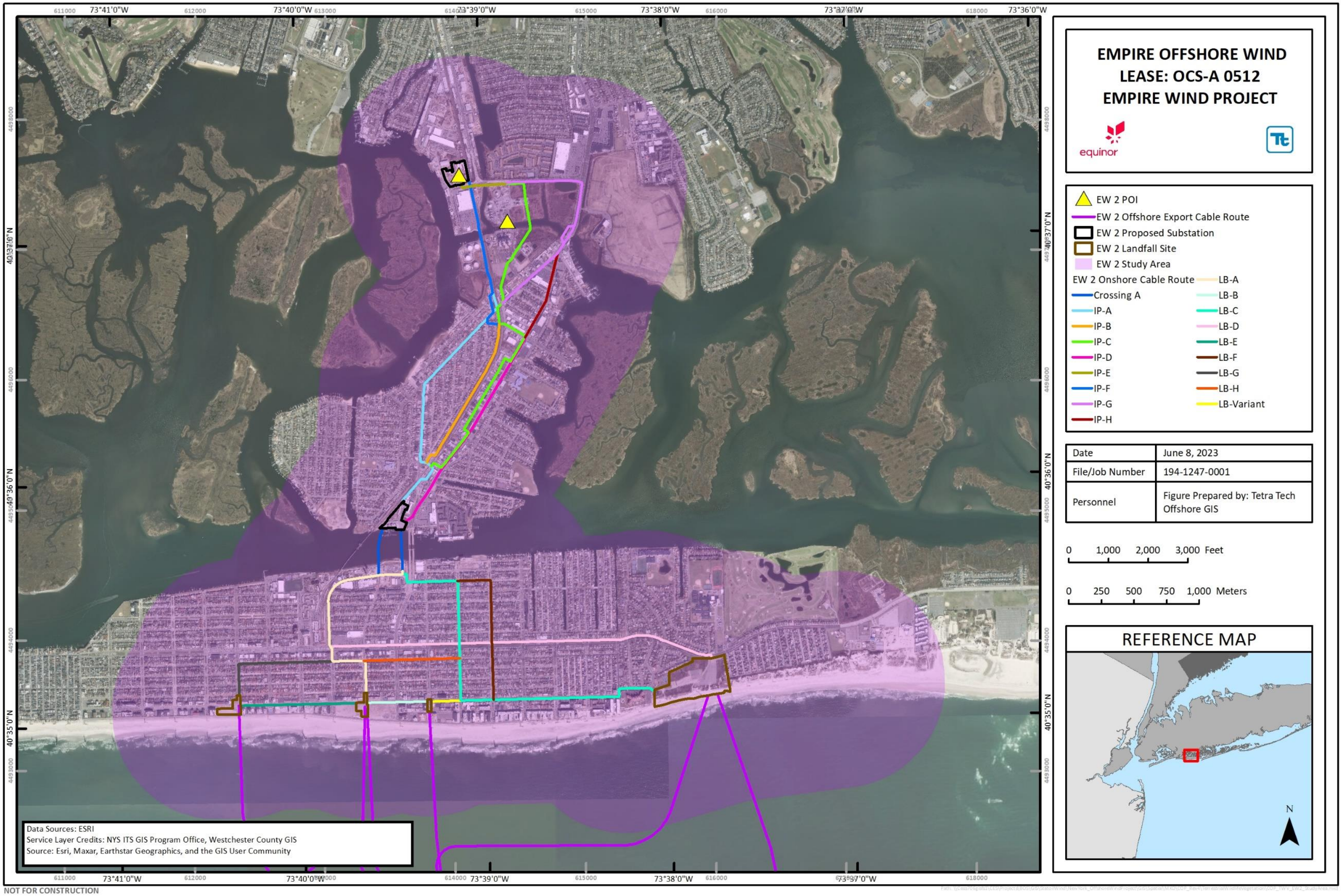


Figure 5.1-2 EW 2 Terrestrial Vegetation and Wildlife Study Area

In order to determine the baseline terrestrial vegetation and wildlife conditions within the Study Area, a desktop review was conducted with respect to the onshore electrical system for each of the onshore export and interconnection cable routes and associated onshore substations, using the following resources:

- 2016 National Land Cover Dataset: Land Cover Conterminous United States (USGS 2019);
- Google Earth Historical Aerial Imagery, 1994 – 2018. Brooklyn, New York;
- Google Earth Historical Aerial Imagery, 1994 – 2018. Long Beach, Island Park, and Oceanside, New York; and
- USFWS Information for Planning and Consultation (IPaC).

In January 2019, formal inquiries were submitted to the NYSDEC Division of Fish and Wildlife to review the Natural Heritage Program databases and determine potential state- and federally protected wildlife species likely to be present on or proximal to the Project Area. Updated inquiries were submitted to the NYSDEC for both the EW 1 onshore export and interconnection cable route in June 2019 and the EW 2 onshore export and interconnection cable route in August 2019, as new parcels had recently been added into the defined Project Area. Empire submitted an additional inquiry to the NYSDEC in July 2020 for the updated onshore export and interconnection cable routes and onshore substations. In April 2021 and May 2022, Empire submitted additional inquiries to the NYSDEC for EW 1 and updated EW 2 onshore export and interconnection cable routes and onshore substations. Although the location of the proposed O&M Base was not included in the April 2021 inquiry, this area was included in the June 2019 inquiry; the responses to these requests have been incorporated into Section 5.1.1 and Section 5.1.2.

In addition to the list of protected species provided by the NYSDEC, Official Species Lists associated with the Project were also obtained from the USFWS IPaC project planning tool. This tool identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may be present within or in the immediate vicinity of the Study Area, and therefore may be directly or indirectly affected by the Project. The most recent IPaC reviews were conducted for EW 1 and EW 2 on March 3, 2022. The results generated by review of the IPaC tool have been incorporated into Section 5.1.1 and Section 5.1.2.

A field reconnaissance was conducted at the EW 1 Project Area on December 5, 2018 as part of a preliminary assessment from publicly accessible areas, to verify the presence of mapped wetland and waterbody resources, to assess the potential presence of unmapped wetlands and waterbodies, and to characterize the terrestrial vegetation and wildlife habitat. A field reconnaissance was conducted at the EW 2 Project Area on November 4, 2021 in conjunction with wetland delineation surveys (see Section 5.2). As part of this field reconnaissance, habitats within the potential Project limits of disturbance were assessed and assigned appropriate community classifications according the 2014 *Ecological Communities of New York State, Second Edition* (Edinger et al. 2014). Additionally, a preliminary assessment of invasive plant species identified as prohibited or regulated on 6 NYCRR Part 575 was conducted. A formal survey for invasive plant species will be conducted before Project construction, if needed, in accordance with Empire's Invasive Species Control Plan, to document the location of invasive plant stands within the limits of disturbance. The field reconnaissance was generally conducted from publicly-accessible areas, with the exception of the EW 2 Onshore Substation C site, which was assessed in its entirety. Field surveys to document terrestrial vegetation and wildlife resources for all remaining unsurveyed portions of EW 2 began in 2022 and continue through late summer 2023.

5.1.1 Affected Environment

The affected environment is defined as the coastal and onshore areas that have the potential to be directly affected by the construction, operations, and decommissioning of the Project. This includes the onshore export and interconnection cable route corridors from export cable landfall to the onshore substations and POIs, as well as the O&M Base. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities. The onshore export and interconnection cables, onshore substations, and O&M Base are located within urbanized landscapes in New York metropolitan areas, primarily along or within existing roadway corridors. Vegetation almost entirely consists of landscape plants, including trees, shrubs, other ornamental plants, and maintained grass (with exceptions noted below). This includes landscaped areas along roadways, within roadway medians, and in local parks. Terrestrial wildlife is expected to be limited to those species adapted to living in urban environments, such as gulls, pigeons, squirrels, and other small rodents or other commensal wildlife. Areas that contain larger expanses of open space and natural land cover, such as parks and riparian areas associated with existing waterbodies, are expected to have higher densities of common wildlife species. However, due to the urban nature of these terrestrial areas, wildlife species that are expected to occur will be limited to those adapted to living in association with human-influenced landscapes, disturbance, and noise. Additionally, shorebirds may forage on the public beaches adjacent to the export cable landfall locations, and marsh islands at the periphery of the Study Area may serve as foraging and/or nesting habitat.

Invasive plant species commonly associated with disturbed and urban areas occur, often at high densities, throughout the terrestrial regions of the Project. Due to the high level of development, impervious surface, and other such areas that are devoid of vegetation within the onshore export and interconnection cable construction corridors, onshore substations, and O&M Base, invasive plant species are concentrated within and adjacent to disturbed wetlands and streams as well as along vegetated edges of public roadways.

5.1.1.1 EW 1

South Brooklyn Marine Terminal is a paved commercial shipping terminal that is devoid of vegetation. From the EW 1 landfall at SBMT, where the onshore substation will also be located, the interconnection cable route traverses northeast along an existing public roadway (2nd Avenue) to the Gowanus POI. The O&M Base will be located on SBMT, directly to the south of the EW 1 onshore substation. The Gowanus POI consists of a paved lot that already contains electrical transmission infrastructure and is devoid of any vegetation. Based on the 2016 National Land Cover Database (NLCD), the onshore substation parcel is primarily situated within developed lands of variable development intensity (see **Figure 5.1-3**; USGS 2019). NLCD land cover classifications for the onshore components of the Project are available in **Table 5.1-1**.

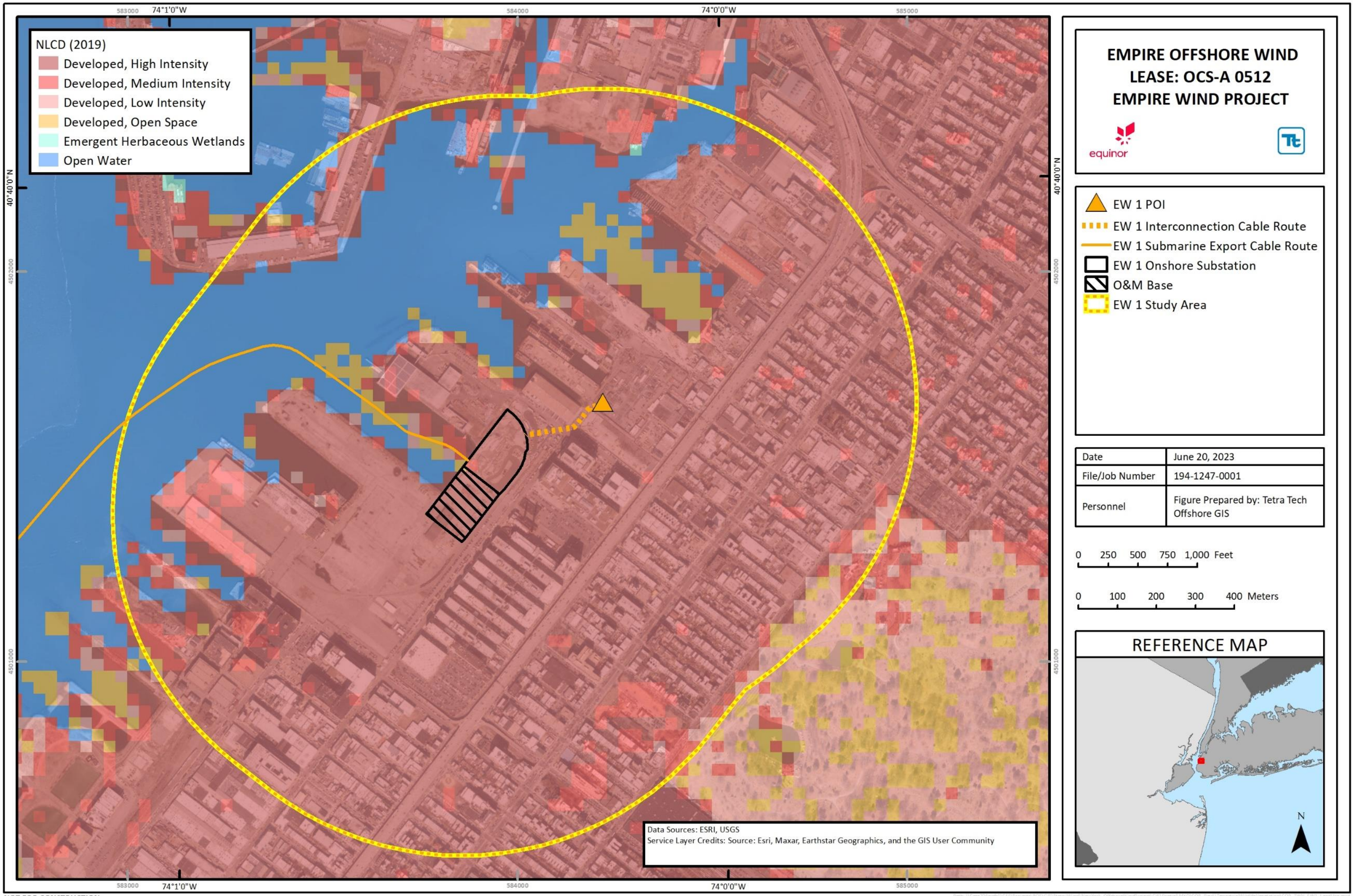


Figure 5.1-3 EW 1 Land Cover

Table 5.1-1 2016 NLCD Land Use for the EW 1 Project Area

Route Feature	NLCD Cover Class (2016)	Area (Acres)	Percent of Total
Interconnection Cable Route	Developed, High Intensity	0.87	100%
	Total	**0.87**	**100%**
Onshore Substation	Developed, High Intensity	4.71	99%
	Developed, Open Space	0.05	1%
	Total	**4.76**	**100%**
O&M Base	Developed, High Intensity	4.4	99%
	Developed, Medium Intensity	0.01	<1%
	Developed, Open Space	0.04	<1%
	Total	**4.5**	**100%**

Federally listed threatened and endangered species known or expected to be present in the vicinity of the EW 1 Study Area were determined through review of the USFWS IPaC online tool on March 3, 2022. IPaC identified one endangered bird species, the Roseate Tern; two threatened bird species, the Piping Plover and the Red Knot; one candidate insect species, the Monarch Butterfly; and one endangered plant species, the seabeach amaranth; that may be present within and/or are near the onshore components of the Project and may be affected by the Project. No critical habitats were identified (see **Appendix N Information for Planning and Conservation (IPaC) Report and New York State Department of Environmental Conservation Natural Heritage Response Letters** for a copy of the IPaC Report). A total of 46 bird species protected under the Migratory Bird Treaty Act of 1918 (MBTA) were identified.

Natural Heritage Database inquiries were also submitted to the NYSDEC Division of Fish and Wildlife on January 16, 2019, June 26, 2019, July 10, 2020, April 20, 2021, and May 11, 2022, with responses received on February 14, 2019, July 30, 2019, August 21, 2020, and June 3, 2021, respectively, with the final letter pending response. Multiple inquiries were submitted as alternatives were considered, and refinements were made to the Project location associated with the EW 1 landfall and onshore substation parcel. Each response provided by the NYSDEC indicated that the Peregrine Falcon (*Falco peregrinus*) may be present in the vicinity of the EW 1 submarine export cable route, as there is a documented breeding occurrence on the Verrazzano-Narrows Bridge; however, no Significant Natural Communities were identified (see **Appendix N** for a copy of the Natural Heritage Response Letter). In addition, the EW 1 Study Area is not located within NYS Significant Coastal Fish and Wildlife Habitats. It should be noted that NYSDEC is proposing changes to the protection status of several species due to documented growth or decline in populations (NYSDEC 2019). This includes a downgrade in status for those listed species that have experienced population growth and an upgrade in status, or a newly assigned status for previously unlisted species, due to documented declines in populations. The Peregrine Falcon is listed as potentially being downgraded from a state-listed endangered species to a state-listed Species of Special Concern. The draft list of changes was open for public comment until January 24, 2020 and a formal proposal to revise the list is pending. Further consultation with NYSDEC during the Article VII state permitting process will identify if the final changes to the protection status of the species in question are applicable to the Project.

As the EW 1 interconnection cable route and onshore substation are located within an urban landscape and within an area primarily devoid of vegetation, wildlife expected to occur would be limited to scavengers and those adapted to living in association with human disturbance and noise, including gulls, pigeons, and small rodents. Other seabird species and migratory birds, including those identified in the IPaC and NYSDEC review, could occur along the route; however, due to the lack of natural habitat that is already fragmented, these are not expected to occur at high densities.

5.1.1.2 EW 2

Based on the 2016 NLCD data, the onshore export and interconnection cable routes are situated within developed lands of variable development intensity (**Table 5.1-2**). Vegetated areas are primarily limited to the area within and adjacent to the existing Oceanside POI, as well as strips along the Long Island Rail Road (LIRR) right-of-way (ROW), existing roadways, and maintained lawn (see **Figure 5.1-4**; USGS 2019).

Four export cable landfall options are currently under review for EW 2. EW 2 Landfall A is located on Riverside Boulevard and exhibits a paved road and a vacant lot with a gravel surface devoid of vegetation. EW 2 Landfall B is located two blocks east on Monroe Boulevard and exhibits paved road and concrete and is also devoid of vegetation. EW 2 Landfall C is located in Lido Beach West Town Park and exhibits a mixture of parking lots, recreational facilities such as tennis courts, as well as supporting buildings. EW 2 Landfall E is located at Laurelton Boulevard and West Broadway, and exhibits existing paved roads and undeveloped lots. Based on NYSDEC consultation, Lido Beach is a maritime beach with a sand to pebble and shell substrate. The beach is very wide with distinct dunes throughout (**Appendix N**). While maritime beaches are extremely sparsely vegetated, the composition and structure of vegetation on maritime dunes varies depending on the stability of the dunes, amounts of sand deposition and erosion, and the distance from the ocean (Edinger et al. 2014). However, as cable landfall is proposed to be installed using trenchless installation (HDD or Direct Pipe), dune habitat along the beach is not expected to be directly affected by the Project.

The onshore export cable route is located primarily within existing roadways, which exhibits sparse vegetation that includes intermittent mowed roadside/pathway ecological community with occasional planted trees and shrubs within the road median. A total of nine onshore export cable route segments are under review to traverse the island of Long Beach from the export cable landfall options to the Reynolds Channel crossing:

- From EW 2 Landfall A, the EW 2 Route Long Beach (LB)-A follows Riverside Boulevard to East Walnut Street, and then turns west to Reverend JJ Evans Boulevard, which turns into Park Place, to approach the Reynolds Channel crossing at Riverside Boulevard.
- From EW 2 Landfall B, the EW 2 Route LB-B follows Monroe Street to East Broadway and then turns west to connect with EW 2 Route LB-A to approach the Reynolds Channel crossing.
- From EW 2 Landfall C, the EW 2 Route LB-C traverses west through the park to Richmond Road. The onshore export cables will continue west on Richmond Road until turning south on Maple Boulevard and then immediately west on East Broadway. The onshore export cables will then turn north onto Lincoln Boulevard or continue west on the EW 2 Route LB Variant. From Lincoln Boulevard, the onshore export cables will continue north until turning west onto East Harrison Street. The onshore export cables will then cross perpendicular to Long Beach Boulevard and turn north onto Long Beach Road, to the crossing at Reynolds Channel. From the EW 2 Route LB Variant, the onshore export cables will connect into LB-B to the crossing at Reynolds Channel.
- From the EW 2 Landfall C, the EW 2 Route LB-D traverses north along Lido Boulevard and continues to traverse west, as Lido Boulevard turns into East Park Avenue. The onshore export cables will either turn north onto Lincoln Boulevard, connecting to EW 2 Route LB-C, and/or continue west on Park Avenue to Reverend JJ Evans Boulevard, connecting with the EW 2 Route LB-A, to the crossing at Reynolds Channel.
- From the EW Landfall E, the EW 2 Route LB-E will proceed east along West Broadway to reach EW 2 Landfall A, from which the EW 2 Route LB-E could connect to EW 2 Route LB-A or EW 2 Route LB-B to the crossing at Reynolds Channel.

- EW 2 Route LB Variant represents the portion of East Broadway between Monroe Boulevard and Lincoln Boulevard in which the EW 2 Route LB-C could connect to EW 2 Route LB-B to the crossing at Reynolds Channel.
- From EW 2 Landfall C, the EW 2 Route LB-F follows EW 2 Route LB-C, traversing west through the park to Richmond Road, continuing west on Richmond Road until turning south on Maple Boulevard and then immediately west on East Broadway. The route then turns north on Franklin Boulevard, then turns west onto East Harrison Street and rejoins EW 2 Route LB-C to the crossing at Reynolds Channel.
- From EW 2 Landfall E, one or more onshore export cables follow Laurelton Boulevard north, then turn east onto West Walnut Street and continue to Edwards Boulevard. The EW 2 Route LB-G then turns north on Edwards Boulevard and joins EW 2 Route LB-A, crossing Park Avenue and turning slightly west onto Reverend JJ Evans Boulevard, which turns into Park Place, until the crossing at Reynolds Channel.
- From EW 2 Landfall A, the onshore export cables could proceed north on Riverside Boulevard along EW 2 Route LB-A to East Walnut Street, at which point EW 2 Route LB-H turns east along East Walnut Street until it reaches Lincoln Boulevard to connect with EW 2 Route LB-C until the crossing at Reynolds Channel.

Table 5.1-2 2019 NLCD Land Use for the EW 2 Project Area

Route Feature	NLCD Cover Class (2019)	Area (Acres)	Percent of Total
EW 2 Landfall A	Developed, High Intensity	1.41	59%
	Developed, Medium Intensity	0.94	40%
	Barren Land	0.03	1%
	Total	**2.38**	**100%**
EW 2 Landfall B	Developed, High Intensity	0.72	100%
	Total	**0.72**	**100%**
EW 2 Landfall C	Developed, Medium Intensity	9.80	29%
	Barren Land	8.46	25%
	Developed, Low Intensity	5.10	15%
	Developed, High Intensity	4.52	13%
	Herbaceous	3.11	9%
	Developed, Open Space	2.98	9%
	Total	**33.96**	**100%**
EW 2 Landfall E	Developed, High Intensity	1.97	62%
	Developed, Medium Intensity	0.71	22%
	Barren Land	0.50	16%
	Total	**3.18**	**100%**

Table 5.1-2 2019 NLCD Land Use for the EW 2 Study Area (continued)

Route Feature	NLCD Cover Class (2019)	Area (Acres)	Percent of Total
EW 2 Route LB-A	Developed, High Intensity	47.12	70%
	Developed, Medium Intensity	19.40	29%
	Developed, Low Intensity	0.87	1%
	Open Water	0.01	0%
	Total	**67.40**	**100%**
EW 2 Route LB-B	Developed, High Intensity	15.56	73%
	Developed, Medium Intensity	5.45	26%
	Developed, Low Intensity	0.22	1%
	Total	**21.24**	**100%**
EW 2 Route LB-C	Developed, High Intensity	68.63	61%
	Developed, Medium Intensity	41.73	37%
	Developed, Low Intensity	1.42	1%
	Barren Land	0.35	0%
	Total	**112.14**	**100%**
EW 2 Route LB-D	Developed, High Intensity	64.26	56%
	Developed, Medium Intensity	45.57	40%
	Developed, Low Intensity	4.35	4%
	Developed, Open Space	0.35	0%
	Total	**114.54**	**100%**
EW 2 Route LB-E	Developed, High Intensity	28.47	76%
	Developed, Medium Intensity	7.32	20%
	Barren Land	0.99	3%
	Developed, Low Intensity	0.47	1%
	Total	**37.25**	**100%**
EW 2 Route LB-Variant	Developed, High Intensity	11.31	86%
	Developed, Medium Intensity	1.78	14%
	Total	**13.08**	**100%**
EW 2 Route LB-F	Developed, Medium Intensity	29.30	62%
	Developed, High Intensity	17.63	37%
	Developed, Low Intensity	0.67	1%
	Total	**47.60**	**100%**

Table 5.1-2 2019 NLCD Land Use for the EW 2 Study Area (continued)

Route Feature	NLCD Cover Class (2019)	Area (Acres)	Percent of Total
EW 2 Route LB-G	Developed, High Intensity	53.32	65%
	Developed, Medium Intensity	27.02	33%
	Developed, Low Intensity	1.48	2%
	Open Water	0.01	0%
	Total	**81.84**	**100%**
EW 2 Route LB-H	Developed, Medium Intensity	18.78	59%
	Developed, High Intensity	12.25	39%
	Developed, Low Intensity	0.69	2%
	Total	**31.72**	**100%**
Reynolds Channel Crossing	Open Water	14.55	42%
	Developed, High Intensity	13.35	39%
	Developed, Medium Intensity	5.34	15%
	Developed, Low Intensity	0.65	2%
	Emergent Herbaceous Wetlands	0.46	1%
	Barren Land	0.22	1%
	Total	**34.57**	**100%**
EW 2 Route IP-A	Developed, High Intensity	49.08	63%
	Developed, Medium Intensity	27.48	35%
	Developed, Low Intensity	1.68	2%
	Developed, Open Space	0.06	0%
	Total	**78.31**	**100%**
EW 2 Route IP-B	Developed, High Intensity	25.99	52%
	Developed, Medium Intensity	23.34	47%
	Developed, Low Intensity	0.64	1%
	Total	**49.98**	**100%**
EW 2 Route IP-C	Developed, High Intensity	69.03	63%
	Developed, Medium Intensity	19.15	17%
	Developed, Low Intensity	6.19	6%
	Emergent Herbaceous Wetlands	5.40	5%
	Barren Land	3.16	3%
	Open Water	2.26	2%
	Deciduous Forest	1.36	1%
	Developed, Open Space	1.33	1%
	Herbaceous	1.04	1%

Table 5.1-2 2019 NLCD Land Use for the EW 2 Study Area (continued)

Route Feature	NLCD Cover Class (2019)	Area (Acres)	Percent of Total
	Woody Wetlands	0.63	1%
	Shrub/Scrub	0.41	0%
	Total	**109.97**	**100%**
EW 2 Route IP-D	Developed, High Intensity	57.55	85%
	Developed, Medium Intensity	9.85	15%
	Developed, Low Intensity	0.26	0%
	Barren Land	0.10	0%
	Emergent Herbaceous Wetlands	0.01	0%
	Total	**67.76**	**100%**
EW 2 Route IP-E	Developed, Medium Intensity	8.95	51%
	Developed, High Intensity	6.92	40%
	Developed, Low Intensity	1.10	6%
	Barren Land	0.38	2%
	Developed, Open Space	0.09	1%
	Deciduous Forest	0.03	0%
	Total	**17.48**	**100%**
EW 2 Route IP-F	Developed, Medium Intensity	21.76	43%
	Developed, High Intensity	17.18	34%
	Developed, Low Intensity	8.76	17%
	Developed, Open Space	2.06	4%
	Open Water	0.48	1%
	Total	**50.24**	**100%**
EW 2 Route IP-G	Developed, High Intensity	34.52	43%
	Developed, Medium Intensity	22.26	28%
	Emergent Herbaceous Wetlands	8.02	10%
	Open Water	3.62	4%
	Woody Wetlands	3.60	4%
	Developed, Low Intensity	2.93	4%
	Barren Land	2.47	3%
	Shrub/Scrub	2.06	3%
	Deciduous Forest	1.13	1%
	Total	**80.60**	**100%**
EW 2 Route IP-H	Developed, High Intensity	28.01	93%
	Developed, Medium Intensity	2.15	7%
	Total	**30.16**	**100%**

Table 5.1-2 2019 NLCD Land Use for the EW 2 Study Area (continued)

Route Feature	NLCD Cover Class (2019)	Area (Acres)	Percent of Total
EW 2 Onshore Substation A	Developed, High Intensity	4.50	70%
	Developed, Medium Intensity	1.43	22%
	Developed, Low Intensity	0.49	8%
	Total	**6.43**	**100%**
EW 2 Onshore Substation C	Developed, High Intensity	2.86	55%
	Developed, Medium Intensity	2.18	42%
	Barren Lands	0.09	2%
	Emergent Herbaceous Wetlands	0.07	1%
	Total	**5.20**	**100%**

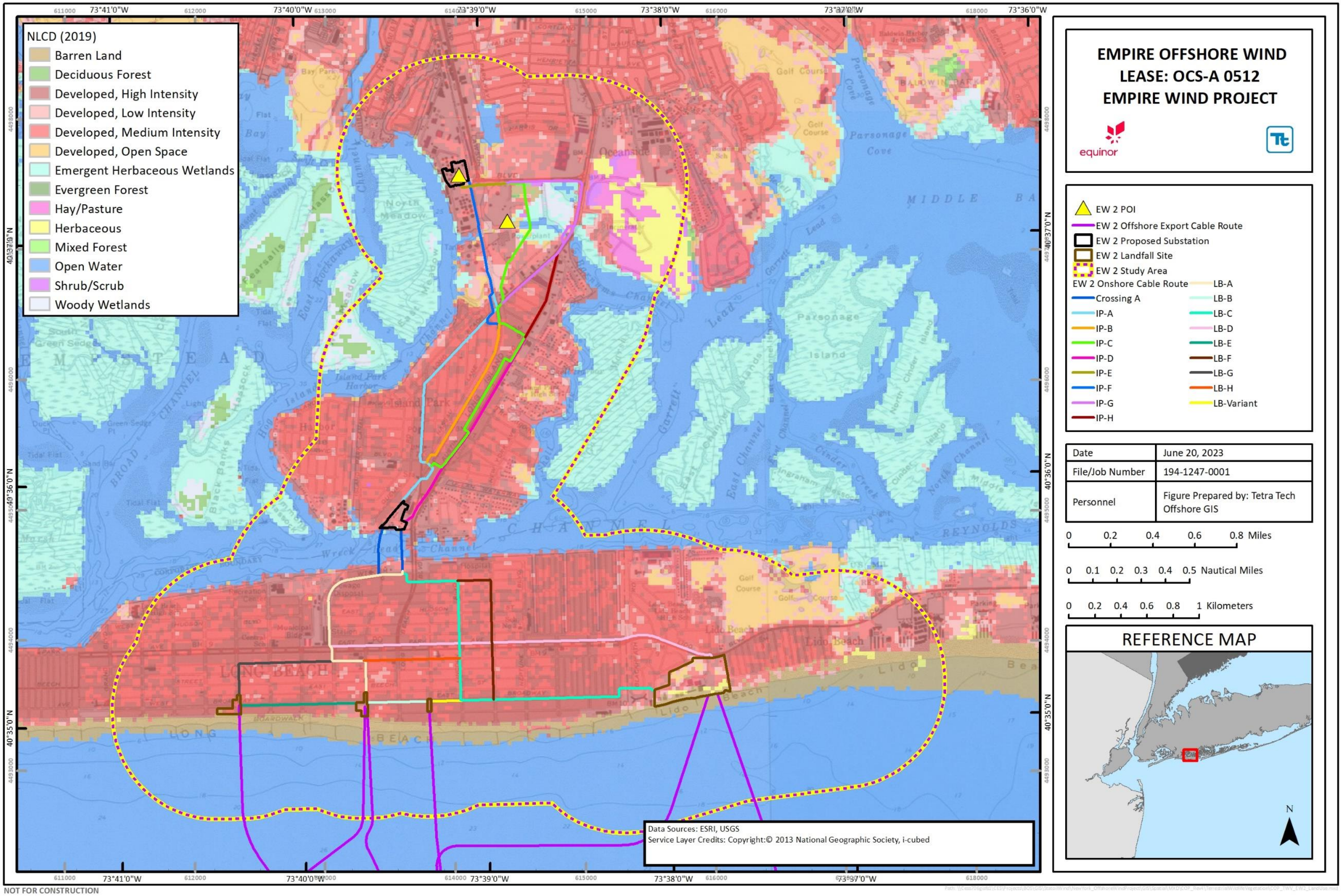


Figure 5.1-4 EW 2 Land Cover

The EW 2 onshore export cable route then crosses Reynolds Channel to Island Park. Empire is evaluating both open cut and HDD solutions to cross Reynolds Channel. A total of eight onshore cable route segments are under review to traverse Island Park from Reynolds Channel to the onshore substation site or POI, which will be traversed by onshore export cables (if EW 2 Onshore Substation A is selected) or interconnection cables (if EW 2 Onshore Substation C is selected):

- The EW 2 Route Island Park (IP)-A crosses to the west side of the LIRR and traverses northeast until crossing an existing parking lot along Warwick Road and turning north onto Long Beach Road until reaching the LIRR again where it could connect into EW 2 Route IP-C or turn northwest along the LIRR until connecting to EW 2 Route IP-F.
- The EW 2 Route IP-B follows EW 2 Route IP-A until crossing an existing parking lot along Warwick Road where EW 2 Route IP-B follows the LIRR and traverses northeast until connecting into either EW 2 Route IP-C or EW 2 Route IP-F. The EW 2 Route IP-C follows EW 2 Route IP-A until turning east through an existing parking lot and then north on Austin Boulevard. The route will then turn west onto Sagamore Road, then immediately north onto Industrial Place, then east onto Trafalgar Boulevard, and north onto Austin Boulevard before turning west onto Saratoga Boulevard and crossing the LIRR to continue along D'Amato Drive until turning northeast at Long Beach Road. The route then continues northwest onto Ladomus Ave to to enter into the Oceanside POI parcel, where it will cross Barnums Channel by either an open cut or trenchless crossing method, to connect with EW 2 Route IP-E.
- The EW 2 Route IP-D follows Austin Boulevard north until connecting with EW 2 Route IP-C.
- The EW 2 Route IP-E continues from the EW 2 Route IP-C or IP-G through the Oceanside POI parcel, turning west and traversing parallel to Daly Boulevard and crossing over the LIRR ROW before turning north into the EW 2 Onshore Substation A site.
- The EW 2 Route IP-F follows EW 2 Route IP-A until crossing an existing parking lot along Warwick Road, from which it will follow EW 2 Route IP-B along the LIRR and traverses northeast until turning west on Parente Lane North. The route will then turn north on Kildare Road, northeast on Long Beach Road, and north on North Nassau Lane. The route continues north across an industrial lot and access roads immediately to the west of the LIRR, crosses Barnums Channel, and follows the LIRR north before connecting into EW 2 Onshore Substation A or the POI.
- The EW 2 Route IP-G follows EW 2 Route IP-A until connecting to EW 2 Route IP-C. From the intersection of Sherman Road and Long Beach Road, EW 2 Route IP-G traverses northeast along Long Beach Road until turning west on Daly Boulevard to reach EW 2 Route IP-E and connecting into the EW 2 Onshore Substation A or the POI. EW 2 Route IP-G may require a new cable bridge immediately west of the existing bridge where Long Beach Road crosses Barnums Channel or it may use the existing road bridge.
- The EW 2 Route IP-H follows Austin Boulevard north along EW 2 Route IP-C or IP-D. At the intersection of Austin Boulevard and Saratoga Boulevard, EW 2 Route IP-H follows Austin Boulevard northeast until connecting to EW 2 Route IP-G at the intersection of Long Beach Road and Austin Boulevard.

Areas along the northern portion of the Island Park routes in the vicinity of the POI are comprised of shrub habitats that may provide foraging and nesting habitat for wildlife species. Due to the limited amount of natural habitat, these species are not expected to occur at high densities or be dependent on habitats in the Project Area. While numerous tidal creeks and impoundments drain into the south shore bays and associated salt marshes around Long Beach Island and Island Park, these areas have been highly impacted from activities such as dredging, mosquito control ditching, erosion, and removal of fill for development.

Two onshore substation sites are currently under review, EW 2 Onshore Substation A and EW 2 Onshore Substation C. EW 2 Onshore Substation A is located on a parcel on the corner of Hampton Road and Daly Boulevard. EW 2 Onshore Substation C is located north of Reynolds Channel between the LIRR ROW and Long Beach Road.

The EW 2 Onshore Substation C site is located within developed lands of medium to high development intensity (USGS 2019). The land currently supports a marina, restaurant, and self-storage facility. The field reconnaissance identified multiple ecological communities within the site, each within the Terrestrial Cultural subsystem, which includes communities either created or maintained by human activities or modified by human influence (Edinger et al. 2014). The dominant ecological communities include dredge spoils, urban structure exterior, and urban vacant lot. The vegetation is primarily sparse and consists of ornamental plantings around the marina with weedy invasive growth along the edges of the road and parking areas. The area of dredge spoils comprises a large soil stockpile mound that has regenerated with a dense community of invasive plants, including black locust (*Robinia pseudoacacia*) trees along with mugwort (*Artimisia vulgaris*) and multiflora rose (*Rosa multiflora*). Invasive vines including oriental bittersweet (*Celastrus orbiculatus*) and sweet autumn virgin's-bower (*Clematis terniflora*) coexist with herbaceous and shrub species.

Due lack of access at the time of the field reconnaissance, the vegetation and habitat within and in the immediate vicinity of EW 2 Onshore Substation A and the POI were not assessed in the field. Aerial imagery review and limit observations from public vantage points during the field reconnaissance indicate that the area is highly developed and is dominated by human-altered ecological communities. Upland areas comprise herbaceous lands interspersed with shrubby habitats. Low areas bordering tidal creeks are dominated by tidal wetlands and estuarine common reed (*Phragmites australis*) marsh communities, with common reed forming dense monocultures.

In addition to the Project components, temporary work areas are proposed to support the construction of the Project. These temporary work areas are distributed throughout the Project area and often overlap with one or more of the Project components.

Federally listed threatened and endangered species that may occur within and/or near, and may be affected by, the Project were reviewed using the USFWS IPaC on March 3, 2022, which identified a total of six listed species. These species include one federally threatened mammal species, the northern long-eared bat; one federally endangered bird species, the Roseate Tern; two federally threatened bird species, the Piping Plover and the Red Knot; one candidate insect species, the Monarch Butterfly; and one plant species, the seabeach amaranth (federally threatened). In addition, IPaC also identified 41 species of migratory birds protected under the MBTA and the BGEPA that have the potential to occur within the Project Area (see **Appendix N** for a copy of the IPaC report).

Natural Heritage Database inquiries were submitted to NYSDEC Division of Fish and Wildlife. NYSDEC indicated that ten threatened, endangered, or species of conservation concern have been documented in the vicinity of the Project; including two mammal species, seven bird species, and one plant species (see **Appendix N**). Two significant natural communities, whichcomprised sensitive beach habitats, were identified at EW 2 Landfall C and the temporary work areas associated with the landfall sites. The results of the IPaC review and the NYSDEC Natural Heritage Database inquiry are summarized in **Table 5.1-3**. In addition, the EW 2 Study Area is not located within NYS Significant Coastal Fish and Wildlife Habitats, except for a small mapped overlap with the dunes along the beach near EW 2 Landfall C. As cable landfall is proposed to be installed using trenchless installation (HDD or Direct Pipe), dune habitat along the beach is not expected to be directly affected by the Project.

Table 5.1-3 Summary of Potential Threatened, Endangered, and of Conservation Concern Species on or in the Vicinity of the EW 2 Onshore Components as Identified by USFWS and NYSDEC Consultation

Common Name	Scientific Name	Taxonomic Group	Federal Protection Status	State Protection Status	Potentially Within Project Components	Potentially Adjacent to Project Components	Observation Type	Additional Location Information Provided By NYSDEC
Animals								
Fin Whale a/ b/	*Balaenoptera physalus*	Mammal	Endangered	Endangered		X	Not Identified	Within the New York Bight and the offshore waters south of Long Island
Humpback Whale a/ b/	*Megaptera novaeangliae*	Mammal	Endangered	Endangered c/		X	Nonbreeding	Within the New York Bight and the offshore waters south of Long Island
Northern Long-eared Bat	*Myotis septentrionalis*	Mammal	Threatened	Threatened d/			Not Identified	Identified on IPaC report only; therefore, no species-specific location data acquired.
Harlequin Duck	*Histrionicus*	Bird	Unlisted	Unlisted		X	Nonbreeding	Long Beach Island at Long Beach east to Jones Beach Island at Tobay Beach, and in Jones Inlet.
Common Tern	*Sterna hirundo*	Bird	Unlisted	Threatened	X		Breeding	Lido Beach and Garrett Marsh, a salt marsh about 1/3 mile east of the route in Island Park
Forster's Tern	*Sterna forsteri*	Bird	Unlisted	Unlisted		X	Breeding	Garrett Marsh, a salt marsh about 1/3 mile east of the route in Island Park
Gull-Billed Tern	*Gelochelidon nilotica*	Bird	Unlisted	Unlisted		X	Breeding	Garrett Marsh, a salt marsh about 1/3 mile east of the route in Island Park
Least Tern	*Sterna antillarum*	Bird	Threatened	Unlisted	X		Breeding	Lido Beach
Black Skimmer	*Rynchops niger*	Bird	Unlisted	Unlisted	X		Breeding	Lido Beach
Piping Plover	*Charadrius melodus*	Bird	Threatened	Endangered	X		Not Identified	Lido Beach
Red Knot	*Calidris canutus rufa*	Bird	Threatened	Threatened			Not Identified	Identified on IPaC report only; therefore, no species-specific location data acquired.
Roseate Tern	*Sterna dougallii*	Bird	Endangered	Endangered			Not Identified	Identified on IPaC report only; therefore, no species-specific location data acquired.
Plants								
Seabeach Amaranth	*Amaranthus pumilus*	Plant	Threatened	Threatened	X		Individual or Population	Long Beach Island at Lido Beach
Sandplain Gerardia	*Agalinis acuta*	Plant	Endangered	Endangered		X	Individual or Population	Identified on IPaC report only; therefore, no species-specific location data acquired.
Communities								
Low Salt Marsh					X			Within the channels south, west, and east of the EW 2 onshore substation. e/
High Salt Marsh					X			Within the channels south, west, and east of the EW 2 onshore substation. e/
Salt Panne					X			Within the channels south, west, and east of the EW 2 onshore substation. e/
Marine Intertidal Gravel/Sand Beach					X			Long Beach Island
Maritime Beach					X			Long Beach Island

Notes:
a/ The Fin Whale and Humpback Whale were identified in the NYSDEC's Natural Heritage Database responses in 2019 and 2020
b/ Marine species identified through agency consultations as potentially occurring in the vicinity of the Project are discussed in **Section 5.6 Marine Mammals** and **Section 5.7 Sea Turtles**
c/ Humpback Whale is identified on NYSDEC's draft list of changes to threatened and endangered species as being downgraded from State-endangered to Unlisted (NYSDEC 2019)
d/ Northern Long-eared Bat is proposed for being reclassified from federally threatened to endangered (87 FR 16442)
e/ The onshore substation referenced by NYSDEC is no longer under consideration in the Project Design Envelope; however, onshore cable routes may approach or intersect these communities.

As the onshore components of the Project will be located predominantly within the developed lands identified within the onshore export and interconnection cable corridors, the Project Area is generally most suitable for species common to urban environments, comprising sparsely vegetated and highly fragmented habitats, including mammals such as Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Scirus carolinensis*), meadow vole (*Microtus pennsylvanicus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*). Bird species likely to utilize these urban habitats include house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), gulls, and rock pigeon (*Columba livia*; see **Section 5.3** for further discussion of avian species).

5.1.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For terrestrial vegetation and wildlife, the maximum design scenario is the greatest amount of vegetation clearing and conversion, as described in **Table 5.1-4**. This design concept incorporates the full build-out of onshore structures, including the onshore export and interconnection cable routes, the onshore substations, and the O&M Base.

Table 5.1-4 Summary of Maximum Design Scenario Parameters for Terrestrial Vegetation and Wildlife Resources

Parameter	Maximum Design Scenario	Rationale
Construction		
Export cable landfall	Based on EW 1 and EW 2. EW 1: HDD in a 200-ft by 200-ft (61-m by 61-m) area. EW 2: HDD or Direct Pipe installation in a 260-ft by 680-ft (79-m by 207-m) area.	Representative of the maximum area to be utilized to facilitate the export cable landfall.
Onshore export and interconnection cables	Based on EW 1 and EW 2. EW 1: 0.2 mi (0.4 km). EW 2: 5.6 mi (9.1 km).	Representative of the maximum length of onshore export and interconnection cables to be installed.
Onshore substations	Based on EW 1 and EW 2. EW 1: 10.8-ac (4.4-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation(s).
O&M Base	6.5-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the O&M Base.
Work compounds and lay-down areas, including ports and construction and staging areas	Based on EW 1 and EW 2. Maximum number of work compounds and lay-down areas required. Ground disturbing activities are not anticipated. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.

Table 5.1-4 Summary of Maximum Design Scenario Parameters for Terrestrial Vegetation and Wildlife Resources (Continued)

Parameter	Maximum Design Scenario	Rationale
Operations and Maintenance		
Onshore substations	Based on EW 1 and EW 2. EW 1: 4.8-ac (3.6-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the presence of a new structure in an area where there was previously none.
O&M Base	4.5-ac (1.8-ha) area.	Representative of the presence of a new structure in an area where there was previously none.

5.1.2.1 Construction

During construction, the potential impact-producing factors to terrestrial vegetation and wildlife resources may include:

- Construction of the onshore export cable system, including splice bays (installation techniques include open cut trenching, HDD, Direct Pipe, and jack and bore);
- Staging and construction activities and assembly of Project components at applicable facilities or areas; and
- Construction of new onshore substations and O&M Base.

The following impacts may occur as a consequence of factors identified above:

- Short-term removal of vegetation;
- Short-term potential for an inadvertent return of drilling fluids during HDD activities;
- Short-term potential for accidental releases from construction vehicles or equipment;
- Short-term disturbance associated with soil stockpile areas;
- Short-term potential for erosion into adjacent vegetation and wildlife habitat;
- Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing; and
- Short-term disturbance to terrestrial biota as a result of Project-related construction activities.

Short-term removal of vegetation. During construction and installation activities, including trench excavation, HDD/Direct Pipe work areas, and wareyard areas for staging of equipment and supplies, adjacent vegetation may be temporarily impacted. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project-related activities. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The implementation of an invasive species control plan at EW 2, which will be provided for agency review and approval, as applicable, to avoid the spread of invasive species and replant with native vegetation only. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation; and

- Temporarily disturbed areas will be revegetated with appropriate native species at EW 2, as needed and in compliance with applicable permits, mitigation plans, and/or invasive species control plan to prevent the introduction of invasive plant species. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation.

Short-term potential for an inadvertent return of drilling fluids during HDD activities. HDD technologies may be implemented to avoid impacts to sensitive areas, such as wetlands, tidal creeks, coastal beaches, and dunes. In the event of an inadvertent frac-out within a regulated area, drilling fluids have the potential to escape to the surface and impact adjacent vegetation, wildlife habitats, and the biota inhabiting such areas. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable; and
- The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable.

Short-term potential for accidental releases from construction vehicles or equipment. Construction vehicles and equipment may be accessing regulated areas during construction activities and will be refueled and potentially serviced within the Project site. Direct Pipe installation, if selected, requires a volume of lubricant to fill the annular space between the excavated bore and the steel casing pipe. This volume is anticipated to be smaller than the volume of drilling fluids pumped downhole to support an HDD installation. While on the Project site, there is the potential for accidental releases onto the surrounding surfaces. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable; and
- Management of accidental spills or releases of oils or other hazardous wastes through a Spill Prevention, Control, and Countermeasure (SPCC) Plan, which will be provided for agency review and approval, as applicable.

Short-term temporary disturbance associated with soil stockpile areas. During construction and installation activities, soil stockpile areas will be created as a result of the ground disturbing activities. Soil stockpile areas will be placed on paved surfaces and previously disturbed areas to the extent practicable, but have the potential to be located over existing vegetation. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) for the New York landfalls, including development of a SWPPP, as applicable; and
- Incorporation of the NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State into the site-specific best management practices for activities located within the SSER, as recommended by the SSER Comprehensive Management Plan.

Short-term potential for erosion into adjacent vegetation and wildlife habitat resulting from construction activities. Excavation, soil stockpile, and grading associated with installation of the onshore export and interconnection cable and construction of the onshore substation, O&M Base, and supporting infrastructure will increase the potential for erosion and sedimentation to adjacent vegetation and wildlife habitat resources down gradient. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) for New York land falls, including development of a SWPPP, as applicable; and
- Incorporation of the NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State into the site-specific best management practices for activities located within the SSER, as recommended by the SSER Comprehensive Management Plan.

Short-term temporary impedance to local migration of terrestrial biota as a result of placement of silt fencing. During construction and installation activities, silt fencing will be installed around ground disturbing activities. While installed, terrestrial biota will be restricted from passing through these areas. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

Short-term disturbance to terrestrial biota as a result of Project-related construction activities. During construction and installation activities, terrestrial biota may be temporarily disturbed. As these species are mobile, they may relocate to nearby areas in order to avoid construction-related noise during these activities. This disturbance will only be temporary, and the species are expected to return to all areas following the completion of construction. See **Section 5.3** and **Section 5.4 Bat Species** for additional information on the species that have the potential to be temporarily disturbed during Project activities. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to allow the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process;
- Limiting lighting associated with construction vehicles and work zones to the extent practicable to reduce the attraction of insect prey for wildlife species such as bats and insectivorous birds; and
- Evaluation of seasonal restrictions for vegetation clearing at EW 2 where sensitive species are detected to mitigate potential impacts to breeding individuals. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and absence of suitable habitat.

5.1.2.2 Operations and Maintenance

During operations and maintenance, the potential impact-producing factors to terrestrial vegetation and wildlife resources may include:

- Operations and maintenance activities associated with the onshore export and interconnection cables, onshore substations, and O&M Base.

The following impacts may occur as a consequence of factors identified above:

- Long-term presence of permanent above-ground structures within previously undeveloped areas;
- Long-term conversion of existing vegetation cover types;

Operations of permanent structures within previously undeveloped areas. The onshore substations and the O&M Base, including concrete foundations, gravel lots, fencing, and associated structures, will remain on-site throughout the lifetime of the Project. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of a mitigation plan for the mitigation of long-term unavoidable impacts within jurisdictional wetlands, streams, or their regulated buffer areas at EW 2, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the absence of wetlands and streams within the onshore area.

The permanent conversion of existing vegetation cover types. Naturally vegetated lands, including those woody wetlands and deciduous forest, may be converted to permanent Project structures, such as an onshore substation, throughout the lifetime of the Project. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of a mitigation plan for the mitigation of long-term unavoidable impacts within jurisdictional wetlands, streams, or their regulated buffer areas at EW 2, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the absence of wetlands and streams within the onshore area;
- The implementation of an invasive species control plan at EW 2 to avoid the spread of invasive species and replant with native vegetation only, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Limiting access of Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable; and
- The implementation of lighting reduction measures such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable, where safe.

5.1.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.1.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and all potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.1.3 Summary of Avoidance, Minimization and Mitigation Measures

In order to mitigate the potential impact-producing factors described in Section 5.1.2, Empire is proposing to implement the following avoidance, minimization, and mitigation measures.

5.1.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.1.2.1:

- Limiting lighting associated with construction vehicles and work zones, to the extent practicable, to reduce the attraction of insect prey for wildlife species such as bats and insectivorous birds;
- Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book), including development of a SWPPP, as applicable;
- Incorporation of the NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State into the site-specific best management practices for activities located within the SSER, as recommended by the SSER Comprehensive Management Plan for EW 2;
- The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable;
- The implementation of an invasive species control plan at EW 2 to avoid the spread of invasive species and replant with native vegetation only, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Temporarily disturbed areas will be revegetated with appropriate native species at EW 2, as needed and in compliance with applicable permits, mitigation plans, and/or invasive species control plan to prevent the introduction of invasive plant species. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation; and
- Management of accidental spills or releases of oils or other hazardous wastes through a SWPPP and/or SPCC Plan, which will be provided for agency review and approval, as applicable.

In addition, during construction, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.1.2.1:

- Evaluation of seasonal restrictions for vegetation clearing at EW 2, where sensitive species are detected, to mitigate potential impacts to breeding individuals. This is not anticipated to be required at EW 1 or the O&M Base due to the highly developed nature of the onshore area and absence of suitable habitat; and
- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

5.1.3.2 Operations and Maintenance

During operations and maintenance, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.1.2.2:

- The implementation of a mitigation plan for the mitigation of long-term unavoidable impacts within jurisdictional wetlands, streams, or their regulated buffer areas at EW 2, which will be provided for agency review and approval, as applicable. This is not anticipated to be required at EW 1 or the O&M Base due to the lack of wetlands and streams, as well as the highly developed nature of the onshore area;

- The implementation of an invasive species control plan at EW 2 to avoid the spread of invasive species and replant with native vegetation only, which will be provided for agency review and approval, as applicable. This is not anticipated to be required at EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Temporarily disturbed areas will be revegetated with appropriate native species at EW 2, as needed and in compliance with applicable permits, mitigation plans, and/or invasive species control plan to prevent the introduction of invasive plant species. This is not anticipated to be required at EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Site-specific mitigation strategies as well as post-construction monitoring will be refined during the permitting process and detailed in an approved mitigation plan and SWPPP;
- Limiting access of Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable; and
- The implementation of lighting reduction measures such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable, where safe.

5.1.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those experienced during construction, as described in Section 5.1.3.1 and Section 5.1.3.2. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures will be proposed at that time.

5.1.4 References

Table 5.1-5 Data Sources

Source	Includes	Available at	Metadata Link
USGS	Land Use	https://www.usgs.gov/core-science-systems/science-analytics-and-synthesis/gap/science/land-cover-data-download?qt-science_center_objects=0#qt-science_center_objects	N/A

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero (editors). 2014. *Ecological Communities of New York State*. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Google Earth Historical Aerial Imagery, 1994 – 2018. Brooklyn, New York.

Google Earth Historical Aerial Imagery, 1994 – 2018. Long Beach, Island Park, and Oceanside, New York.

NYSDEC (New York State Department of Environmental Conservation). 2019. Draft List Under Part 182.5 Pre-proposal. Available online at: http://www.dec.ny.gov/docs/wildlife_pdf/preproposal182.pdf. Accessed February 26, 2021.

USGS (United States Geological Survey). 2019. NLCD 2016 Land Cover Conterminous United States. Available online at: https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover&f%5B1

%5D=category%3Aurban%20imperviousness&f%5B2%5D=region%3Aconus&f%5B3%5D=category%3Aland%20cover&f%5B4%5D=category%3Aurban%20imperviousness&f%5B5%5D=region%3Aconus. Accessed February 26, 2021.

5.2 Wetlands and Waterbodies

This section describes the wetland and waterbody resources within and surrounding the Project Area. Potential impacts to wetlands and onshore waterbodies resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project specific measures adopted by Empire are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to wetlands and waterbodies.

Other resources and assessments detailed within this document that are related to wetlands and waterbodies include:

- Water Quality (Section 4.2);
- Terrestrial Vegetation and Wildlife (Section 5.1);
- Avian Species (Section 5.3 and Appendices P and Q);
- Bat Species (Section 5.4 and Appendices Q and R); and
- Benthic Resources and Finfish, Invertebrates, and EFH (Section 5.5 and Appendices T and U).

Wetlands and waterbodies in New York may be protected under federal law, state law, or both. The USACE is responsible for assessing permit applications for activities otherwise prohibited by Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. NYSDEC has responsibility under state law. Under Section 404 of the CWA and Section 10 of the 1899 Rivers and Harbors Act, the USACE has regulatory jurisdiction over navigable waters and waters of the United States, including wetlands. Additionally, under Section 401 of the CWA, applicants for a federal license or permit must obtain certification from the state in which the discharge would originate to ensure that project will not violate the state's water quality standards. The regulatory authority of the NYSDEC, with respect to wetlands and waterbodies, is described in further detail in New York State Regulations.

New York State Regulations

Freshwater wetlands in the State of New York are jointly regulated by both the NYSDEC and the USACE. Under Article 24 of the Environmental Conservation Law, commonly referred to as the Freshwater Wetlands Act, New York regulates freshwater wetlands greater than 12.4 ac (5.0 ha) or freshwater wetlands of any size that possess unique qualities, such as a documented presence of a threatened or endangered species. The USACE regulates all wetlands protected by Section 404 of the CWA and Section 10 of the Rivers and Harbors Act, regardless of size. New York also regulates a wetlands adjacent area, defined as those areas of land or water that are outside a freshwater wetland and within 100 ft (30 m) of the wetland boundary. NYSDEC assigns freshwater wetlands under its jurisdiction a classification value from 1 (highest) to 4 (lowest) based on the presence and degree of various characteristics that provide ecological, hydrological, pollution control, and/or other special benefits. Freshwater wetlands with higher classification values are afforded a higher level of protection.

Tidal wetlands in New York State are protected under Article 25 of the Environmental Conservation Law, known as the Tidal Wetlands Act. Under this Act, New York regulates all tidal wetlands and the associated adjacent area. The tidal wetlands adjacent area is defined as the land adjacent to the wetland boundary to a maximum landward distance of 300 ft (91 m). In New York City, the maximum landward distance is within 150 ft (46 m) of the tidal wetland boundary. This maximum landward distance is reduced per Part 661.4 of the Act in the presence of a lawfully and presently existing structure greater than 100 ft (30 m) in length (including, but not limited to, paved streets and highways, railroads, bulkheads and sea walls, and riprap walls) or where an elevation reaches 10 ft (3 m) above MSL.

Activities subject to regulation within wetlands and adjacent areas include any form of draining, dredging, or excavation, either directly or indirectly; and any form of dumping, depositing, or placement of fill of any kind, either directly or indirectly. This includes the installation of structures and roads, the driving of pilings, or the placement of any other obstructions (whether or not changing the ebb and flow of the water), and any form of pollution, including, but not limited to running a sewer outfall and discharging sewage treatment effluent or other liquid wastes into or so as to drain into a freshwater wetland. Applicants that propose such activities are required to demonstrate that impacts to these resources are avoided or minimized to the extent practicable and that temporary impacts will be restored to pre-existing conditions following construction activities. Permanent impacts associated with these activities may be subject to compensatory mitigation.

Under Article 15 of the Environmental Conservation Law, New York regulates surface water resources by their best uses (fishing, source of drinking water, etc.; 6 NYCRR Part 701) or as Wild, Scenic and Recreation Rivers (6 NYCRR Part 666). State water quality classifications of freshwater watercourses fall into the following four categories based on the assigned best uses by NYSDEC:

- Classification AA or A: assigned to waters used as a source of drinking water.
- Classification B: swimming and other contact recreation but not for drinking water.
- Classification C: waters supporting fisheries and suitable for non-contact activities.
- Classification D: lowest classification/standard.

State water quality classifications of tidal waterbodies fall into the following five categories based on the best uses assigned by NYSDEC:

- Classification SA: assigned to waters used for shell fishing for market purposes along with primary and secondary contact recreation and fishing.
- Classification SB: assigned to waters used for primary and secondary contact recreation and fishing.
- Classification SC: assigned to waters used for fishing and primary and secondary contact recreation, although other factors may limit the use for these purposes.
- Class I: assigned to waters used for secondary contact recreation and fishing. Class I waters may be suitable for primary contact recreation, other factors may limit the use for this purpose.
- Class SD: assigned to waters used for fishing. All of the defined water quality classifications are suitable for fish, shellfish, and wildlife propagation and survival. However, Class SD waters cannot meet the requirements for fish propagation due to natural or manmade conditions.

Waters with classifications AA, A, B, and C may also have a standard of (T), indicating that it may support a trout population, or (TS), indicating that it may support trout spawning. Special requirements apply to sustain these waters that support these valuable and sensitive fisheries resources.

Temporary or permanent disturbances to the bed or bank of a stream with a classification of AA, A or B, or with a classification of C with a standard of (T) or (TS) requires a Protection of Waters Permit administered by the NYSDEC. This includes disturbance associated with the excavation or dredging associated with construction activities, the placement of fill for access, construction, or structure placement, and the installation of support piers. Stream banks are defined by NYSDEC as the land area immediately adjacent to, and which slopes toward, the bed of a watercourse and which is necessary to maintain the integrity of the watercourse. A bank will not be considered to extend more than 50 ft (15 m) horizontally from the mean highwater line unless where a generally uniform slope of 45 degrees (100 percent) or greater adjoins the bed of a watercourse. The bank is then extended to the crest of the slope or the first definable break in slope, either a natural or constructed (road, or railroad grade) feature lying generally parallel to the watercourse.

Estuarine habitats along the south shore of Long Island are additionally protected by the Long Island SSER Act under the management of the SSER pursuant to New York State Executive Law Article 46. This act states that the tidal waters located between the southern shore of Long Island and the coastal barrier beaches, referred to as the South Shore Estuary, constitute a maritime region of statewide importance. The SSER Council prepared a Comprehensive Management Plan, which recommends that projects involving construction within the SSER incorporate best management practices to control erosion and sedimentation before and during site preparation and construction and minimize detrimental effects on the water quality of waterbodies before and during site preparation and construction (SSER Council 2001).

Development within floodplains in New York State is regulated by local municipalities (e.g., town, city, or village) that participate in the National Flood Insurance Program. All construction proposed within those areas of land covered by the floodwaters of the base flood, also known as Special Flood Hazard Areas (FHAs), is subject to floodplain development regulations and requires a floodplain development permit approved by the local administrator. Applicants for such a permit must demonstrate that the proposed development will not increase the surrounding flood hazard and that the development is constructed in a way that minimizes exposure to flooding. Permits must also include certification from a licensed professional engineer or architect that each structure is designed in accordance with the American Society of Civil Engineers (ASCE) standards for *Flood Resistant Design and Construction* (ASCE 24) and/or *Minimum Design Loads for Buildings and Other Structures* (ASCE 7). These standards set forth specific design requirements detailing elevation, building performance during flood events, the use of flood damage-resistant materials, attendant utilities and equipment, and siting requirements.

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes up to a 1-mi (1.6-km) buffer around the EW 1 and EW 2 onshore export and interconnection cable routes and associated onshore substation parcels and the O&M Base[3] (**Figure 5.2-1** and **Figure 5.2-2**).

Existing wetland and waterbody resources in the vicinity of the Study Area were reviewed using a combination of desktop analysis of publicly available data and targeted field surveys. The following resources were reviewed as part the desktop analysis:

- USFWS National Wetlands Inventory (NWI) (USFWS 2019);
- NYSDEC:
  - Regulatory Freshwater Wetlands, Nassau County (NYSDEC 2013);
  - Tidal Wetlands (NYSDEC 2005); and
  - Water Quality Classifications (NYSDEC 2019);
- USGS National Hydrography Dataset (NHD) (USGS 2017); and
- FEMA National Flood Hazard Layer (FEMA 2019).

[3] While the O&M Base will serve both EW 1 and EW 2, the facility will be located at SBMT, adjacent to the EW 1 onshore substation, and will therefore be included within the EW 1 Onshore Study Area for the purposes of this analysis.

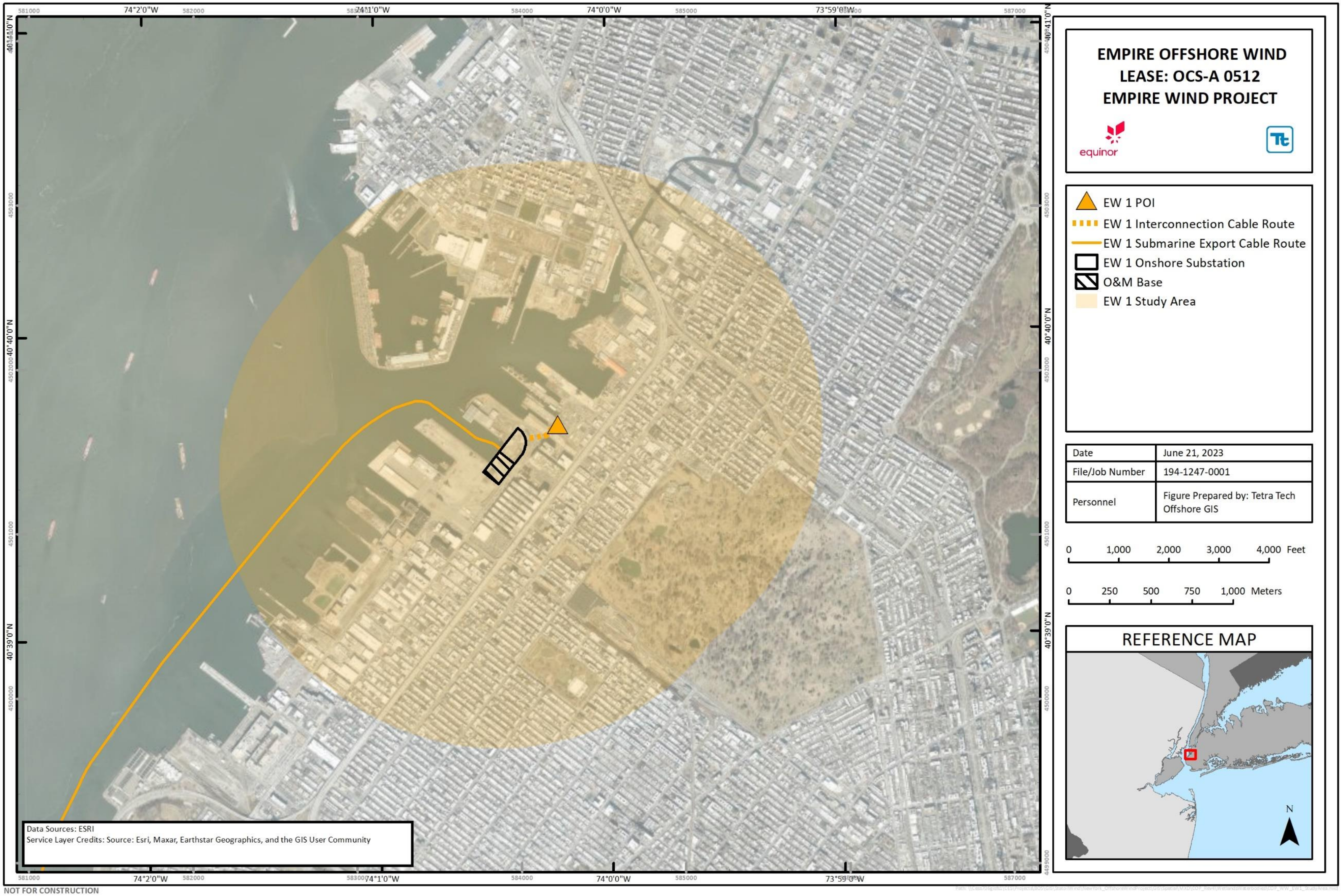


Figure 5.2-1 EW 1 Wetlands and Waterbodies Study Area

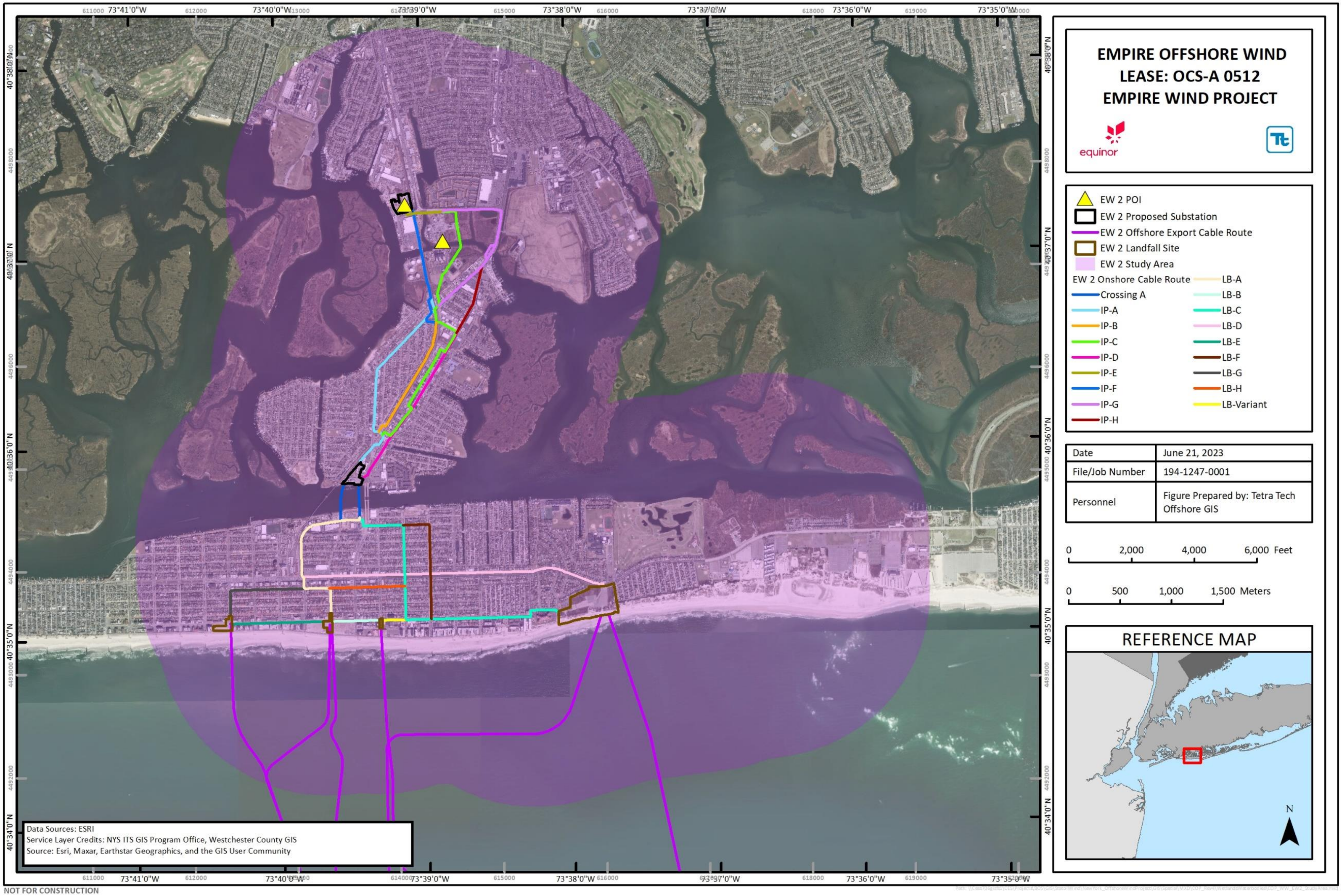


Figure 5.2-2 EW 2 Wetlands and Waterbodies Study Area

A preliminary reconnaissance of the onshore portion of the Project Area was conducted along the EW 1 interconnection cable route on December 5, 2018 from publicly accessible areas to verify the presence of mapped wetland and waterbody resources identified during desktop analysis, and to assess the potential presence of unmapped wetland and waterbody resources. The presence of potential unmapped wetlands within the Project limits of disturbance was evaluated during this reconnaissance based on the occurrence of hydrophytic vegetation within topography conducive to wetland hydrology. A similar preliminary reconnaissance was conducted along the EW 2 onshore export and interconnection cable routes on November 4, 2021. During this effort, a formal wetland delineation was conducted at the EW 2 Onshore Substation C site. Survey methodologies incorporated the requirements detailed within the Northcentral and Northeast regional supplement to the Corps of Engineers Wetlands Delineation Manual (USACE 1987). Tidal wetlands were assigned an additional cover class corresponding the NYSDEC tidal wetland categories (NYSDEC, n.d.), based on the position in the tidal landscape of a given wetland along with the dominant vegetation community. Formal wetland delineations for the remainder of the onshore Project Area will be conducted in 2022.

5.2.1 Affected Environment

The affected environment is defined as the coastal wetlands (including the intertidal zone) and onshore wetlands and waterbody areas that have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. This includes the export cable landfall, onshore construction corridors, onshore substations, and O&M Base. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities. A description of the affected environment below the intertidal zone is provided in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat** and **Appendix T Benthic Resource Characterization Reports**.

5.2.1.1 EW 1

The EW 1 submarine export cable route extends from the Lease Area across New York Bight, into Lower New York Bay, up the Narrows, and into Upper New York Bay before it makes landfall. The Lower Bay (NYSDEC hydrologic unit 0203010404) and the Upper Bay (0203010402) are collectively referred to by NYSDEC as the Sandy Hook/Staten Island Sub-Basin. These waterbodies are designated by NYSDEC as impaired, due to fish consumption that is impaired by PCBs and dioxin in contaminated sediment, resulting in a health advisory for some species. Public bathing and other recreational uses may also experience minor impacts from pathogens, floatable debris and various other pollutants from urban/storm runoff, combined sewer outfalls, and other such sources. Lesser fish consumption impacts for additional species are due to contaminated sediment, but may not be reflective of a specific waterbody or known source of contamination, considering that fish species with a wide migratory range and a high lipid/fat content are more likely to accumulate constituents of concern (NYSDEC 2017).

Wetlands

The EW 1 interconnection cable route and onshore substation and O&M Base site are situated above the bank of the Upper Bay. The Upper Bay, in the vicinity of the onshore portions of the Project, is classified by NWI as an excavated subtidal estuarine system with an unconsolidated bottom (E1UBLx) and by the NYSDEC tidal wetland database as a littoral zone. NWI mapping indicates that a small portion of the Upper Bay enters the interconnection cable route, the onshore substation, and the O&M Base. NYSDEC mapping indicates that the littoral zone of the Upper Bay partially enters the onshore substation. However, the bank is mainly comprised of industrial properties with bulkheaded marine terminals and the Upper Bay terminates at the bulkhead. It is anticipated that the regulated adjacent area associated with the Upper Bay would be truncated along the banks at the seaward edge of all manmade structures (e.g., bulkheads, riprap, roads) pursuant to Part 661.4 of the Tidal Wetlands Land Use Regulations. Based on desktop analysis and observations made during the preliminary site reconnaissance, field delineations were not completed for the export cable landfall location, the EW 1 onshore interconnection cable route, the onshore substation, or the O&M Base due the developed nature of the area and lack of wetland and waterbody resources identified within the Study Area.

Mapped wetlands and waterbodies in the vicinity of the Study Area, as classified by NWI and NYSDEC resources, are provided in **Table 5.2-1** and displayed on **Figure 5.2-3**.

Table 5.2-1 NWI and NYSDEC Mapped Wetlands Within the EW 1 Project Area

Route Feature	NWI Classification	Area (ac)	NYSDEC Classification	Area Within Project Area (ac)
Interconnection Cable Route	(E1UBLx) Estuarine and Marine Deepwater	<0.01	No NYSDEC mapped wetlands within Interconnection Cable Route	0
	Subtotal	*<0.01*		*0*
Onshore Substation	(E1UBLx) Estuarine and Marine Deepwater	0.08	(LZ) Littoral Zone	0.01
	Subtotal	*0.08*		*0.01*
O&M Base	(E1UBLx) Estuarine and Marine Deepwater	*0.2*	(LZ) Littoral Zone	0.01
	Subtotal	*0.2*		*0.01*
	Total	**0.1**		**0.02**

Floodplains

FEMA data indicates that portions of the Project are situated within Special FHAs associated with the Upper New York Bay, including Zone AE, Zone X (shaded), and Zone X (unshaded). Zone AE areas are subject to inundation by the 1-percent-annual-chance flood event but not subject to high velocity wave action and are considered high risk flooding areas. FEMA defines Zone X (shaded) as moderate FHAs between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. Mapped Special FHAs, located on and proximal to the Study Area, are identified on **Figure 5.2-4**, and mapped Special FHAs within the Study Area are provided in **Table 5.2-2**.

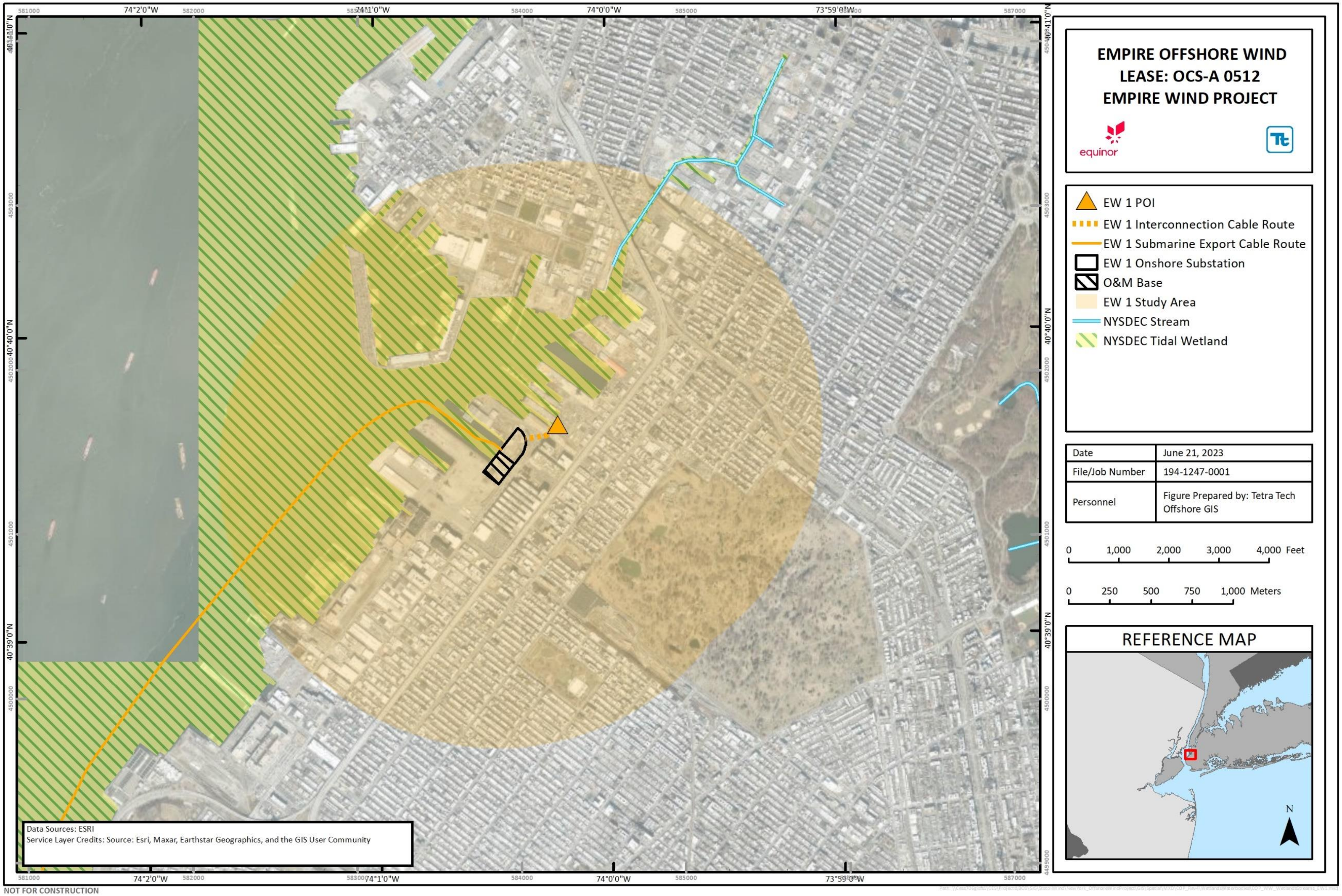


Figure 5.2-3 EW 1 Mapped Wetland/Streams

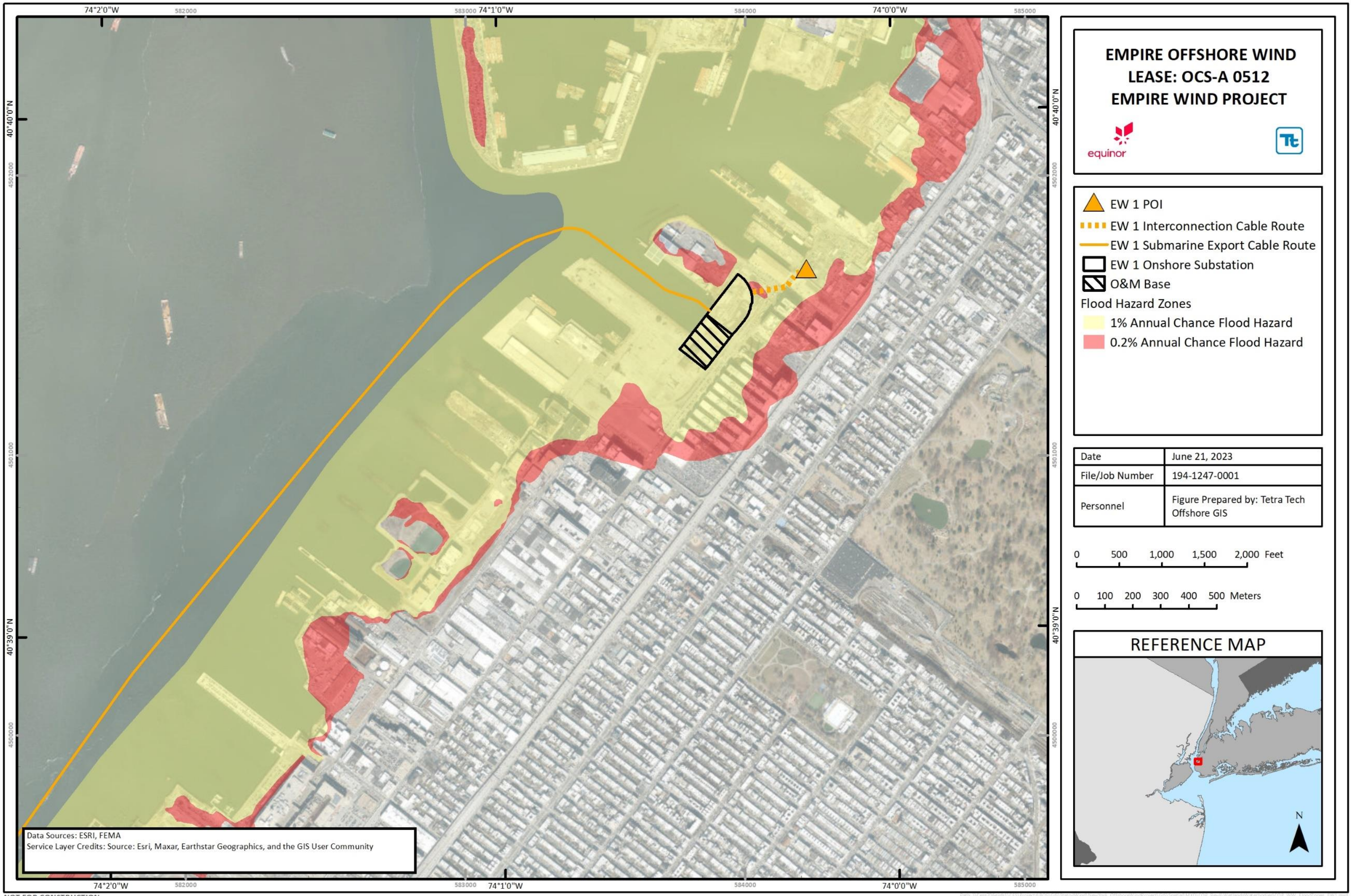


Figure 5.2-4 EW 1 Mapped Floodplains

Table 5.2-2 FEMA-Mapped Special FHAs Within the EW 1 Project Area

Route Feature	FEMA Flood Zone	Area (ac)
Interconnection Cable Route	AE	0.72
	X (0.2% Annual Chance Flood Hazard)	0.14
	Total	**0.87**
Onshore Substation	AE	4.75
	X (0.2% Annual Chance Flood Hazard)	<0.01
	Total	**4.75**
O&M Base	AE	4.5
	Total	**4.5**

5.2.1.2 EW 2

Wetlands

Four export cable landfall options are currently under review for EW 2. EW 2 Landfall A is located on Riverside Boulevard and EW 2 Landfall B is located two blocks east on Monroe Boulevard. EW 2 Landfall C is located in Lido Beach West Town Park. EW 2 Landfalls A, B, and C consist of existing paved parking lots devoid of vegetation. EW 2 Landfall E is located at Laurelton Boulevard and West Broadway, and is composed of existing paved roads and undeveloped lots.

A total of nine onshore export cable route segments are under review to traverse the island of Long Beach from the landfall options to the Reynolds Channel crossing:

- From EW 2 Landfall A, the EW 2 Route LB-A follows Riverside Boulevard
- to East Walnut Street, and then turns west to Reverend JJ Evans Boulevard, which turns into Park Place to approach the Reynolds Channel crossing at Riverside Boulevard.
- From EW 2 Landfall B, the EW 2 Route LB-B follows Monroe Street to East Broadway and then turns west to connect with EW 2 Route LB-A to approach the Reynolds Channel crossing. From EW 2 Landfall C, the EW 2 Route LB-Ctraverses west through the park to Richmond Road. The onshore export cables will continue west on Richmond Road until turning south on Maple Boulevard and then immediately west on East Broadway. The onshore export cables will then turn north onto Lincoln Boulevard or continue west on the EW 2 Route LB Variant. From Lincoln Boulevard, the onshore export cables will continue north until turning west onto East Harrison Street. The onshore export cables will then cross perpendicular to Long Beach Boulevard and turn north onto Long Beach Road, to the crossing at Reynolds Channel. From the EW 2 Route LB Variant, the onshore export cables will connect into LB-B to the crossing at Reynolds Channel.
- From the EW 2 Landfall C, the EW 2 Route LB-D traverses north along Lido Boulevard and continues to traverse west, as Lido Boulevard turns into East Park Avenue. The onshore export cables will either turn north onto Lincoln Boulevard, connecting to EW 2 Route LB-C, and/or continue west on Park Avenue to Reverend JJ Evans Boulevard, connecting with the EW 2 Route LB-A, to the crossing at Reynolds Channel.
- From the EW Landfall E, the EW 2 Route LB-E will proceed east along West Broadway to reach EW 2 Landfall A, from which the EW 2 Route LB-E could connect to EW 2 Route LB-A or EW 2 Route LB-B to the crossing at Reynolds Channel.One additional alternative onshore export cable route, EW

2 Route LB Variant, represents the portion of East Broadway between Monroe Boulevard and Lincoln Boulevard in which the EW 2 Route LB-C could connect to EW 2 Route LB-B to the crossing at Reynolds Channel.

- From EW 2 Landfall C, the EW 2 Route LB-F follows EW 2 Route LB-C, traversing west through the park to Richmond Road, continuing west on Richmond Road until turning south on Maple Boulevard and then immediately west on East Broadway. The route then turns north on Franklin Boulevard, then turns west onto East Harrison Street and rejoins EW 2 Route LB-C to the crossing at Reynolds Channel.
- From EW 2 Landfall E, one or more onshore export cables follow Laurelton Boulevard north, then turn east onto West Walnut Street and continue to Edwards Boulevard. The EW 2 Route LB-G then turns north on Edwards Boulevard and joins EW 2 Route LB-A, crossing Park Avenue and turning slightly west onto Reverend JJ Evans Boulevard, which turns into Park Place, until the crossing at Reynolds Channel.

From EW 2 Landfall A, the onshore export cables could proceed north on Riverside Boulevard along EW 2 Route LB-A to East Walnut Street, at which point EW 2 Route LB-H turns east along East Walnut Street until it reaches Lincoln Boulevard to connect with EW 2 Route LB-C until the crossing at Reynolds Channel. The EW 2 onshore export cable route then crosses Reynolds Channel to Island Park; Empire is evaluating both open cut and HDD solutions to cross Reynolds Channel. Reynolds Channel is classified by NWI as a subtidal estuarine feature with an unconsolidated bottom (E1UBL), and by the NYSDEC tidal wetland database as a littoral zone. NYSDEC also maps portion of the southern bank of Reynolds Channel as mudflat (SM). Based on observations during the November 4, 2021 field reconnaissance, the southern bank of Reynolds Channel is highly modified, comprising of a mix of riprap and natural shoreline that quickly transitions to industrial properties. The field delineation conducted November 4, 2021 revealed that the north bank is composed of approximately 760 ft (231 m) of wooden bulkheading and floating docks associated with an active marina. Approximately 12 ft (3 m) and 30 ft (9 m) of natural shoreline extends from the western and eastern end of the wooded bulkhead, respectively, and extends beyond the limits of the onshore substation site.

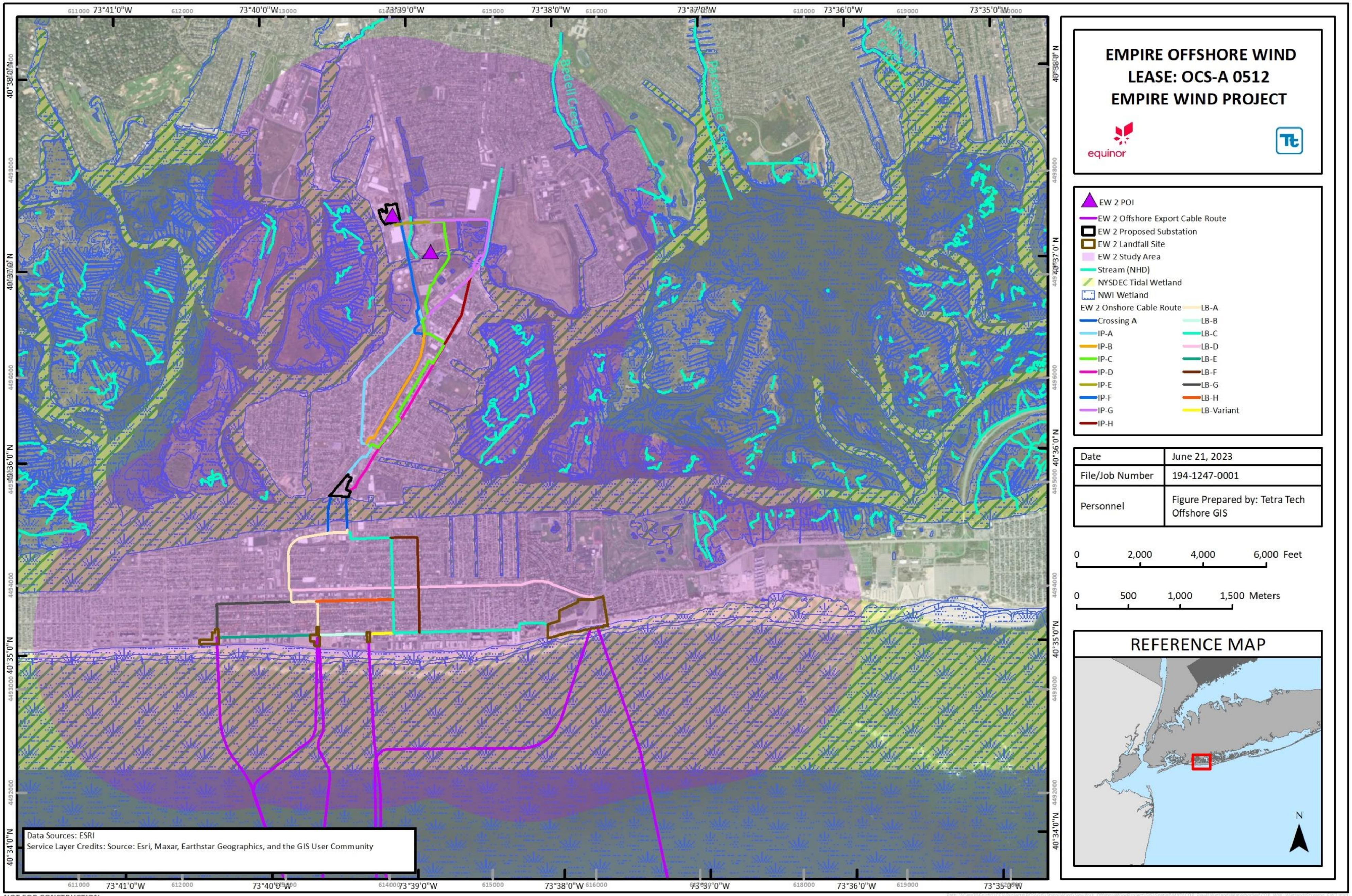
A total of eight onshore cable route segments are under review to traverse Island Park from Reynolds Channel to the onshore substation or POI, which will be traversed by onshore export cables (if EW 2 Onshore Substation A is selected) or interconnection cables (if EW 2 Onshore Substation C is selected):

- The EW 2 Route Island Park (IP)-A crosses to the west side of the LIRR and traverse northeast until crossing an existing parking lot along Warwick Road and turning north onto Long Beach Road until reaching the LIRR again where it could connect into EW 2 Route IP-C or turn northwest along the LIRR until connecting to EW 2 Route IP-F.
- The EW 2 Route IP-B follows EW 2 Route IP-A until crossing an existing parking lot along Warwick Road where EW 2 Route IP-B follows the LIRR and traverses northeast until connecting into either EW 2 Route IP-C or EW 2 Route IP-F.
- The EW 2 Route IP-C follows EW 2 Route IP-Auntil turning east through an existing parking lot and then north on Austin Boulevard. The route will then turn west onto Sagamore Road, then immediately nor onto Industrial Place, then east onto Trafalgar Boulevard, and north onto Austin Boulevard before turning west onto Saratoga Boulevard and crossing the LIRR to continue along D'Amato Drive until turning northeast at Long Beach Road, and then northwest onto Ladomus Ave to enter into the Oceanside POI parcel, where it will cross Barnums Channel by either an open cut or trenchless crossing method, to connect with EW 2 Route IP-E.

- The EW 2 Route IP-D follows Austin Boulevard and traverses north until connecting with EW 2 Route IP-C.
- The EW 2 Route IP-E continues from the EW 2 Route IP-C through the Oceanside POI parcel, turning west and traversing parallel to Daly Boulevard and crossing over the LIRR ROW before turning north into the EW 2 Onshore Substation A site.
- The EW 2 Route IP-F follows EW 2 Route IP-A until crossing an existing parking lot along Warwick Road, from which it will follow EW 2 Route IP-B along the LIRR and traverses northeast until turning west on Parente Lane North. The route will then turn north on Kildare Road, northeast on Long Beach Road, and north on North Nassau Lane. The route continues north across an industrial lot and access roads immediately to the west of the LIRR, crosses Barnums Channel, and follows the LIRR north before connecting into EW 2 Onshore Substation A or the POI.
- The EW 2 Route IP-G follows EW 2 Route IP-A until connecting to EW 2 Route IP-C. From the intersection of Sherman Road and Long Beach Road, EW 2 Route IP-G traverses northeast along Long Beach Road until turning west on Daly Boulevard to reach EW 2 Route IP-E and connecting into the EW 2 Onshore Substation A or the POI. EW 2 Route IP-G may require a new cable bridge immediately west of the existing bridge where Long Beach Road crosses Barnums Channel or it may use the existing road bridge.
- The EW 2 Route IP-H follows Austin Boulevard north along EW 2 Route IP-C or IP-D. At the intersection of Austin Boulevard and Saratoga Boulevard, EW 2 Route IP-H follows Austin Boulevard northeast until connecting to EW 2 Route IP-G at the intersection of Long Beach Road and Austin Boulevard.

Two onshore substations are currently under review, EW 2 Onshore Substation A and EW 2 Onshore Substation C. The EW 2 Onshore Substation A site is located on a parcel on the corner of Hampton Road and Daly Boulevard. The EW 2 Onshore Substation C site is located north of Reynolds Channel between the LIRR ROW and Long Beach Road. NWI and NYSDEC mapping indicates that tidal wetlands exist to the south and west of EW 2 Onshore Substation A site. NWI classifies these wetlands as subtidal estuarine with an unconsolidated bottom (E1UBL) with intertidal estuarine wetlands (E2US2N) along select banks. The NWI mapped wetlands at this location is approximately consistent with NYSDEC tidal wetlands mapping; which indicated littoral zone with intertidal wetlands and mudflats along the banks. Due to access limitations, the EW 2 Onshore Substation A site was not assessed during the November 4, 2021 field reconnaissance.

Mapped wetlands within and adjacent to the EW 2 Study Area, as classified by NWI and NYSDEC resources, are provided in **Table 5.2-3** and displayed on **Figure 5.2-5**.



NOT FOR CONSTRUCTION

Figure 5.2-5 EW 2 Mapped Wetlands/Streams

Table 5.2-3 NWI and NYSDEC Mapped Wetlands Within the EW 2 Project Area

Route Feature	NWI Classification	Area (ac)	NYSDEC Classification	Area Within Project Area (ac)
EW 2 Landfall A	No NWI-mapped wetlands within EW 2 Landfall A		AA (Adjacent Area)	2.38
	Subtotal	*0*		*2.38*
EW 2 Landfall B	No NWI-mapped wetlands within EW 2 Landfall B		AA (Adjacent Area)	0.72
	Subtotal	*0*		*0.72*
EW 2 Landfall C	(M2US2P) Estuarine and Marine Deepwater	1.59	AA (Adjacent Area)	33.96
	Subtotal	*1.59*		*33.96*
EW 2 Landfall E	No NWI-mapped wetlands within EW 2 Landfall E		AA (Adjacent Area)	3.18
	Subtotal	*0*		*3.18*
EW 2 Route LB-A	(E2US2N) Estuarine and Marine Wetland	<0.01	No NYSDEC-mapped wetlands within EW 2 Route LB-A	
	Subtotal	*<0.01*		*0*
EW 2 Route LB-B	No NWI-mapped wetlands within EW 2 Route LB-B		No NYSDEC-mapped wetlands within EW 2 Route LB-B	
	Subtotal	*0*		*0*
EW 2 Route LB-C	No NWI-mapped wetlands within EW 2 Route LB-C		No NYSDEC-mapped wetlands within EW 2 Route LB-C	
	Subtotal	*0*		*0*
EW 2 Route LB-D	(E1UBL) Estuarine and Marine Deepwater	0.03	LZ (Littoral Zone)	0.04
	Subtotal	*0.03*		*0.04*
EW 2 Route LB-E	(M2US2P) Estuarine and Marine Deepwater	0.01	No NYSDEC-mapped wetlands within EW 2 Route LB-E	
	Subtotal	*0.01*		*0*
EW 2 Route LB-Variant	No NWI-mapped wetlands within EW 2 Route LB-Variant		No NYSDEC-mapped wetlands within EW 2 Route LB-Variant	
	Subtotal	*0*		*0*

Table 5.2-3 NWI and NYSDEC Mapped Wetlands Within the EW 2 Project Area (continued)

Route Feature	NWI Classification	Area (ac)	NYSDEC Classification	Area Within Project Area (ac)
EW 2 Route LB-F	No NWI-mapped wetlands within EW 2 Route LB-F		No NYSDEC-mapped wetlands within EW 2 Route LB-F	
	Subtotal	*0*		*0*
EW 2 Route LB-G	(E2US2N) Estuarine and Marine Wetland	<0.01	No NYSDEC-mapped wetlands within EW 2 Route LB-G	
	Subtotal	*<0.01*		*0*
EW 2 Route LB-H	No NWI-mapped wetlands within EW 2 Route LB-H		No NYSDEC-mapped wetlands within EW 2 Route LB-H	
	Subtotal	*0*		*0*
Reynolds Channel Crossing	(E1UBL) Estuarine and Marine Deepwater	17.17	LZ (Littoral Zone)	18.63
	(E1AB1L) Estuarine and Marine Deepwater	0.53	(SM) Coastal Shoals, Bars, and Mudflats	0.21
	(E2US2N) Estuarine and Marine Wetland	0.39		
	Subtotal	*18.09*		*18.84*
EW 2 Route IP-A	No NWI-mapped wetlands within EW 2 Route IP-A		No NYSDEC-mapped wetlands within EW 2 Route IP-A	
	Subtotal	*0*		*0*
EW 2 Route IP-B	No NWI-mapped wetlands within EW 2 Route IP-B		No NYSDEC-mapped wetlands within EW 2 Route IP-B	
	Subtotal	*0*		*0*
EW 2 Route IP-C	(E1UBL) Estuarine and Marine Deepwater	1.20	LZ (Littoral Zone)	1.07
	(PUBK) Freshwater Pond	0.53	(SM) Coastal Shoals, Bars, and Mudflats	0.84
	(E2US2N) Estuarine and Marine Wetland	0.12	IM (Intertidal Marsh)	0.10
	Subtotal	*1.84*		*2.01*
EW 2 Route IP-D	(E1UBL) Estuarine and Marine Deepwater	0.09	LZ (Littoral Zone)	0.37
	(E1UBLx) Estuarine and Marine Deepwater	0.12		
	Subtotal	*0.21*		*0.37*

Table 5.2-3 NWI and NYSDEC Mapped Wetlands Within the EW 2 Project Area (continued)

Route Feature	NWI Classification	Area (ac)	NYSDEC Classification	Area Within Project Area (ac)
EW 2 Route IP-E	(E1UBL) Estuarine and Marine Deepwater	0.57	LZ (Littoral Zone)	0.47
	(E1UBLx) Estuarine and Marine Deepwater	0.15	(SM) Coastal Shoals, Bars, and Mudflats	0.51
	(E2EM1P) Estuarine and Marine Wetland	0.15	IM (Intertidal Marsh)	0.04
	(R5UBH) Riverine	0.14		
	(R4SBC) Riverine	0.10		
	Subtotal	*1.11*		1.02
EW 2 Route IP-F	(E1UBL) Estuarine and Marine Deepwater	3.09	LZ (Littoral Zone)	2.74
	(E2EM1P) Estuarine and Marine Wetland	0.30	(SM) Coastal Shoals, Bars, and Mudflats	1.08
	(R5UBH) Riverine	0.25	IM (Intertidal Marsh)	1.50
	Subtotal	*3.64*		*5.32*
EW 2 Route IP-G	PEM1/SS1S (Freshwater Emergent Wetland)	7.20	LZ (Littoral Zone)	3.27
	E1UBL (Estuarine and Marine Deepwater)	3.73	(SM) Coastal Shoals, Bars, and Mudflats	3.99
	PUBHx (Freshwater Pond)	3.19	IM (Intertidal Marsh)	2.44
	E2USMx (Estuarine and Marine Wetland)	1.87	HM (High Marsh)	0.16
	E2EM5Pd (Estuarine and Marine Wetland)	1.58		
	R2UBH (Riverine)	1.31		
	E2EM1P (Estuarine and Marine Wetland)	0.90		
	E1AB1L (Estuarine and Marine Deepwater)	0.53		
	E2EM1Pd (Estuarine and Marine Wetland)	0.34		
	E2US2M (Estuarine and Marine Wetland)	0.34		
	PEM1R (Freshwater Emergent Wetland)	0.27		
	E2US2N (Estuarine and Marine Wetland)	0.18		

Table 5.2-3 NWI and NYSDEC Mapped Wetlands Within the EW 2 Project Area (continued)

Route Feature	NWI Classification	Area (ac)	NYSDEC Classification	Area Within Project Area (ac)
	E1UBLx (Estuarine and Marine Deepwater)	0.13		
	R1UBV (Riverine)	0.03		
	PEM1A (Freshwater Emergent Wetland)	<0.01		
	Subtotal	*21.60*		*9.87*
EW 2 Route IP-H	No NWI-mapped wetlands within EW 2 Route IP-H		No NYSDEC-mapped wetlands within EW 2 Route IP-H	
	Subtotal	*0*		*0*
EW 2 Onshore Substation A	No NWI-mapped wetlands within EW 2 Onshore Substation A		No NYSDEC-mapped wetlands within EW 2 Onshore Substation A	
	Subtotal	*0*		*0*
EW 2 Onshore Substation C	E1UBL (Estuarine and Marine Deepwater)	0.02	LZ (Littoral Zone)	0.26
	Subtotal	*0.02*		*0.26*

NYSDEC Wetland Adjacent Areas

All of the wetlands identified within and adjacent to the Study Area are classified by NYSDEC mapping as tidal systems, regulated under the Tidal Wetlands Act and assigned a protected adjacent area, as detailed in the subsection Regulatory Framework. The November 4, 2021 field reconnaissance and wetland delineation effort identified that many of the tidal wetland adjacent areas are truncated before entering the Project limits of disturbance due to the presence of intervening lawfully existing structures. A total of 32 ft (10 m) of natural shoreline was delineated within the EW 2 Onshore Substation C site, with the associated tidal wetland adjacent area partially extending into the site. The remaining field delineations proposed for 2022 will demarcate the remaining wetland boundaries within and adjacent to the Study Area where mapped tidal wetlands are identified to determine the extent of additional wetland adjacent areas within the Project.

Surface Waterbodies

NHD mapping identifies four surface waterbodies crossed by the Project that correlate with the Atlantic Ocean coastline (NHD Reach Code: 02030202011788), Reynolds Channel (NHD Reach Code: 02030202019793), one unnamed tidal creek within the Oceanside POI parcel (NHD Reach Code: 02030202011962), and one unnamed tidal creek east of EW 2 Onshore Substation A (NHD Reach Code: 02030202021291). According to NYSDEC surface water quality classifications, Reynolds Channel is a Class SB waterbody (NYSDEC Item Number: 885.168) with designated uses as defined in New York State Regulations. The NHD-mapped unnamed tidal creek located within the Oceanside POI parcel is classified by NYSDEC as Barnums Channel (NYSDEC Item Number 885-165.1). NYSDEC mapping is inconsistent with NHD mapping and aerial imagery with respect to Barnums Channel, with NYSDEC mapping indicating that this feature turns north and bisects the northern portion of the Oceanside POI parcel. NHD mapping indicates that Barnums Creek continues west instead of turning and bisecting the northern portion of the Oceanside POI parcel, which is consistent with the channel visible on aerial imagery. NYSDEC categorizes Barnums Channel as a Class SC waterbody with designated uses as defined in New York State Regulations. The NHD-mapped unnamed tidal creek located east of EW 2 Onshore Substation A is classified by NYSDEC as a Class SB waterbody (NYSDEC Item Number: 885-171).

Mapped waterbodies within and adjacent to the Study Area, as classified by NWI and NYSDEC resources, are displayed on **Figure 5.2-5**.

Floodplains

FEMA data indicates that portions of the Project are situated within Special FHAs, including Zone VE, Zone AE, Zone X (shaded), and Zone X (unshaded). Zone VE and Zone AE areas are subject to inundation by the 1-percent-annual-chance flood event. However, Zone VE areas include additional hazards due to storm-induced velocity wave action. Zone AE areas are not subject to high velocity wave action but are still considered high risk flooding areas. FEMA defines Zone X (shaded) as moderate FHAs between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. Lastly, Zone X (unshaded) are defined as those areas at minimal flood hazard risk (FEMA 2007). Mapped Special FHAs located on and proximal to the Study Area are identified on **Figure 5.2-6**, and mapped Special FHAs within the Study Area are provided in **Table 5.2-4**.

Table 5.2-4 FEMA-Mapped Special FHAs Within the EW 2 Project Area

Route Feature	FEMA Flood Zone	Area (ac)
EW 2 Route LB-A	X (0.2% Annual Chance Flood Hazard)	0.18
	X (Area of Minimal Flood Hazard)	1.06
	Total	**1.24**
EW 2 Route LB-C	X (0.2% Annual Chance Flood Hazard)	1.39
	X (Area of Minimal Flood Hazard)	1.80
	Total	**3.20**
EW 2 Route LB-D	X (0.2% Annual Chance Flood Hazard)	1.74
	Total	**1.74**
EW 2 Route LB-F	X (0.2% Annual Chance Flood Hazard)	0.49
	Total	**0.49**
EW 2 Route LB-G	X (0.2% Annual Chance Flood Hazard)	0.18
	X (Area of Minimal Flood Hazard)	1.06
	Total	**1.24**
EW 2 Route LB-F	X (0.2% Annual Chance Flood Hazard)	1.35
	Total	**1.35**
Reynolds Channel Crossing	X (0.2% Annual Chance Flood Hazard)	0.34
	X (Area of Minimal Flood Hazard)	2.3
	Total	**2.64**

Table 5.2-4 FEMA-Mapped Special FHAs Within the EW 2 Project Area (continued)

Route Feature	FEMA Flood Zone	Area (ac)
EW 2 Route IP-A	X (0.2% Annual Chance Flood Hazard)	3.64
	X (Area of Minimal Flood Hazard)	0.59
	Total	**4.23**
EW 2 Route IP-B	X (0.2% Annual Chance Flood Hazard)	2.16
	Total	**2.16**
EW 2 Route IP-C	X (0.2% Annual Chance Flood Hazard)	12.74
	X (Area of Minimal Flood Hazard)	13.42
	Total	**26.16**
EW 2 Route IP-D	X (0.2% Annual Chance Flood Hazard)	0.73
	X (Area of Minimal Flood Hazard)	2.03
	Total	**2.76**
EW 2 Route IP-E	X (0.2% Annual Chance Flood Hazard)	0.51
	X (Area of Minimal Flood Hazard)	10.71
	Total	**11.22**
EW 2 Route IP-F	X (0.2% Annual Chance Flood Hazard)	7.92
	X (Area of Minimal Flood Hazard)	9.03
	Total	**16.95**
EW 2 Route IP-G	X (0.2% Annual Chance Flood Hazard)	7.95
	X (Area of Minimal Flood Hazard)	9.43
	Total	**17.39**
EW 2 Route IP-H	X (0.2% Annual Chance Flood Hazard)	7.38
	X (Area of Minimal Flood Hazard)	1.42
	Total	**8.80**
EW 2 Onshore Substation A	X (Area of Minimal Flood Hazard)	0.10
	Total	**0.10**
EW 2 Onshore Substation C	X (0.2% Annual Chance Flood Hazard)	0.34
	Total	**0.34**

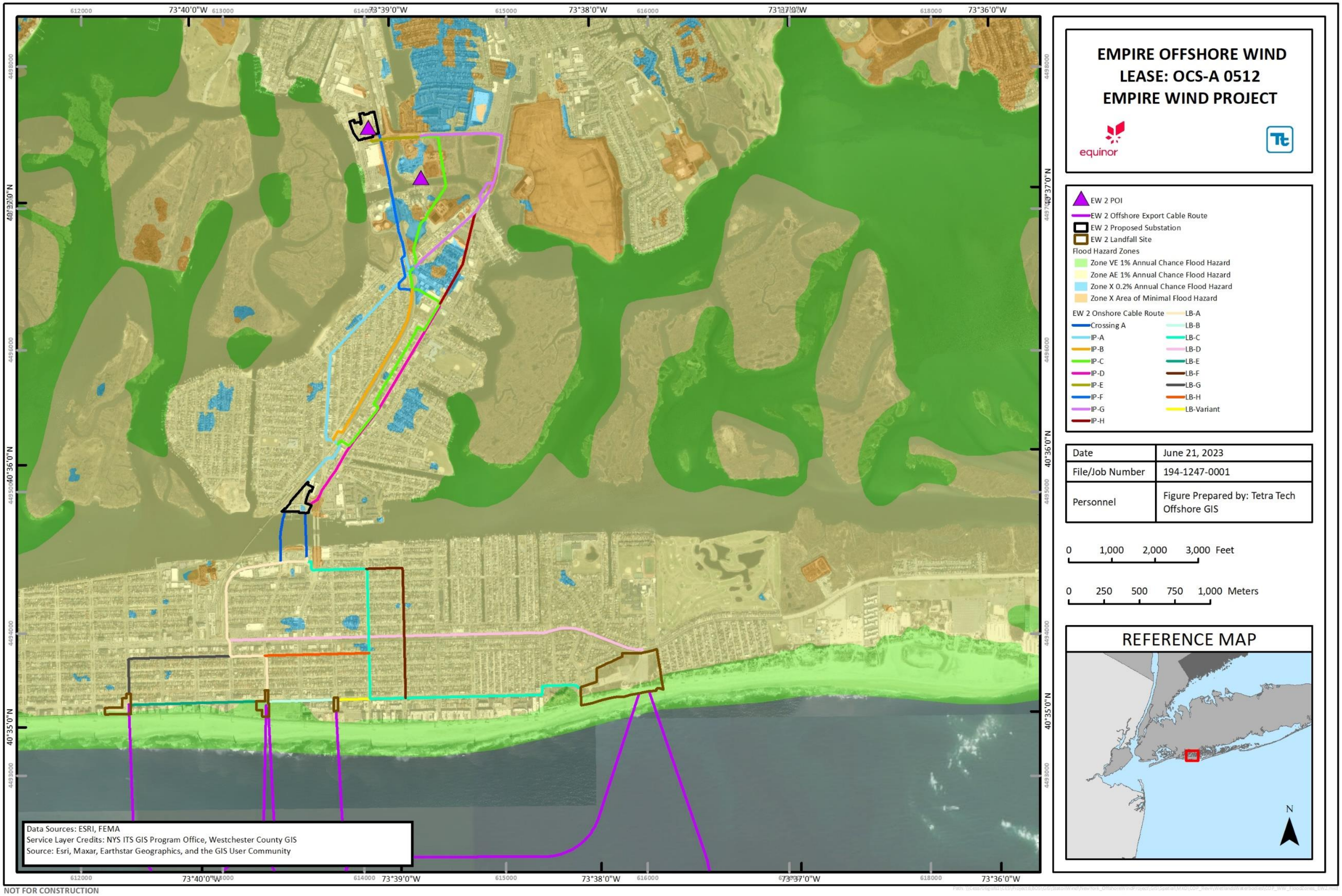


Figure 5.2-6 EW 2 Mapped Floodplains

5.2.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For wetlands and waterbodies, the maximum scenario is the greatest footprint resulting from the full build-out of all onshore Project components for EW 1 and EW 2, as described in **Table 5.2-5**. The parameters provided in **Table 5.2-5** represent the maximum design scenario impact from full Lease Area buildout of EW 1 and EW 2. This design concept incorporates the onshore export cable landfalls, onshore export and interconnection cable routes, onshore substations, and the O&M Base.

Table 5.2-5 Summary of Maximum Design Scenario Parameters for Wetlands and Waterbodies

Parameter	Maximum Design Scenario	Rationale
Construction		
Export cable landfall	Based on EW 1 and EW 2. EW 1: HDD in a 200-ft by 200-ft (61-m by 61-m) area. EW 2: HDD or Direct Pipe installation in a 260-ft by 680-ft (79-m by 207-m) area.	Representative of the maximum area to be utilized to facilitate the export cable landfall.
Onshore export and interconnection cables	Based on EW 1 and EW 2. EW 1: 0.2 mi (0.4 km). EW 2: 5.6 mi (9.1 km).	Representative of the maximum length of onshore export and interconnection cables to be installed.
Onshore substations	Based on EW 1 and EW 2. EW 1: 10.8-ac (4.4-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation(s).
O&M Base	6.5-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the O&M Base.
Work compounds and lay-down areas including ports and construction and staging areas	Based on EW 1 and EW 2. Maximum number of work compounds and lay down areas required. Ground disturbing activities are not anticipated. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.
Operations and Maintenance		
Onshore substations	Based on EW 1 and EW 2. EW 1: 4.8-ac (3.6-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the presence of a new structure in an area where there was previously none.
O&M Base	4.5-ac (1.8-ha) area.	Representative of the presence of a new structure in an area where there was previously none.

5.2.2.1 Construction

During construction, the potential impact producing factors to wetland and waterbodies may include:

- Construction of the onshore cable system, including splice bays (installation techniques include open cut trenching, HDD, Direct Pipe, and jack and bore);
- Staging and construction activities and assembly of Project components at applicable facilities or areas; and
- Construction of new onshore substations and O&M Base, including upgrade or replacement of bulkheading.

The following impacts may occur as a consequence of factors identified above:

- Disturbance to wetlands, waterbodies, associated adjacent areas, and special FHAs due to the installation of permanent structures;
- Conversion of existing wetland cover types;
- Short-term removal of vegetation within wetlands and stream riparian zones due to construction activities;
- Short-term potential for erosion into adjacent wetlands and waterbodies;
- Short-term potential for inadvertent return of drilling fluids during HDD activities;
- Short-term potential for accidental releases from construction vehicles or equipment; and
- Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing.

As the Project design is still preliminary and specific impacts are not known, detailed mitigation strategies will be developed as part of the final design and conform to the requirements of all state and federal permitting respective to wetlands and waterbody resources.

Disturbance to wetlands, waterbodies, associated adjacent areas, and special FHAs due to the installation of permanent structures. The onshore substations and O&M Base will include concrete foundations, gravel lots, fencing, and associated structures. Upgrading or replacement of bulkheading may also be required for EW 1 and EW 2 Onshore Substation C. A cable bridge crossing Barnums Channel installed either adjacent to the existing LIRR railway bridge or adjacent to the Long Beach Road bridge may also involve the installation of piles in the water and adjacent areas. Every practical attempt has been made to avoid wetland and waterbody resources and minimize the permanent conversion of regulated areas by siting Project infrastructure outside and away from jurisdictional wetlands, State open waters, and their corresponding protected adjacent areas.

The placement of structures within special FHAs will be avoided to the extent practicable. Construction will satisfy the design requirements governing the placement of structures within mapped floodplains and specific mitigation strategies with regard to special FHAs and stormwater management will be designed on a case-by-case basis during the regulatory process. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project related activities. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;

- The siting of structures outside of special FHAs at EW 2 to the extent practicable. Note that this is not possible for EW 1 or the O&M Base, due to the proximity of the Gowanus POI to the shoreline; and
- Consideration of the use of trenchless methods (HDD or Direct Pipe) for installation of the export cable landfalls at EW 2 to avoid surficial disturbances.

Conversion of existing wetland/riparian zone cover types. During construction, forested wetlands, wetland transition areas, and/or riparian zones may be converted to other cover types as a result of the Project construction footprint, though this conversion is not anticipated. There are no impacts anticipated for EW 1, the EW 2 Onshore Substation A site, or the O&M Base, and the tidal wetland adjacent area associated with Reynolds Channel that extends into the EW 2 Onshore Substation C site is primarily unvegetated. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project related activities. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- During construction, access will be restricted to existing paved roads and approved access roads at wetland and stream crossings where possible, to avoid excessive soil compaction in sensitive areas, to the extent practicable;
- The installation of temporary matting at EW 2 if access through wetlands is required during construction activities to protect vegetation root systems, reduce compaction, and minimize ruts. This is not anticipated to be required for EW 1 or the O&M Base due to the absence of wetlands within the onshore area;
- The implementation of an invasive species control plan at EW 2 to avoid the spread of invasive species and replant with native vegetation only, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Restricting access through wetlands at EW 2 to identified construction sites, access roads, and work zones, to the extent practicable. This is not anticipated to be required for EW 1 or the O&M Base due to the absence of wetlands within the onshore area; and
- Landscaping and restoration work at EW 2 will be completed with appropriate native species, per a landscape restoration plan or other appropriate plan, and in compliance with the invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation.

Short-term removal of vegetation within wetlands and stream riparian zones. During construction and installation activities, including trench excavation, HDD/Direct Pipe work areas, and wareyard areas for staging of equipment and supplies, there is a potential to temporarily impact adjacent vegetation within these areas. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project related activities. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The installation of temporary matting at EW 2 if access through wetlands is required during construction activities to protect vegetation root systems, reduce compaction, and minimize ruts. This is not anticipated to be required at EW 1 or the O&M Base due to the absence of wetlands within the onshore area;
- Restricting access through wetlands at EW 2 to identified construction sites, access roads, and work zones, to the extent practicable. This is not anticipated to be required at EW 1 or the O&M Base due to the absence of wetlands within the onshore area;
- During construction, access will be restricted to existing paved roads and approved access roads at wetland and stream crossings where possible, to avoid excessive soil compaction in sensitive areas;
- The implementation of an invasive species control plan at EW 2, which will be provided for agency review and approval, as applicable, to avoid the spread of invasive species and replant with native vegetation only. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Landscaping and restoration work at EW 2 will be completed with appropriate native species, in compliance with the invasive species control plan to prevent the introduction of invasive plant species. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation.

Short-term potential for erosion from construction activities into adjacent wetlands and waterbodies. Excavation, soil stockpile, and grading associated with installation of the onshore export and interconnection cable and development of the onshore substation, O&M Base, and supporting infrastructure may increase the potential for erosion and sedimentation to wetland and waterbody resources down gradient. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of soil erosion and sediment control plans for each landfall location satisfactory to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) including development of a SWPPP; as applicable;
- During construction, access will be restricted to existing paved roads and approved access roads at wetland and waterbody crossings where possible, to avoid excessive soil compaction in sensitive areas; and
- The installation of temporary matting at EW 2 if access through wetlands is required during construction activities to protect vegetation root systems, reduce compaction, and minimize ruts. This is not anticipated to be required for EW 1 or the O&M Base due to the absence of wetlands within the onshore area.

Short-term potential for inadvertent return of drilling fluids during HDD. HDD technologies may be implemented to avoid sensitive areas such as shorelines, wetlands, wetland transition areas, and riparian zones. In the event of an inadvertent return within a regulated area, drilling fluids have the potential to escape to the surface and impact wetland and/or waterbody habitats and the biota inhabiting such areas. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable.

Short-term potential for accidental releases from construction vehicles or equipment. Construction vehicles and equipment may be accessing regulated areas during construction activities and will be refueled and potentially serviced within the Project Site. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- The management of accidental spills or releases of oils or other hazardous wastes through a SPCC plan, which will be provided for agency review and approval, as applicable; and
- During construction, access will be restricted to existing paved roads and approved access roads at wetland and waterbody crossings where possible, to avoid excessive soil compaction in sensitive areas.

Short-term impedance to local migration of terrestrial biota as a result of placement of silt fencing. During construction and installation activities, silt fencing will be installed around ground disturbing activities. While installed, terrestrial biota will be restricted from passing through these areas. Empire will consider the following measures to avoid, minimize, and mitigate impacts:

- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

5.2.2.2 Operations and Maintenance

During operations, no new impacts to wetlands and waterbodies are anticipated, as Project-related activities are expected to utilize existing permitted access roads and entry points. Temporary workspaces will be restored to pre-construction conditions to the extent possible, however, permanent aboveground structures associated with the onshore substations and O&M Base will remain. Stormwater management and sediment control features approved and installed during Project construction, such as infiltration ponds, will avoid soil erosion to offsite wetlands and waterbodies during Project operations. Accidental releases into wetlands and waterbodies will be avoided, minimized, or mitigated to the extent practicable by the development and implementation of a SPCC plan.

When onshore export and interconnection cable inspection or repairs require excavation or other ground disturbance, short-term localized impacts to wetland and waterbody resources (or adjacent areas) may occur; these activities are not anticipated to have long-term effects. In this instance, mitigation strategies similar to those detailed in Section 5.2.2.1 will be implemented on a case-by-case basis and would be defined through the regulatory process, as applicable, including:

- Protective measures will be installed around Project-components at EW 2, to restrict access to wetlands during operations and maintenance activities. This is not anticipated to be required for EW 1 or the O&M Base due to the lack of wetlands within the onshore area;
- Revegetation monitoring at EW 2 will be conducted consistent with a landscaping restoration plan and an invasive species control plan, which will be provided for agency review and approval, as applicable, within wetlands, waterbodies, and protected adjacent areas and riparian zones that were temporarily disturbed during Project construction to ensure that functionality is restored in these areas satisfactory to permit requirements. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Mitigation monitoring at EW 2, as required and defined during the regulatory process for any areas identified as mitigation sites as a result of long-term unavoidable impacts to wetlands, waterbodies and protected adjacent areas and riparian zones. This is not anticipated to be required for EW 1 or the O&M Base due to the lack of wetlands within the onshore area; and

- Stormwater control features will be routinely inspected and cleaned to remove debris or excess vegetation that may impede the designed functionality. The inspection schedule will be detailed in the SWPPP and/or SPCC.

5.2.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.2.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be reevaluated at that time. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in Section 5.2.2, Empire is proposing to implement the following avoidance, minimization, and mitigation measures.

5.2.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.2.2.1:

- The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable;
- The siting of structures outside of special FHAs at EW 2 to the extent practicable. Note that this is not possible for EW 1 or the O&M Base, due to the proximity of the Gowanus POI to the shoreline;
- The implementation of soil erosion and sediment control plans, which will be provided for agency review and approval, as applicable, for each onshore component to the requirements detailed in the New York State Standards and Specifications for Erosion and Sediment Control (Blue Book), including development of a SWPPP, as applicable;
- The incorporation of the NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State into the site-specific best management practices for activities located within the SSER, as recommended by the SSER Comprehensive Management Plan for EW 2;
- The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable;
- The management of accidental spills or releases of oils or other hazardous wastes through a SPCC plan, which will be provided for agency review and approval, as applicable;
- During construction, access will be restricted to existing paved roads and approved access roads at wetland and waterbody crossings where possible, to avoid excessive soil compaction in sensitive areas;
- The installation of temporary matting at EW 2 if access through wetlands is required during construction activities to protect vegetation root systems, reduce compaction, and minimize ruts. This is not anticipated to be required for EW 1 or the O&M Base due to the lack of wetlands within the onshore area;
- The implementation of an invasive species control plan at EW 2, which will be provided for agency review and approval, as applicable, to avoid the spread of invasive species and replant with native vegetation only. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;

- Restricting access through wetlands at EW 2 to identified construction sites, access roads, and work zones to the extent practicable. This is not anticipated to be required at EW 1 or the O&M Base due to the absence of wetlands within the onshore area; and
- Landscaping and restoration work at EW 2 will be completed with appropriate native species, per a landscape restoration plan or other appropriate plan, which will be provided for agency review and approval, as applicable, and in compliance with an invasive species control plan to prevent the introduction of invasive plant species, which will be provided for agency review and approval, as applicable. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation.

In addition, during construction, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.2.2.1:

- Consideration of the use of trenchless methods (HDD or Direct Pipe) for installation of the export cable landfalls at EW 2 to avoid surficial disturbances;
- Evaluation of seasonal restrictions for vegetation clearing at EW 2, where sensitive species are detected, to mitigate potential impacts to breeding individuals. This is not anticipated to be required at EW 1 or the O&M Base due to the highly developed nature of the onshore area and absence of suitable habitat; and
- Consideration of staggering silt fencing or other erosion control devices in sensitive areas to facilitate the passage of biota, if deemed effective. The strategy will be implemented on a site-specific basis and finalized during the permitting process.

As the Project design is still preliminary and specific impacts are not known, detailed mitigation strategies will be developed as part of the final design and conform to the requirements of all state and federal permitting respective to wetlands and waterbody resources.

5.2.3.2 Operations and Maintenance

During operations, Empire will commit to the following avoidance, minimization and mitigation measures will be implemented to mitigate the impacts described in Section 5.2.2.2:

- Protective measures will be installed around Project components at EW 2, to restrict access to wetlands during operation and maintenance activities. This is not anticipated to be required for EW 1 or the O&M Base due to the lack of wetlands within the onshore area;
- Revegetation monitoring at EW 2 will be conducted consistent with a landscaping restoration plan and an invasive species control plan, which will be provided for agency review and approval, as applicable, within wetlands, waterbodies, and protected adjacent areas and riparian zones that were temporarily disturbed during Project construction to ensure that functionality is restored in these areas satisfactory to permit requirements. This is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area;
- Mitigation monitoring at EW 2, as required and defined during the regulatory process for any areas identified as mitigation sites as a result of long-term unavoidable impacts to wetlands, waterbodies and protected adjacent areas and riparian zones. This is not anticipated to be required for EW 1 or the O&M Base due to the lack of wetlands within the onshore area; and
- Stormwater control features will be routinely inspected and cleaned to remove debris or excess vegetation that may impede the designed functionality. The inspection schedule will be detailed in the SWPPP and/or SPCC.

5.2.3.3 Decommissioning

Avoidance, minimization and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those experienced during construction and operations, as described in Section 5.2.2.1 and Section 5.2.2.2. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.2.4 References

Table 5.2-6 Data Sources

Source	Includes	Available at	Metadata Link
FEMA	Flood Hazard Zones	https://www.fema.gov/national-flood-hazard-layer-nfhl	N/A
NHD	Stream	https://www.usgs.gov/core-science-systems/ngp/national-hydrography/access-national-hydrography-products	N/A
NYSDEC	Stream	http://gis.ny.gov/gisdata/fileserver/?DSID=1118&file=nysdec_wtrcls.zip	http://gis.ny.gov/gisdata/metadata/nysdec.wtrcls.xml
NYSDEC	Tidal Wetland	http://gis.ny.gov/gisdata/fileserver/?DSID=1139&file=tidal_wetlands_lower.zip	http://gis.ny.gov/gisdata/metadata/nysdec.tidal_wetlands_lower.html

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5.3 Avian Species

This section describes the avian species known to occur within and surrounding the Project Area, which includes the Lease Area, submarine export cable routes, onshore export and interconnection cable routes, onshore substations, and O&M Base. Potential impacts to birds resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Empire are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to avian species.

Other resources and assessments detailed within this COP that are related to birds include:

- Terrestrial Vegetation and Wildlife (Section 5.1);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (Section 5.5);
- Ornithological and Marine Fauna Aerial Survey (Appendix P); and
- Avian Impact Assessment Analysis (Appendix Q).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area for the offshore components includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the EW 1 and EW 2 submarine export cable routes (Offshore Study Area; see **Figure 5.3-1**). The Study Area for the onshore components consists of a 1.5-mi (2.4-km) buffer around the EW 1 and EW 2 onshore export and interconnection cable routes, the onshore substation parcels, and the O&M Base[4] (Onshore Study Areas; see **Figure 5.3-2** and **Figure 5.3-3**).

This section was prepared in accordance with:

- BOEM's site characterization requirements in 30 CFR § 585.626(3); and
- BOEM's *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2017).

In accordance with BOEM's avian guidelines (BOEM 2017), this section relies on several sources of data and information in its assessment of birds that may be present in the Study Area. Offshore, these include publicly available information, such as a NYSERDA-funded APEM marine wildlife digital aerial survey data (NYSERDA 2018); MDAT Version 2 models (Curtice et al. 2016; Winship et al. 2018); USFWS IPaC database (USFWS 2018a); rare species records in the Northwest Atlantic Seabird Catalog, and individual tracking studies completed in and near the Study Area.

In addition to the data sources described in this section, Empire collected Project-specific sighting data that encompassed the Lease Area plus a 2.5-mi (4-km) buffer around it (**Appendix P Ornithological and Marine Fauna Aerial Survey**). The aerial surveys were conducted monthly over the course of a year, from November 2017 to October 2018, and recorded sightings of avian, marine mammal, sea turtle, and other species, including sharks, rays and large fish assemblages using high resolution digital photography. The data collected by Empire (**Appendix P**) was intended to supplement data collected by other entities, including the NYSERDA-funded APEM aerial survey data (NYSERDA 2018), which collected aerial survey data within a large area in the New York Bight (encompassing the Lease Area).

[4] While the O&M Base will serve both EW 1 and EW 2, the facility will be located at SBMT, adjacent to the EW 1 onshore substation, and will therefore be included within the EW 1 Onshore Study Area for the purposes of this analysis.

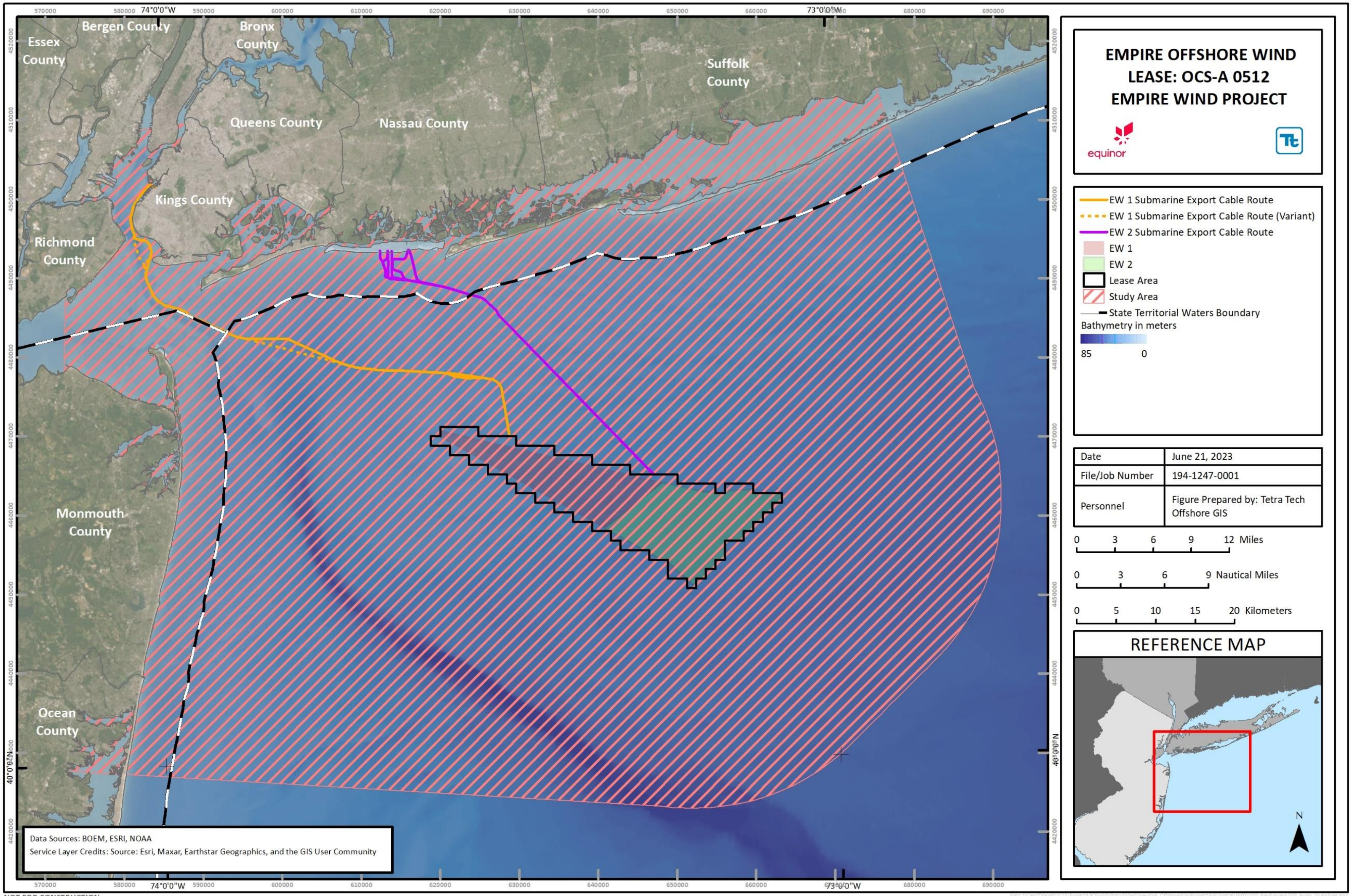

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Figure 5.3-1 Avian Species Offshore Study Area

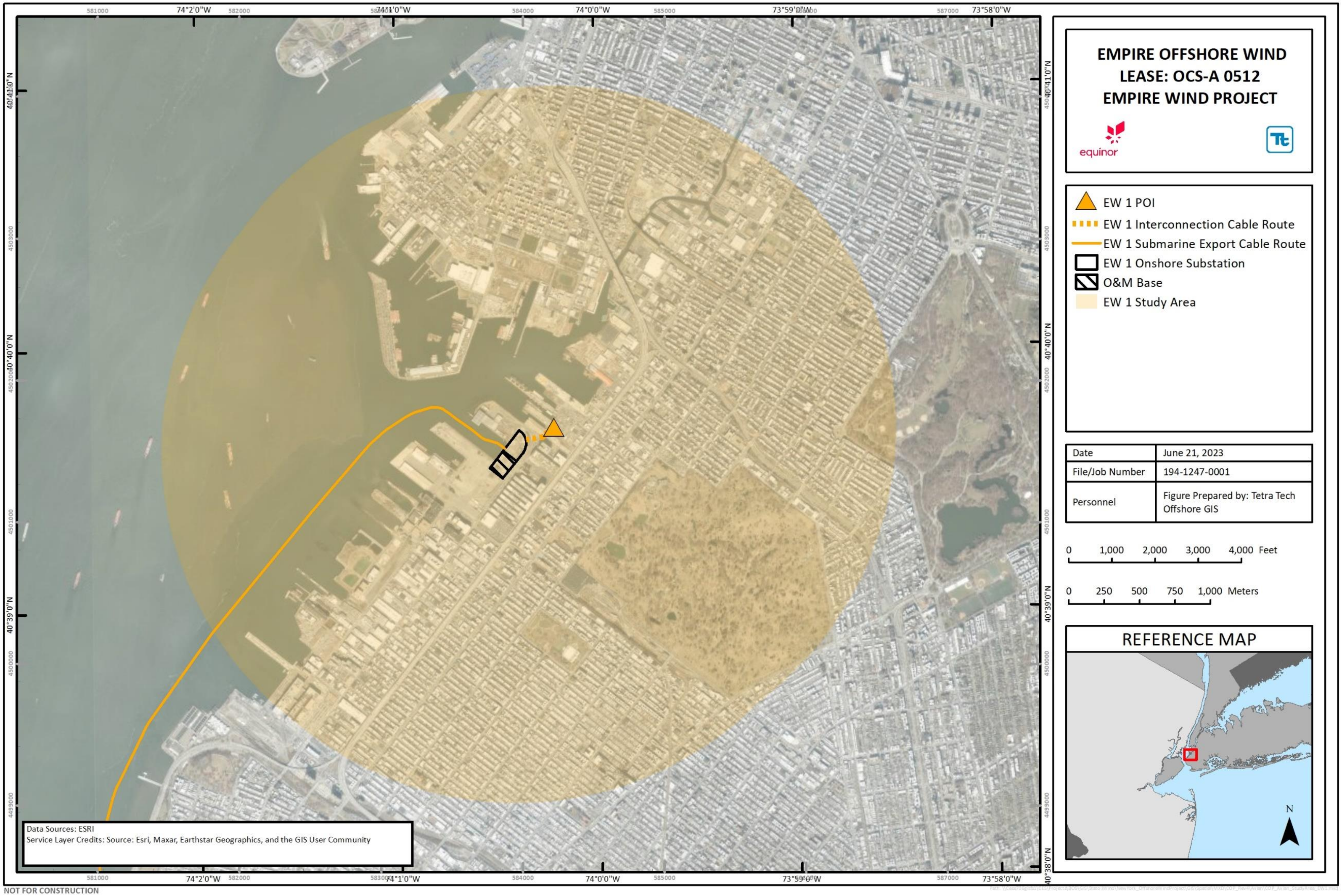

Figure 5.3-2 EW 1 Avian Species Onshore Study Area

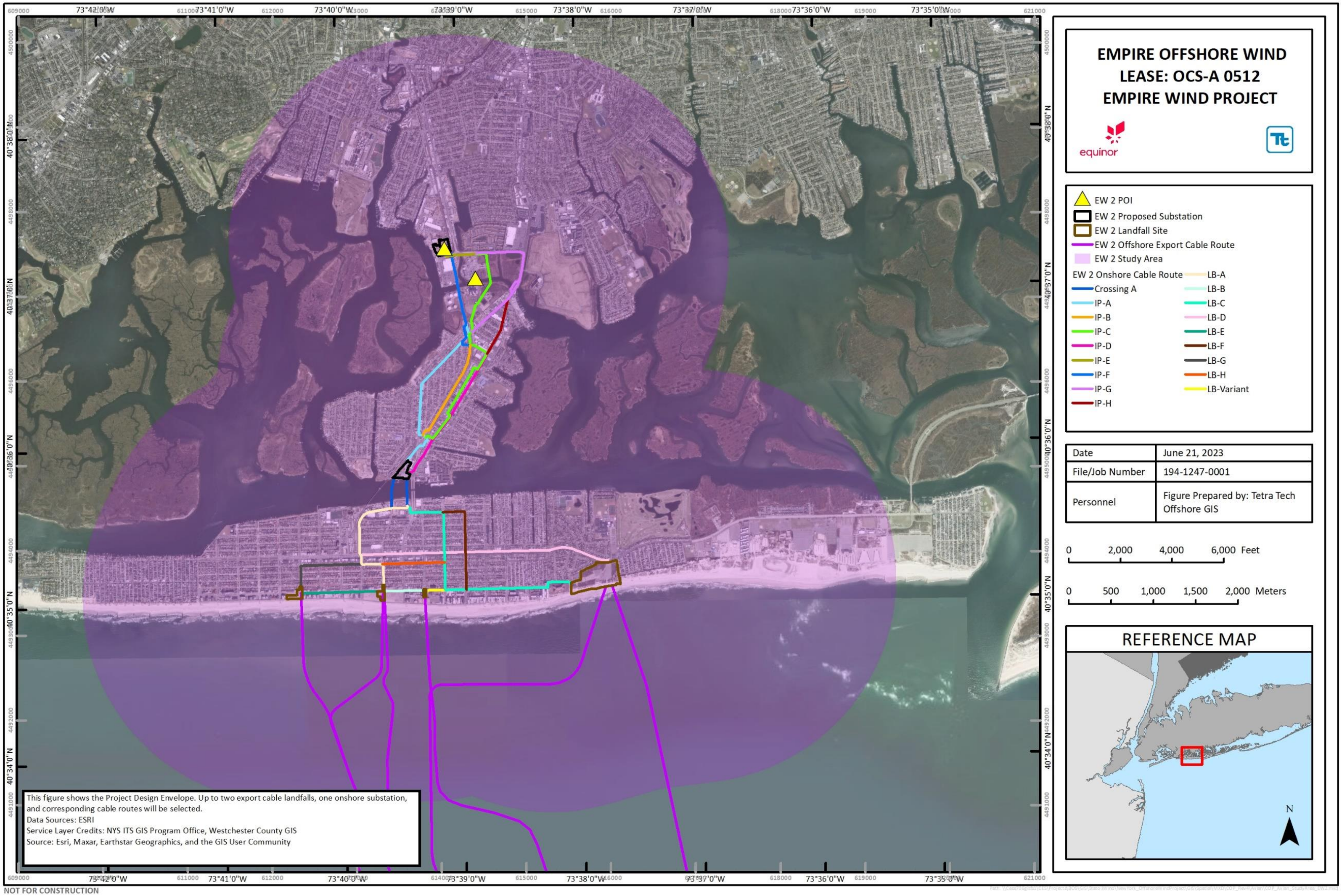

Figure 5.3-3 EW 2 Avian Species Onshore Study Area

Empire contracted Biodiversity Research Institute to conduct an exposure and risk assessment for both offshore and onshore species of birds known to and/or that have the potential to occur in the Project Area. Using a risk assessment framework, the potential effects associated with the construction and operation of the proposed offshore wind developments were evaluated. The framework used a weight-of-evidence approach and combined evaluations of both exposure (i.e., likelihood of occurrence in the Offshore Study Area), and behavioral vulnerability within the context of the literature to establish potential risk (see **Appendix Q Avian Impact Assessment** for additional information).

Habitat was identified for each onshore export and interconnection cable route option using Google Earth (satellite and street view), the New York Wildlife Action Plan (NYSDEC 2015), and through assessments conducted by Tetra Tech. Then, using eBird data, IPaC data (USFWS 2018a), and the best available datasets, the species likely to occur in each habitat type were identified. Data on possible bird species present was primarily compiled from eBird citizen science data (Sullivan et al. 2009; eBird 2019) from within a 9.3 mi (15 km) buffer of the center of each Onshore Study Area, and was temporally constrained to ten years[5].

Formal inquiries were also submitted to the NYSDEC Division of Fish and Wildlife to review the Natural Heritage Program databases and determine potential state and federally protected wildlife species likely to be present on or proximal to the Project Area in January 2019. Updated inquiries were submitted to the NYSDEC for both the EW 1 onshore export and interconnection cable route in June 2019 and the EW 2 onshore export and interconnection cable route in August 2019, as new parcels had recently been added into the defined Project Area. In April 2021, and May 2022, Empire submitted additional inquiries to the NYSDEC for EW 1 and updated EW 2 landfalls, onshore substations, and onshore export and interconnection cable routes. Although the location of the proposed O&M Base was not depicted in the April 2021 inquiry, this area was included in the June 2019 inquiry; the responses from these request have been incorporated into Section 5.3.1 and Section 5.3.2.

The NYSDEC provided a list of species that have been documented in the vicinity of the EW 1 and EW 2 onshore export and interconnection cable routes and onshore substations. Official Species Lists were also attained from the USFWS IPaC project planning tool to identify threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat that may be present within or in the immediate vicinity of the Onshore Study Areas.

A field reconnaissance was also conducted at the EW 1 Onshore Study Area on December 5, 2018, as part of a preliminary assessment from publicly accessible areas, to verify the presence of mapped wetland and waterbody resources and to assess the potential presence of unmapped wetland and waterbody resources to support the assessment for terrestrial vegetation and wildlife. Field surveys to document terrestrial vegetation and wildlife resources associated with the EW 2 Onshore Study Area began in 2021, continued in 2022, and are anticipated to continue through late summer 2023.

5.3.1 Affected Environment

The affected environment is defined as the offshore and onshore areas where birds are known to be present, traverse, or incidentally occur, and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. This includes the Lease Area, the submarine export cable routes, the onshore export and interconnection cable routes, the onshore substations, and the O&M Base. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of

[5] As the eBird database is a citizen science effort, a 9.3-mi (15-km) buffer was conservatively selected to account for a potential lack of bird watching efforts within the Project Area.

the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

5.3.1.1 Baseline Characterization: Offshore

A broad group of avian species has been documented in or may pass through the Lease Area, including migrants (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and sea ducks; **Table 5.3-1**). There is a high diversity of marine birds that may use the Lease Area, as it is located in the New York Bight, which overlaps with northern and southern species assemblages.

The New York Bight, located within the Mid-Atlantic Bight, spans an area from Cape May, New Jersey, to Montauk Point on Long Island, New York, and includes the Hudson River Canyon. The area is characterized by gently sloping continental shelf, with shallow waters and a sandy seafloor. In this area, the continental shelf extends from 93 to 124 mi (150 to 200 km) offshore. Beyond the shelf edge, the continental slope descends rapidly to approximately10,000 ft (3,000 m) below sea level. The coastal climate of the region is primarily temperate, due to the influence of both cool Arctic waters brought south by the Labrador Current, and warmer waters of the Gulf Stream, which flows northward along the Atlantic coast of North America. The area exhibits a strong seasonal cycle in sea surface temperature and in salinity, with a large volume of freshwater emptying onto the shelf via the Hudson River.

Situated within the Atlantic Flyway, the Lease Area is located within one of four major North American north-south migration routes for many species of seabirds, shorebirds, waterfowl, raptors, and songbirds (Menza et al. 2012). The Atlantic Flyway is located along the eastern coast of North America, which includes several states and Canadian provinces that span the route from Canada to South America and the Caribbean. Coastal and marine environments along the Atlantic Flyway provide important habitat and food resources for hundreds of avian species at stopover sites, breeding locations, and wintering areas (Menza et al. 2012). Migrant terrestrial species may follow the coastline during migration or choose more direct flight routes over expanses of open water. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and sea ducks), taking them directly through the New York Bight region in spring and fall. The New York Bight also supports large populations of birds in summer, some of which breed in the area, such as gulls and terns. Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). In the fall, many of the summer residents leave the area and migrate south to warmer regions and are replaced by species that breed further north and winter in the Mid-Atlantic region. This results in a complex ecosystem where the community composition shifts regularly, and temporal and geographic patterns are highly variable.

Three species listed under the ESA are present in the region: the piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and roseate tern (*Sterna dougallii*). Piping plovers nest along New York and New Jersey beaches, and will also migrate (spring and fall) through the region to and from northern breeding sites. Red knots pass through the region during migration in transit to far northern breeding sites. Roseate terns also fly through the Mid-Atlantic region on their way north to breeding sites in New York and New England.

Table 5.3-1 lists bird species potentially exposed to the offshore components of the Project, identified through species recorded offshore of New York in the NYSERDA (2018) and Empire-funded, high resolution digital aerial surveys (**Appendix P**), and cross-referenced with USFWS IPaC database (2018a). Other species that were not detected in the Lease Area that have potential to move through the Lease Area are discussed in the text.

Table 5.3-1 Bird Species Potentially Exposed to the Offshore Components of the Project

Taxonomic Group	Species	IPaC	NY Listed	Federally Listed
Dabblers, geese, and swans				
American black duck	*Anas rubripes*			
Canada goose	*Branta canadensis*			
Gadwall	*Mareca strepera*			
Mallard	*Anas platyrhynchos*			
Tundra swan	*Cygnus columbianus*			
Coastal diving ducks				
Bufflehead	*Bucephala albeola*			
Common goldeneye	*Bucephala clangula*			
Lesser scaup	*Aythya affinis*			
Sea ducks				
Black scoter	*Melanitta americana*	x		
Common eider	*Somateria mollissima*	x		
Long-tailed duck	*Clangula hyemalis*	x		
Red-breasted merganser	*Mergus serrator*	x		
Surf scoter	*Melanitta perspicillata*	x		
White-winged scoter	*Melanitta fusca*	x		
Grebes				
Horned grebe	*Podiceps auritus*			
Shorebirds				
Black-bellied plover	*Pluvialis squatarola*			
Semipalmated plover	*Charadrius semipalmatus*			
Phalaropes				
Red phalarope	*Phalaropus fulicarius*	x		
Red-necked phalarope	*Phalaropus lobatus*			
Skuas and jaegers				
Great skua	*Stercorarius skua*			
Parasitic jaeger	*Stercorarius parasiticus*	x		
Pomarine jaeger	*Stercorarius pomarinus*	x		
South polar skua	*Stercorarius maccormicki*	x		

Table 5.3-1 Bird Species Potentially Exposed to the Offshore Components of the Project (continued)

Taxonomic Group	Species	IPaC	NY Listed	Federally Listed
Auks				
Atlantic puffin	*Fratercula arctica*	x		
Black guillemot	*Cepphus grylle*			
Common murre	*Uria aalge*	x		
Dovekie	*Alle alle*	x		
Razorbill	*Alca torda*	x		
Small gulls				
Bonaparte's gull	*Chroicocephalus philadelphia*	x		
Little gull	*Hydrocoloeus minutus*			
Medium gulls				
Black-legged kittiwake	*Rissa tridactyla*	x		
Laughing gull	*Leucophaeus atricilla*			
Ring-billed gull	*Larus delawarensis*	x		
Large gulls				
Great black-backed gull	*Larus marinus*	x		
Glaucous gull	*Larus hyperboreus*			
Herring gull	*Larus argentatus*	x		
Iceland gull	*Larus glaucoides*			
Lesser black-backed gull	*Larus fuscus*			
Small terns				
Black tern	*Chlidonias niger*		E	
Least tern	*Sternula antillarum*	x	T	
Medium terns				
Common tern	*Sterna hirundo*	x	T	
Forster's tern	*Sterna forsteri*			
Roseate tern	*Sterna dougallii*	x	E	E
Royal tern	*Thalasseus maximus*	x		
Loons				
Common loon	*Gavia immer*	x		
Red-throated loon	*Gavia stellata*	x		
Storm-petrels				
Leach's storm-petrel	*Oceanodroma leucorhoa*	x		
Wilson's storm-petrel	*Oceanites oceanicus*	x		

Table 5.3-1 Bird Species Potentially Exposed to the Offshore Components of the Project (continued)

Taxonomic Group	Species	IPaC	NY Listed	Federally Listed
Shearwaters and petrels				
Audubon's shearwater	*Puffinus lherminieri*			
Black-capped petrel	*Pterodroma hasitata*			
Cory's shearwater	*Calonectris diomedea*	x		
Great shearwater	*Ardenna gravis*	x		
Manx shearwater	*Puffinus puffinus*	x		
Northern fulmar	*Fulmarus glacialis*			
Sooty shearwater	*Ardenna grisea*			
Gannet and booby				
Northern gannet	*Morus bassanus*	x		
Cormorants				
Double-crested cormorant	*Phalacrocorax auritus*	x		
Pelicans				
Brown pelican	*Pelecanus occidentalis*	x		
Heron and egrets				
Great blue heron	*Ardea herodias*			
Raptors				
Osprey	*Pandion haliaetus*			
Passerines				
Common nighthawk	*Chordeiles minor*			

Sources:
USFWS 2018a; NYSERDA 2018, and site-specific baseline studies (**Appendix P**). See **Appendix Q** for further details.

Note:
E=Endangered; T=Threatened

Migratory Birds

Shorebirds: Shorebirds are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the U.S. Atlantic Coast and few were observed offshore in New York; most shorebirds that pass through the region are northern or Arctic breeders that migrate along the U.S. East Coast on their way to and from wintering areas in the Caribbean islands, or Central or South America. Of the shorebirds, only the two phalarope species (red phalarope and red-necked phalarope) are generally considered marine (Rubega, Schamel, and Tracy 2000; Tracy, Schamel, and Dale 2002). Very little is known regarding the migratory movements of these species, although they are known to travel well offshore. Two shorebird species are federally protected under the ESA; the piping plover and the red knot.

Piping plovers are present in New Jersey and New York during spring and fall migratory periods, and during the breeding season (USFWS 2018b). Piping plovers are also state listed as endangered in New York. In New

York, piping plovers breed on Long Island's beaches (from Queens to the Hamptons), in the eastern bays, and in the harbors of northern Suffolk County (NYSDEC 2019). They breed above the high tide line along the coast, primarily on sand beaches (USFWS 2018b). Non-migratory movements in May–August appear to be exclusively coastal (Burger et al. 2011). Piping plovers make nonstop, long-distance migratory flights (Normandeau Associates Inc. 2011), or offshore migratory "hops" between coastal areas (Loring et al. 2017). As such, at least some individuals of this species likely traverse the Offshore Study Area because the birds favor short, direct ocean crossings rather than following coastal routes (Loring et al. 2019). A recent nanotag study tracked migrating piping plovers captured in Massachusetts and Rhode Island from 2015–2017. The study estimated that one bird (out of 102 tracked) was exposed to the Lease Area. In addition, probability densities developed from the tracking data indicated primarily low to limited-high use of the western portion of the Lease Area (Loring et al. 2019).

Red knots would be present in the Offshore Study Area only during migratory periods (BOEM 2016, Loring et al. 2018). The fall migration period is generally July–October, but birds may pass through as late as November (Loring et al. 2018). Migration routes appear to be highly diverse, with some individuals flying out over the open ocean from the northeastern U.S. directly to stopover/wintering sites in the Caribbean and South America, while others make the ocean "jump" from farther south, or follow the U.S. Atlantic Coast for the duration of migration (Baker et al. 2013). Of the birds that winter on the southeast U.S. Coast and/or the Caribbean (considered short-distance migrants), a small proportion may pass through the Offshore Study Area during migration, and are thus at higher likelihood of exposure than the segment of the population wintering in South America, for example, that set out further north and make longer migration flights (Loring et al. 2018). While at stopover locations, red knots make local movements (e.g., commuting flights between foraging locations related to tidal changes), but are thought to remain within 3 mi (5 km) of shore (Burger et al. 2011). The Northwest Atlantic Seabird Catalog did not have any records of red knots in the vicinity of the Lease Area. In the telemetry study, one bird tagged in the Mingan Islands, Canada (n = 245) was estimated to cross the Lease Area in mid-November (Loring et al. 2018).

Wading Birds*:* Most long-legged wading birds (such as herons and egrets, etc.) breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal breeders and foragers and generally avoid straying out over deep waters (Kushlan and Hafner 2000). Most long-legged waders breeding along the U.S. Atlantic Coast migrate south to the Gulf of Mexico coast, the Caribbean islands, or Central or South America, and thus they are capable of crossing large areas of ocean and may traverse the Offshore Study Area during spring and fall migration periods. The IPaC database did not indicate any wading birds in the Lease Area or adjacent waters. Exposure to the Lease Area is minimal because wading birds spend a majority of the year in freshwater aquatic systems and near-shore marine systems. Furthermore, the digital aerial surveys (NYSERDA 2018 and site-specific surveys conducted by Empire, see **Appendix P**) showed no wading bird records within the Lease Area (see maps in **Appendix Q**). In addition, there were few observations of species within this group offshore and outside the Lease Area during all seasons (NYSERDA 2018).

Raptors: Limited data exists documenting the use of offshore habitats by diurnal and nocturnal raptors in North America. The only raptor observed in the digital aerial surveys (NYSERDA 2018 and **Appendix P**) was osprey, which occurred near the northwest portion of the Lease Area. However, individual tracking data and species accounts indicate that falcons are the primary species of raptor that will be exposed to the Lease Area. Falcons are the most likely to be encountered in offshore settings (Cochran 1985; DeSorbo et al. 2012, 2018). Merlins are the most abundant diurnal raptor observed at offshore islands during fall migration (DeSorbo et al. 2012, 2018). Peregrine falcons fly hundreds of kilometers offshore during migration, and have been observed on vessels and oil drilling platforms considerable distances from shore (DeSorbo et al. 2015; Johnson et al. 2011; McGrady et al. 2006; Voous 1961).

Bald eagles are present year-round in New York and New Jersey. In New York, eagle territories are primarily located inland, and in 2010 no territories were identified on Long Island (Nye 2010); in New Jersey, nesting is concentrated on the edge of Delaware Bay (NJDEP 2017). The golden eagle is generally associated with open forested regions and is generally not expected offshore (**Appendix Q**). Exposure for both species to the Lease Area is expected to be minimal, due to their limited distribution in the eastern U.S. coastal environment and the species reliance on terrestrial habitats. Bald eagle exposure is unlikely because the Lease Area is not located along any likely or known migration route, they tend not to fly long distances over large waterbodies, and the digital aerial surveys only contained one bald eagle observation, which was documented close to shore. No eagles were recorded in or near the Lease Area during the digital aerial surveys (**Appendix Q**).

Songbirds: Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats, and do not use the offshore marine system except during migration. Songbirds regularly cross large bodies of water (Bruderer and Lietchi 1999; Gauthreaux and Belser 1999), and there is some evidence that species migrate over stretches of the northern Atlantic (Adams et al. 2015). Some songbirds may briefly fly over the water while others, like the blackpoll warbler (*Setophaga striata*), can migrate over vast expanses of ocean (Faaborg et al. 2010; DeLuca et al. 2015). Evidence for a variety of species suggests that overwater migration in the Atlantic is much more common in fall (than in spring), perhaps due to consistent tailwinds (e.g., see Morris et al. 1994, Hatch et al. 2013, Adams et al. 2015, DeLuca et al. 2015). Migrating songbirds have been detected at or in the vicinity of smaller offshore wind developments in Europe (Kahlert et al. 2004; Krijgsveld et al. 2011; Pettersson and Fågelvind 2011) and may have greater passage rates during the middle of the night (Huppop and Hilgerloh 2012). Although not designed specifically to detect small songbirds, the digital aerial surveys recorded few detections of passerines during both spring and fall migration periods. Exposure to the Lease Area is low for songbirds, with the possible exception of the migratory periods.

Coastal Waterbirds: Coastal waterbirds use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. This group includes aquatic species that are not captured in other groupings, such as grebes and waterfowl, which are generally restricted to freshwater, or that use saltmarshes, beaches, and other strictly coastal habitats. Waterfowl comprises a broad group of swans, geese, and ducks, most of which spend much of the year in terrestrial or coastal wetland habitats (Baldassarre and Bolen 2006). The diving ducks generally winter on open freshwater, as well as brackish or saltwater. Species that regularly winter on saltwater, including mergansers, scaup, and goldeneyes, usually restrict their distributions to shallow, very nearshore waters (Owen and Black 1990). Sea ducks are discussed in the Marine Bird section. Most coastal waterfowl spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little to no use of the Lease Area during any season.

Marine Birds

The MDAT models indicate marine bird abundance is greater closer to shore than in the Lease Area. However, the models do predict an area of high bird abundance in the northwest portion of the Lease Area, which appears to be due to high predicted abundance of common murre in winter (**Figure 5.3-4**). This estimated higher use area represents one species during one season, not that of seabirds as a group. Below summarizes the exposure of each marine bird species group to the Lease Area; further details and seasonal maps for all species are provided in **Appendix Q**.

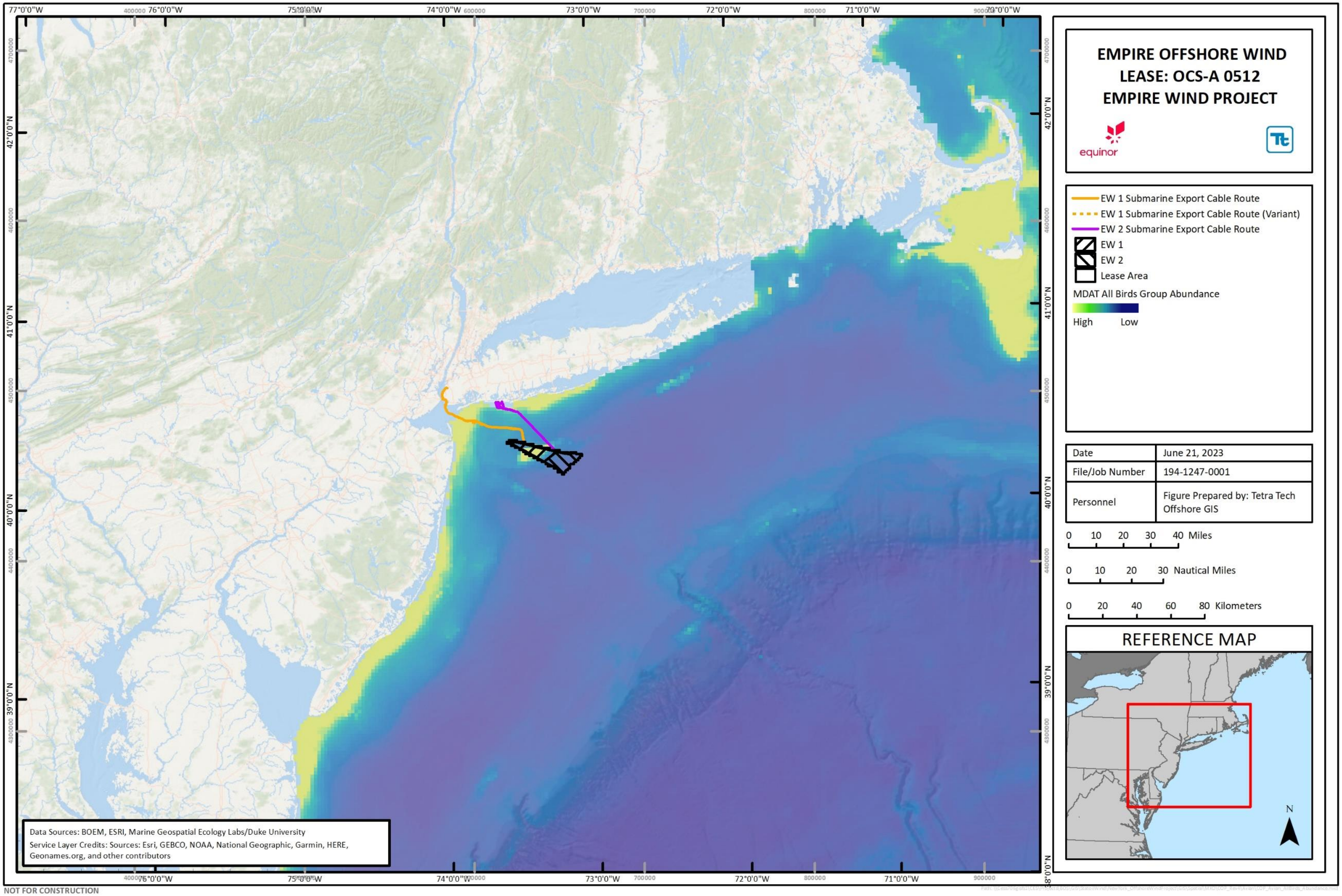

Figure 5.3-4 Year Round Bird Abundance Estimates from the MDAT Models

Loons: Common loons and red-throated loons breed in inland freshwater lakes and ponds during the summer, but both species are known to use the OCS during winter, and during migration periods in the spring and fall. Analysis of satellite-tracked red-throated loons, captured and tagged in the mid-Atlantic region, found their winter distributions to be largely inshore of the Lease Area, although they did overlap with the Lease Area somewhat during their migration periods, particularly in spring (Gray et al. 2016). In the mid-Atlantic, common loons generally show a broader and more dispersed distribution in winter than red-throated loons (Williams et al. 2015). As expected, based on the summer breeding habitat of loons, the digital aerial surveys and MDAT models show lower use of the Lease Area by loons in the summer than in other seasons.

Sea Ducks: Sea ducks include common eider, scoters, and long-tailed ducks, all of which are northern or Arctic breeders that use the OCS heavily in winter. Most sea ducks forage on mussels and/or other benthic invertebrates, and generally winter in either shallow inshore waters or out over large offshore shoals where they can access prey. The digital aerial survey data and MDAT models indicate that sea duck exposure is generally minimal to low, and the literature indicates that sea duck exposure will be primarily limited to migration or travel between wintering sites. Sea ducks tracked with satellite transmitters remained largely inshore of the Lease Area, with the exception of surf scoter and black scoter during spring migration.

Petrel Group: Petrels, shearwaters, and storm-petrels that breed in the Southern Hemisphere visit the Northern Hemisphere during the austral winter (boreal summer). Several of these species (e.g., Cory's shearwater, Wilson's storm-petrel) are found in high densities across the broader region, concentrating beyond the OCS and the Gulf of Maine as shown in the MDAT avian abundance models (Winship et al. 2018). Overall, exposure to the Lease Area is expected to be minimal because, while the petrel group is commonly observed throughout the region during the summer months, they are typically found much further offshore and north of the Lease Area. The black-capped petrel (ESA candidate species) is extremely uncommon in areas not directly influenced by the warmer waters of the Gulf Stream (Haney 1987), and thought to be found in coastal waters of the U.S. only as a result of tropical storms (Lee 2000). Recent satellite tracking of a few birds, however, suggests possibly greater use of shelf waters than previously known, especially in the South Atlantic Bight (Jodice et al. 2015). The closest sightings are from northern New York waters, where five observations were reported in 2016 (see maps in **Appendix Q**).

Gannets, Cormorants, and Pelicans: Only one brown pelican was detected during the digital aerial survey. Since pelicans are rare in the area, and New Jersey is at the northern extent of their range, they will not be discussed in detail. Northern gannets use the OCS during winter and migration. Based on analysis of satellite-tracked northern gannets captured and tagged in the mid-Atlantic region, these birds show a preference for shallow, productive waters and are mostly found inshore of areas being considered for offshore wind energy in the mid-Atlantic during the winter (Stenhouse et al. 2017). The digital aerial surveys (NYSERDA 2018 and site-specific surveys conducted by Empire, see **Appendix P**) and MDAT models indicate that northern gannet exposure is low. However, individual tracking data indicates that the Lease Area is within a portion of the 50 percent core use area (i.e., high use areas) during fall migration. The double-crested cormorant is the most likely species of cormorant to be exposed to the Lease Area. The regional MDAT abundance models show that cormorants are concentrated close to shore and are not commonly encountered offshore, and few cormorants were observed within the Lease Area during the digital aerial surveys.

Gulls, Skuas, and Jaegers: There are 14 species of gulls, skuas, and jaegers that could be exposed to the Lease Area, all of which were observed in the digital aerial surveys (**Table 5.3-1;** see **Appendix P**). The regional MDAT abundance models show that these birds have a wide distribution ranging from near shore (gulls) to offshore (jaegers). Herring gulls and great black-backed gulls are resident in the region year-round, and are found further offshore outside of the breeding season (Winship et al. 2018). The jaegers are all Arctic breeders that regularly migrate through the western North Atlantic region. Parasitic jaegers are often observed closer to shore during migration than the other species (Wiley and Lee 1999) and great skuas may pass along the OCS outside the breeding season. The digital aerial survey data and MDAT models indicate that exposure for the gull group is generally minimal to low, depending upon the species and season; herring gulls and black-legged kittiwakes had higher exposure in the spring compared to other months.

Terns: Black tern, least tern, common tern, Forster's tern, roseate tern, and royal tern were observed in the digital aerial surveys (**Table 5.3-2)**; least tern, common tern, and unidentified tern were identified within the Lease Area in the spring. Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Lease Area during migration. Exposure is varied by species and season, but tern exposure is probably highest for migrating common terns and relatively low for other species, and common tern exposure is primarily in the spring (see maps in **Appendix Q**). The available information all indicates minimal exposure of roseate terns to the Lease Area during breeding or staging. Roseate terns have not been confirmed in the Lease Area, and none of the 145 roseate terns tracked with nanotags, from New York and Massachusetts breeding colonies, were estimated to pass through the Lease Area (Loring et al. 2019).

Table 5.3-2 Tern Listing Status

Taxonomic Group a/	Species	Federally Listed b/
Black tern	*Chlidonias niger*	
Least tern	*Sternula antillarum*	
Common tern	*Sterna hirundo*	
Forster's tern	*Sterna forsteri*	
Roseate tern	*Sterna dougallii*	E
Royal tern	*Thalasseus maximus*	

Notes:
a/ See **Appendix Q** for further details.
b/ E = Endangered

Auks: The auk species present in the region of the proposed Project are generally northern or Arctic-breeders that winter along the OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, and is dependent upon broad climatic conditions and the availability of prey (Gaston and Jones 1998). The MDAT abundance models during the winter show that auks are generally concentrated offshore, along the shelf edge, and southwest of Nova Scotia Based upon the digital aerial survey and the MDAT models, exposure was considered to be minimal to low (see **Appendix Q**).

5.3.1.2 Baseline Characterization: Onshore

EW 1: Habitats within and in the vicinity of the EW 1 Onshore Study Area are significantly altered by human development and are primarily used for industrial and commercial operations. The EW 1 area and surrounding vicinity serve as a transportation and service corridor and associated infrastructure is a dominant feature. Due to the mobility of birds, a variety of species have the potential to pass through the EW 1 Onshore Study Area. However, due to the highly developed nature of the EW 1 Onshore Study Area, the area does not provide important bird habitat for native species or species of conservation concern, with the exception of species that associate with coastal urbanized areas (e.g., pigeons, seagulls). The nearest Audubon Important Bird Area (IBA) is located approximately 1.5 mi (2.4 km) east of EW 1. This IBA (Prospect Park) supports a high diversity of migrant songbirds and is thought to be an important migratory stopover site for land birds (**Figure 5.3-5**, New York Audubon Society 2016).

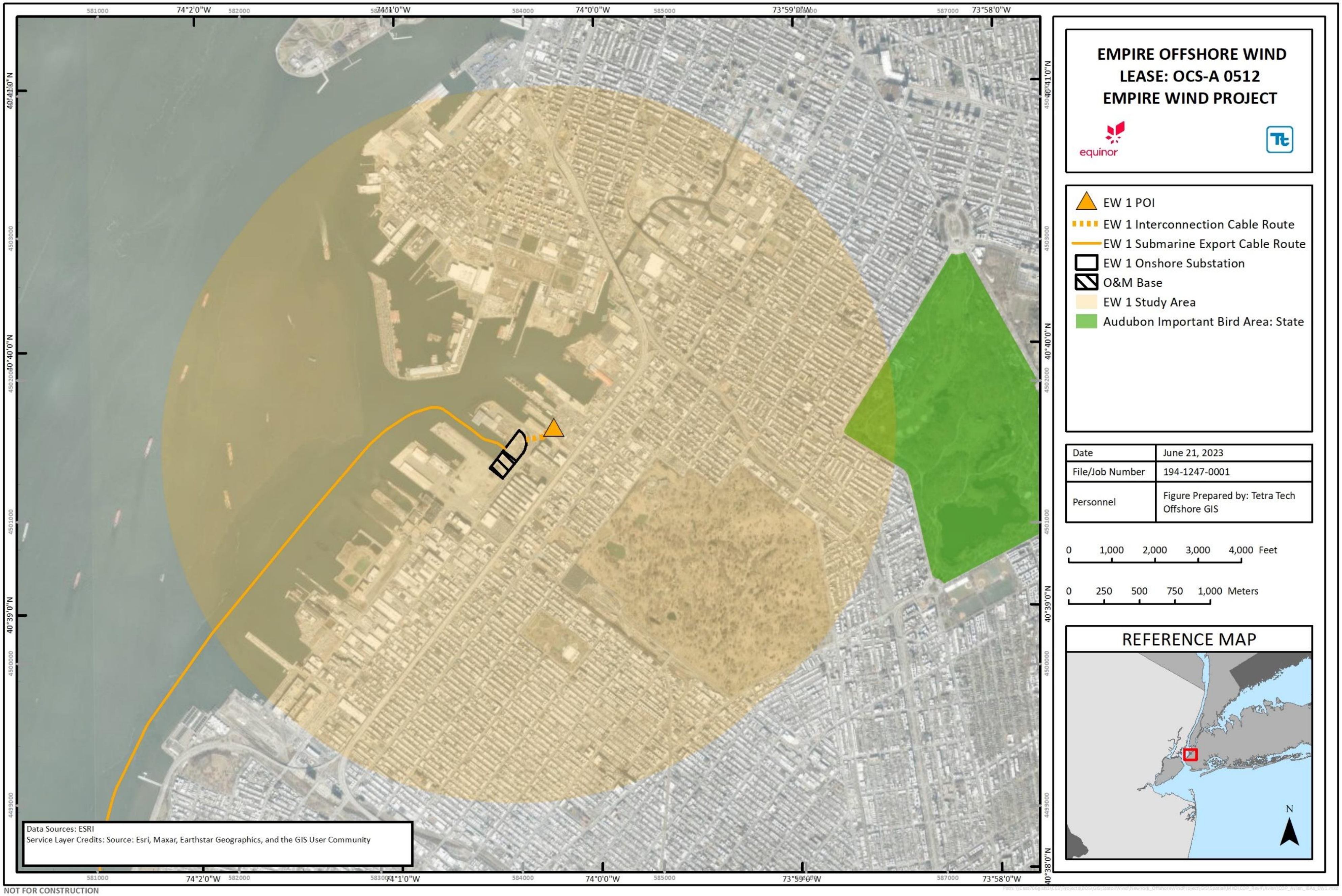

Figure 5.3-5 Audubon IBAs in the Vicinity of the EW 1 Avian Species Onshore Study Area

EW 2: Habitats within and in the vicinity of the EW 2 Onshore Study Area are significantly altered by human development. Natural habitat is minimal, as the landscape is highly characterized by residential and commercial development and only provides edge habitat for common urban birds. This area serves as a transportation and service corridor and associated infrastructure is a dominant feature. Portions of the Oceanside POI parcel are characterized by upland forested land and scrub shrub, which could provide habitat for songbirds, and is bordered by commercial and residential developments. The proposed EW 2 Onshore Substation C site occurs in a highly developed area bordered by commercial and residential developments. Only a small portion of the site contains vegetation, which may be cleared during construction of the site. Although undeveloped areas onsite may have the potential to provide some habitat for certain species of birds, this area is not expected to be important habitat for any species. While numerous tidal creeks and impoundments drain into the south shore bays and associated salt marshes, these areas have been highly impacted from activities such dredging, mosquito control ditching, erosion, and removal of fill for development. Coastal habitats consist of barrier beaches developed for tourism and recreational use. Long Beach is sandy with no vegetation and could provide habitat for common marine bird species (e.g., gulls), while Lido Beach includes vegetated dunes that provide nesting habitat to various coastal nesting species, including piping plovers and least terns. While piping plovers may pass through the area during migration and post-breeding dispersal, Long Beach is unlikely to provide important breeding habitat for plovers because it is highly developed. The landfall sites are located in a paved parking area site, directly adjacent to commercial areas and existing roadways. Piping plover nests on Lido Beach are actively monitored, and 26 chicks were fledged from 14 pairs in 2018 (Dazio 2018). The EW 2 Onshore Study Area is surrounded by the West Hempstead Bay/Jones Beach West IBA, a global-IBA; the IBA does not include the islands of Long Beach and Island Park, however. A global IBA, this area has over 60 recorded species known to occur, with known breeding of the piping plover and short-eared owl (National Audubon Society 2018). The eBird (2019) database indicates that a variety of bird species are present within 9.3 mi (15 km) of the EW 2 Onshore Study Area. Since the area is highly developed, the birds mostly likely to be present are common coastal, urban (some introduced), and upland species. The birds most likely to be exposed to the EW 2 Landfall A and EW 2 Landfall B sites would include gulls, geese, dabbling ducks, and cormorants, while some coastal nesting species such as piping plover and least tern may be exposed at the EW 2 Landfall C site. Upland species are likely to include European starling, house sparrow, song sparrow, and mockingbird. Portions of the Oceanside POI parcel exhibit small, wooded areas that may be disturbed during cable installation and may also support common upland species such as downy woodpecker, American goldfinch, and black-capped chickadee. While piping plovers may pass through the area during migration and post-breeding dispersal, Long Beach is unlikely to provide important breeding habitat for plovers because it is highly developed and lacks vegetation. Lido Beach consists of vegetated dune habitat that provides nesting habitat to various coastal bird species, including piping plovers and least terns. The beach areas and inland waterways are identified as a global IBA (**Figure 5.3-6**).

Avian species recorded in the last 10 years in the eBird dataset within 9.3 mi (15 km) of the EW 2 Onshore Study Area include species listed by the federal government as Endangered, Threatened, and Birds of Conservation Concern, and by the state of New York as Endangered, Threatened, or Special Concern (including the piping plover, red knot, and roseate tern). In the eBird (2019) database there are 23 species listed as high priority species, five of which are state-listed (see **Table 5.3-3** for a full list). The listed species that occur in upland habitats (i.e., peregrine falcon and short-eared owl) are not likely to be present because available habitat, including the wooded parcel adjacent to the Oceanside POI, is located in an urban developed area. It is possible that the federally listed coastal species (e.g., terns) may pass through the beach areas at the cable landfall site during migration (see the **Section 5.3.1.1**, and **Appendix Q** for additional information on red knot and roseate tern).

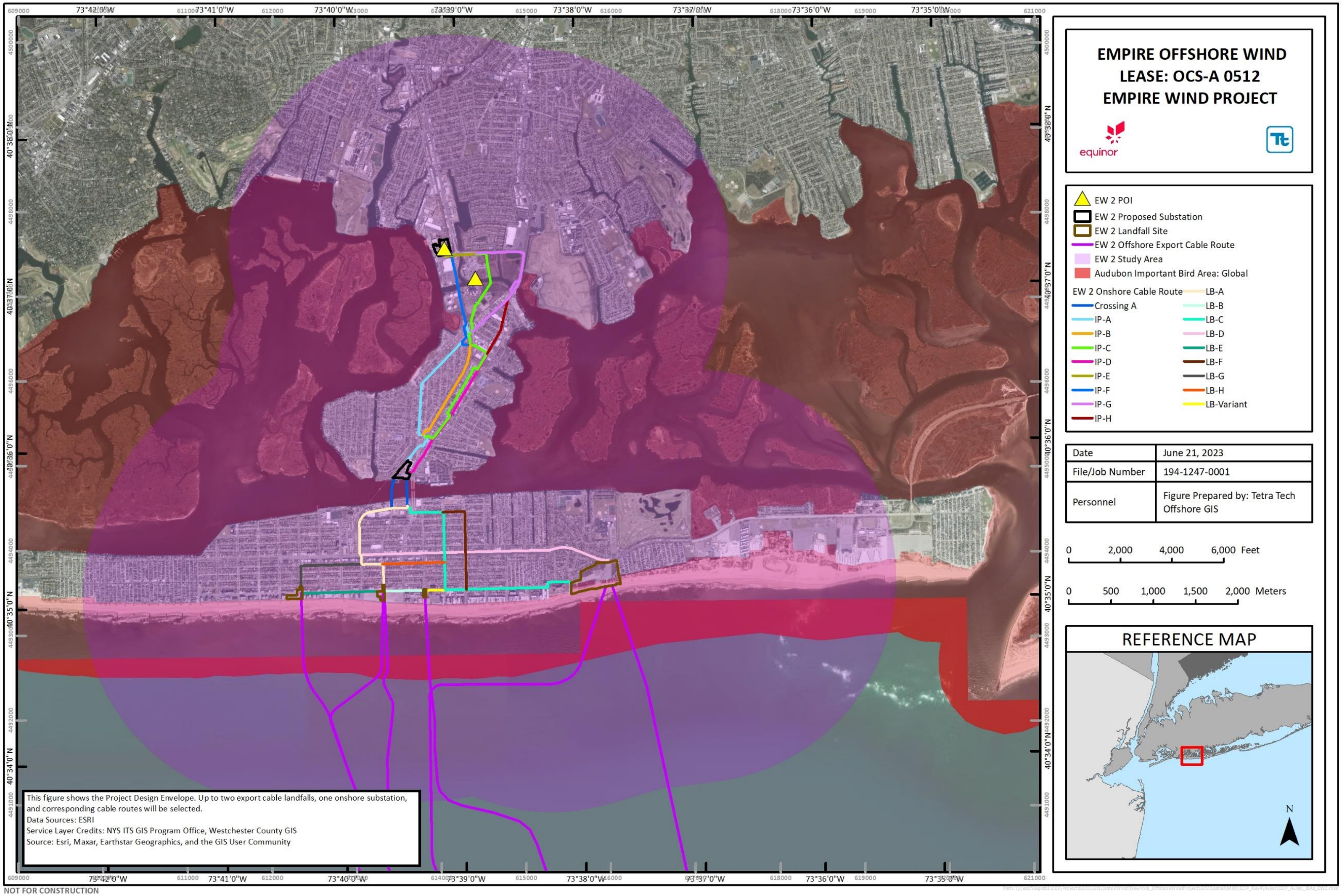

Figure 5.3-6 Audubon IBAs in the Vicinity of the EW 2 Avian Species Onshore Study Area

Table 5.3-3 New York State-Listed Species Recorded in the Last 10 Years Within 9.3 mi (15 km) of the EW 2 Onshore Study Area

Species	Scientific Name	eBird Count	NY Listed a/	Fed. Listed a/	Habitat
Piping plover	*Charadrius melodus*	841	E	T	Aquatic
Black tern	*Chlidonias niger*	134	E		Aquatic
Roseate tern	*Sterna dougallii*	111	E	E	Aquatic
Peregrine falcon	*Falco peregrinus*	2,982	E		Upland
Short-eared owl	*Asio flammeus*	33	E		Upland

Source: eBird 2019

Note:
a/ T=Threatened; E = endangered.

5.3.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For avian species, the maximum design scenario is the full build-out of both the offshore and onshore components, as described in **Table 5.3-4**. The maximum design scenario for assessments associated with full build-out of EW 1 and EW 2 incorporates a total of up to up to 149 foundations at any of 176 locations within the Lease Area (made up of up to 147 wind turbines and 2 offshore substations) with two submarine export cable routes to EW 1 and EW 2 and the associated onshore structures. This design concept also incorporates the full build-out of onshore structures, including the onshore export and interconnection cable routes, onshore substations, and O&M Base.

Table 5.3-4 Summary of Maximum Design Scenario Parameters for Avian Species

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum number of structures for EW 1 and EW 2.
Duration Offshore construction	Based on full build-out of EW 1 and EW 2. EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum period required to install the offshore components, which has the potential to have Project-related vessels and associated lighting in the Project Area.
Onshore substations	Based on EW 1 and EW 2. EW 1: 10.8-ac (4.4-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation(s).

Table 5.3-4 Summary of Maximum Design Scenario Parameters for Avian Species (continued)

Parameter	Maximum Design Scenario	Rationale
O&M Base	6.5-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the O&M Base.
Staging and construction areas, including use of port facilities, temporary mooring, work compounds and lay-down areas	Based on EW 1 and EW 2. Maximum number of work compounds and lay-down areas required. Ground disturbing activities are not anticipated. Independent activities to upgrade or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.
Operations and Maintenance		
Wind turbines	Based on full build-out of EW 1 and EW 2 (176 wind turbines). EW 1: 57 wind turbines. EW 2: 90 wind turbines.	Representative of the maximum number of wind turbines, which will result in the greatest overall total rotor swept area and potentially increase risks of collision mortality and displacement.
Project-related vessels	Based on full build-out of EW 1 and EW 2, which correspond to the maximum amount of structures (147 wind turbines and 2 offshore substations), submarine export and interarray cables, and maximum associated vessels.	Representative of the maximum predicted Project-related vessels, which has the potential to increase attraction of avian species offshore and result in disturbance.
Onshore substations	Based on EW 1 and EW 2. EW 1: 4.8-ac (3.6-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the presence of a new structure in an area where there was previously none.
O&M Base	4.5-ac (1.8-ha) area.	Representative of the presence of a new structure in an area where there was previously none.

5.3.2.1 Construction

During construction, the potential impact-producing factors to avian species may include:

- Construction of the onshore components, including the onshore export and interconnection cables, export cable landfalls, onshore substations, and O&M Base;
- Staging and construction activities and assembly of Project components at the applicable facilities and/or areas; and
- Construction of the offshore components, including installation of foundations, wind turbines, offshore substations, and submarine export and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Short-term increased attraction to Project-related vessels, equipment, and/or components;
- Short-term disturbance of offshore foraging habitat and prey species;
- Short-term alteration of terrestrial habitat; and
- Short-term disturbance and displacement.

Attraction to Project-related vessels, equipment, and/or Project components: During construction activities, avian species may be attracted to construction equipment, Project components, and/or vessel lighting. Risk of increased collision risk and light entrapment due to lighting during nighttime construction activities is considered to be temporary (Fox and Petersen 2019). Empire proposes to implement measures to limit lighting not required by the FAA and the USCG, or for safety, during construction to reduce attraction for birds. Such measures may include downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent safe and practicable.

Disturbance of foraging habitat and prey species: During construction, there may be temporary disturbance of sediment during submarine export cable and interarray cable installation. As the disturbance will be confined to a relatively small area, permanent loss of foraging habitat for seabirds is not anticipated. In addition, construction and installation activities may temporarily disturb prey species. As this disturbance will be temporary and localized, and prey species are expected to return, this impact is expected to be negligible (see **Section 5.5** for additional information).

Terrestrial habitat alteration: During construction, the onshore export and interconnection cables and onshore substations for EW 2 will require varying acreage of tree removal. To minimize disturbance, the majority of the proposed onshore export and interconnection cable routes were sited in already disturbed areas. Tree clearing is expected for construction of a portion of the EW 2 Routes IP-C and IP-E through the Oceanside POI parcel, and minimal tree clearing is possible at the EW 2 Onshore Substation C site. No tree clearing is expected for the EW 1 onshore substation, EW 2 Onshore Substation A, or the O&M Base. Impacts to the nearshore and beach habitats will be avoided and minimized to the extent practicable through the use of HDD for the export cable landfall associated with EW 2, where feasible. Tree clearing and habitat alteration is not anticipated to be required for EW 1 due to the highly developed nature of the onshore area and lack of natural vegetation. Empire also proposes to site all onshore components in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat and/or ROWs to the extent practicable. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities; Empire will comply with applicable permitting standards to limit environmental impacts from Project-related activities.

Disturbance and displacement: During construction, bird species may be temporarily displaced from nesting or foraging habitat due to noise, vibrations, and general human activity, even if permanent habitat alteration is not experienced. Birds are expected to return to the area once construction is complete in areas where habitat alteration is minor and/or temporary. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities; Empire will comply with applicable permitting standards to limit environmental impacts from Project-related activities. In order to further minimize disturbance and displacement of birds onshore, Empire will adhere to time of year restrictions, as necessary, in sensitive onshore bird habitats, where feasible and required. In addition, Empire proposes to implement the following measures to avoid, minimize, and mitigate these potential impacts:

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat and/or ROWs to the extent practicable; and
- Lighting not required during construction will be limited, as appropriate, to peak exposure and subject to other receptor and user requirements, to reduce attraction of avian species.

5.3.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to avian species may include:

- Presence of new permanent structures offshore (i.e., wind turbines and offshore substations);
- Operations and maintenance activities associated with the offshore components of the Project Presence of new permanent structures onshore (i.e., onshore substations and O&M Base); and
- Operations and maintenance activities associated with the onshore export and interconnection cables and onshore substations.

With the following potential consequential impact-producing factors:

- Long-term increased risk of collision with wind turbines;
- Long-term increased risk of attraction to and collision with offshore substations;
- Long-term displacement from the wind farm area;
- Attraction to or displacement from offshore operations and maintenance vessels; and
- Long-term conversion of terrestrial habitat.

Attraction to and collision with wind turbines: During operations, birds have the potential to collide with the wind turbines, resulting in mortality. The lighting associated with wind turbines and offshore substations may also result in attraction of birds and increased risk of collision (Montevecchi 2006) or mortality resulting from exhaustion associated with light entrapment (USFWS 2018c). For most bird species, collision fatalities from wind turbines are considered to pose a low risk to populations (Allison et al. 2019). The level of risk varies, however, based on the species and associated use of the Offshore Study Area. The level of risk is based on both spatial and temporal components. Spatially, birds are exposed on the horizontal (i.e., habitat area) and vertical planes (i.e., flight altitude). Temporally, bird exposure is dictated by a species' life history and may be limited to breeding, staging, migrating, or wintering. Therefore, to be at risk of potential collision or attraction effects, a bird must be both exposed to an offshore wind development and be vulnerable to either displacement or collision (Goodale and Stenhouse 2016).

The Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Coastal birds that may forage in the Lease Area occasionally, visit the area sporadically, and/or pass through on their spring and/or fall migrations include shorebirds (e.g., sandpipers, plovers), waterbirds (e.g., grebes), waterfowl (e.g., scoters, mergansers), wading birds (e.g., herons, egrets), raptors (e.g., falcons, eagles), and songbirds (e.g., warblers, sparrows). Overall, with the exception of migratory falcons and songbirds, coastal birds are considered to have minimal exposure (occurrence) to the Lease Area. Falcons, primarily peregrine falcons, may be exposed to the Lease Area during migration. However, uncertainty exists about what proportion of migrating peregrine falcons might be attracted to offshore wind energy projects for perching, roosting, and foraging, and the extent to which individuals might avoid turbines or collide with them. Some migratory songbirds may also be exposed to the Lease Area during migration periods, but population level impacts are unlikely because exposure to the Lease Area is expected to be minimal to low and limited in duration.

Of the marine species with potential exposure to the Project, multiple species were documented in the Lease Area. Loons were documented during all seasons, though collision risk and exposure to the Lease Area are low. Loons are consistently identified as vulnerable to displacement due to strong avoidance behaviors. Sea ducks are documented in the area primarily during fall and winter, though exposure is minimal to low given the distance from shore. Sea ducks are generally not considered vulnerable to collision as they primarily fly below the rotor swept zone (RSZ). Sea ducks, particularly scoters, have been shown not be vulnerable to displacement, though this has been shown to be temporary for some species. Seabirds such as petrels, shearwaters, and storm-petrels are expected to have minimal exposure to the Lease Area as they are typically found much further offshore and usually only during the summer. Collision risk is considered low, though some reported attraction to artificial light sources (particularly in poor visibility) could increase risk at times. These species are ranked low for displacement vulnerability. Gannets were documented primarily during winter and migration. Exposure is considered low, though the Lease Area does occur within a 50 percent core use area during fall migration based on tracking data. Collision risk is low, in part due to reported strong avoidance behavior. Strong avoidance behavior also indicates a high vulnerability to displacement, though there is little information suggesting permanent displacement. Cormorant exposure is considered minimal to low due to few observations within the lease area, though cormorants are considered vulnerable to collision due to reported attraction to wind turbines, and thus at low risk for displacement. Jaeger and gull exposure is minimal to low. Gulls rank at the top of collision vulnerability because they often fly within the RSZ, have been documented to be attracted to turbines, and have been reported to collide with turbines. Gulls are not considered vulnerable to displacement. Terns were documented during all seasons except winter, with the highest levels occurring during the spring season. The most frequently documented tern species was the common tern. Terns will be most exposed during spring migration and are considered to have low collision vulnerability because they are generally thought to fly below the RSZ. Auk exposure to the Lease Area is minimal to low and are generally not considered vulnerable to collision as they primarily fly much lower than the RSZ. Auks are considered vulnerable to displacement due to sensitivity to disturbance from boat traffic and high habitat specialization (see **Table 5.3-5** and **Appendix Q** for additional information). While the MDAT models predict high winter use of the Lease Area by common murre, exposure of all auk species combined at a population level is considered to be minimal to low when the MDAT models and APEM surveys are assessed together. Generally, auks are not considered vulnerable to collision as they primarily fly much lower than the RSZ.

Bald and golden eagle, and Federally listed bird species, which include red knot, piping plover, and roseate tern, and the black-capped petrel, which is a candidate species, were also assessed. The Project is not expected to pose substantial risk to any of these species. Eagle exposure to the Lease Area is considered minimal because these species are rarely detected in the offshore environment. Red knots and piping plovers have the potential to be exposed only during migration and vulnerability to collision is considered minimal to low because shorebirds generally fly substantially above the RSZ during migrations. Additionally, though displacement for red knots and piping plovers is not well studied, avoidance behavior is not likely to lead to habitat loss in the offshore environment. Black-capped petrel exposure is considered minimal because this species is primarily found on the shelf break, which is well offshore of the Lease Area. Roseate tern exposure is considered to be minimal to low because roseate terns have not been detected in the Lease Area, are rare in the Offshore Study

Area, and would only potentially pass through the Lease Area during migration. While displacement in terns has not been well studied, some studies have reported moderate to high avoidance rates of turbines, though uncertainty in these studies is high. As such, terns are generally not considered vulnerable to displacement.

Potential impacts to birds are summarized by species group in **Table 5.3-5**; additional information can be found in **Appendix Q**. Wading birds and coastal water birds are not discussed in detail because they are expected to have minimal exposure.

Table 5.3-5 Summary of Potential Impacts to Avian Species from Collision and/or Displacement

Taxonomic Group/Species	Summary of Potential Impacts
Listed Species	
Piping plover	The exposure of piping plovers to the Lease Area will be limited to migration, they have minimal to low vulnerability to collision, and there is no evidence of vulnerability to displacement; for these reasons, individual level impacts during operations are unlikely.
Red knot	The exposure of red knot to the Lease Area will be limited to migration, they have low vulnerability to collision, and there is no evidence of vulnerability to displacement; for these reasons, individual level impacts during operations are unlikely.
Roseate tern	Potential impacts to individual roseate terns from collision are unlikely because these birds have minimal to low exposure, which would be limited to migratory periods.
Golden eagle	The exposure of golden eagles to the Lease Area is expected to be minimal due to their limited distribution in the eastern U.S., and reliance on terrestrial habitats.
Bald eagle	The exposure of bald eagles to the Lease Area is expected to be minimal because the Lease Area is not located along any likely or known bald eagle migration route, and they tend not to fly over large waterbodies at such a large distance from shore.
Taxonomic Groups	
Shorebirds	There is little to no evidence that migratory shorebirds are displaced by offshore wind farms during migration. Given minimal exposure, shorebird collisions are expected to be rare or nonexistent, and unlikely to adversely affect the populations.
Raptors	Population level impacts to falcons are unlikely because falcons have low exposure.
Songbirds	Population-level impacts to songbirds are unlikely because, while these birds have low to medium vulnerability to collision, they have minimal to low exposure, both spatially and temporally.
Loons	The potential impacts to loon populations are unlikely because these birds are considered to have minimal to low exposure, both spatially and temporally.

Table 5.3-5 Summary of Potential Impacts to Avian Species from Collision and/or Displacement (continued)

Taxonomic Group/Species	Summary of Potential Impacts
Sea ducks	Potential impacts to sea duck populations are unlikely because, while they are vulnerable to displacement, these birds have minimal to low exposure, both spatially and temporally.
Petrel group	The potential population level impacts to the petrel group are highly unlikely because, overall, these birds have minimal spatial exposure. For the black-capped petrel, an ESA candidate species, individual level impacts are unlikely because few individuals are expected to enter the Lease Area and the birds likely fly below the RSZ.
Gannets	The potential impacts to the northern gannet population are unlikely because these birds have low exposure, both spatially and temporally.
Cormorants	There is little evidence to suggest cormorants will be displaced by offshore wind farms and cormorants are considered to have low vulnerability to displacement. Potential impacts to cormorant populations are unlikely because these birds have minimal to low exposure and robust populations.
Gulls, skuas, & jaegers	Potential impacts to gull, skua, and jaeger populations is unlikely due to their minimal to low exposure. Across all species, collision and displacement vulnerability is considered to be low to medium.
Terns	Potential impacts to tern populations are unlikely given tern exposure to the Lease Area is primarily limited to spring migration and terns generally fly below the RSZ.
Auks	Potential impacts to auk populations are unlikely because they have minimal to low exposure. Collision vulnerability is considered minimal; and displacement vulnerability is considered medium to high, depending on the species.

Long-term increased risk of attraction to and collision with offshore substations: During operations and maintenance activities, birds may be attracted to offshore substations. Lighting on offshore substations may attract birds, particularly during poor visibility conditions. However, lights are not expected to cause long-term adverse effects because, to the extent practicable, lighting will be minimized, which will reduce the potential for collisions. Empire proposes to implement measures to limit lighting that is not required by the FAA and the USCG during construction to reduce attraction for birds. Such measures may include downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent safe and practicable. Thus, impacts associated with attraction to or collision with offshore substations are expected to be minimal.

Long-term displacement from the wind farm area: Species such as sea ducks, loons, gannets, terns, and auks have been documented showing varying degrees of avoidance behavior suggesting vulnerability to displacement. Existing literature is varied, though overall lacking, in determining the temporal extent of such displacement, with species such as scoters potentially exhibiting short-term displacement from offshore wind farms, and other species like red-throated loons demonstrating what may be long-term or permanent displacement from some European wind areas. Overall, while there is uncertainty on the effects of displacement on individual fitness, the impacts of displacement from individual offshore wind farms are considered to be insignificant at the population level (Fox and Petersen 2019).

Attraction to or displacement from Project-related vessels: During operations and maintenance activities, birds may be attracted to equipment and/or vessel lighting. Maintenance vessels may temporarily attract or displace birds, but are not expected to cause adverse effects (BOEM 2018). Thus, impacts associated with attraction to or displacement from Project-related vessel and equipment is expected to be minimal. However, Empire intends to install bird deterrent devices, where appropriate, on offshore, above-water structures to minimize the introduction of perching structures to the offshore environment.

Conversion of terrestrial habitat. Naturally vegetated lands, including woody wetlands and deciduous forest, may be converted to support permanent Project structures, such as onshore substations, throughout the lifetime of the Project. The impacts of habitat alteration are discussed in detail in the construction section, and are expected to be negligible for EW 1, EW 2 Onshore Substation A, and the O&M Base. Temporarily disturbed areas will be revegetated with appropriate native seed mix and native tree species, as needed, to minimize impacts.

5.3.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.3.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.3.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in Section 5.3.2, Empire is proposing to implement the following avoidance, minimization, and mitigation measures.

5.3.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.3.2.1:

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat and/or ROWs to the extent practicable;
- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction of avian species;
- Installation of bird deterrent devices, where appropriate, on offshore, above-water Project-related vessels and structures to minimize introduction of perching structures to the offshore environment;
- Lighting not required by the FAA and the USCG, and for safety, during offshore construction will be limited to reduce attraction of birds, where practicable;
- An annual report will be submitted to DOI and USFWS by January 31, accounting for any dead or injured birds found on vessels or Project structures during construction, O&M, and decommissioning. The following information will be included: species name, date found, location, photo (if available), other relevant infromation. Any carcasses that have federal or research bands will be reported to the U.S. Geological Survey Bird Band Laboratory, BOEM, and USFWS; and
- The development and enforcement of an OSRP (**Appendix F**).

In addition, during construction, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.3.2.1:

- Consideration of the use of HDD for installation of the export cable landfalls at EW 2 to avoid surficial disturbances.

5.3.3.2 Operations and Maintenance

During operations, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.3.2.2:

- Development of an offshore monitoring program to answer specific questions, including identifying key species of interest, and when possible, to contribute to the understanding of long-term, Project-specific impacts and larger scale efforts to understand cumulative impacts;
- Implement an Avian and Bat Post-Construction Monitoring Plan in coordination with the USFWS;
- Temporarily disturbed areas will be revegetated with appropriate native species at EW 2, as appropriate. This is not anticipated to be required at EW 1 due to the highly developed nature of the onshore area and lack of natural vegetation;
- Offshore lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction and possibly collision of birds at night;
- Use an FAA-approved ADLS on wind turbines and offshore substations, which will only activate the FAA hazard lighting when an aircraft is in the vicinity of the wind facility, to reduce the visibility of nighttime lighting and nighttime visual impact; and
- The development and enforcement of an OSRP (**Appendix F**).

In addition, during operations, will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.3.2.2:

- Bird deterrent devices will be maintained where appropriate on offshore, above-water Project-related vessels and structures to minimize introduction of perching structures to the offshore environment.

5.3.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in Section 5.3.2.1 and Section 5.3.2.2. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.3.4 References

Table 5.3-6 Data Sources

Source	Includes	Available at	Metadata Link
APEM	Avian Observations	https://remote.normandeau.com/ewind_overview.php	N/A
Audubon	IBAs	https://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Polygon/MapServer	N/A
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
Marine Geospatial Ecology Labs/Duke University	MDAT All Birds Group Abundance	http://seamap.env.duke.edu/models/mdat/	http://seamap.env.duke.edu/models/mdat/Avian/MDAT_Avian_Summary_Products_Metadata.pdf
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A

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5.4 Bat Species

This section includes information on bat species known or expected to occur in the Project Area. Potential impacts to bat species resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Empire are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to bat species.

Other resources and assessments detailed within this COP that are related to bat species include:

- Terrestrial Vegetation and Wildlife (Section 5.1);
- 2018 Bat Survey Report (Appendix R); and
- Bat Impact Assessment (Appendix S).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area is discussed from the perspective of the offshore and onshore portions of the Project, each of which present different habitats and risk considerations for bats. The Study Area for the offshore components includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the EW 1 and EW 2 submarine export cable routes (Offshore Study Area; see **Figure 5.4-1**). The Study Area for the onshore components consists of a 1.5-mi (2.4-km) buffer around the EW 1 and EW 2 onshore export and interconnection cable routes, onshore substation parcels, and O&M Base (Onshore Study Area; see **Figure 5.4-2** and **Figure 5.4-3**)[6].

This section is based on existing available data sources and an offshore bat acoustic survey conducted in the Offshore Study Area from May 29 to December 2, 2018. The offshore acoustic survey was a baseline characterization and species inventory study, in which acoustic bat data was collected from a 200-ft [61-m] geophysical research vessel (*RV Ocean Researcher*) operating in the Lease Area. Results of this survey are provided in **Appendix R 2018 Bat Survey Report**.

5.4.1 Affected Environment

The affected environment is defined as the offshore and onshore areas where bat species are known to be present, traverse, or incidentally occur, and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

[6] While the O&M Base will serve both EW 1 and EW 2, the facility will be located at SBMT, adjacent to the EW 1 onshore substation, and will therefore be included within the EW 1 Onshore Study Area for the purposes of this analysis.

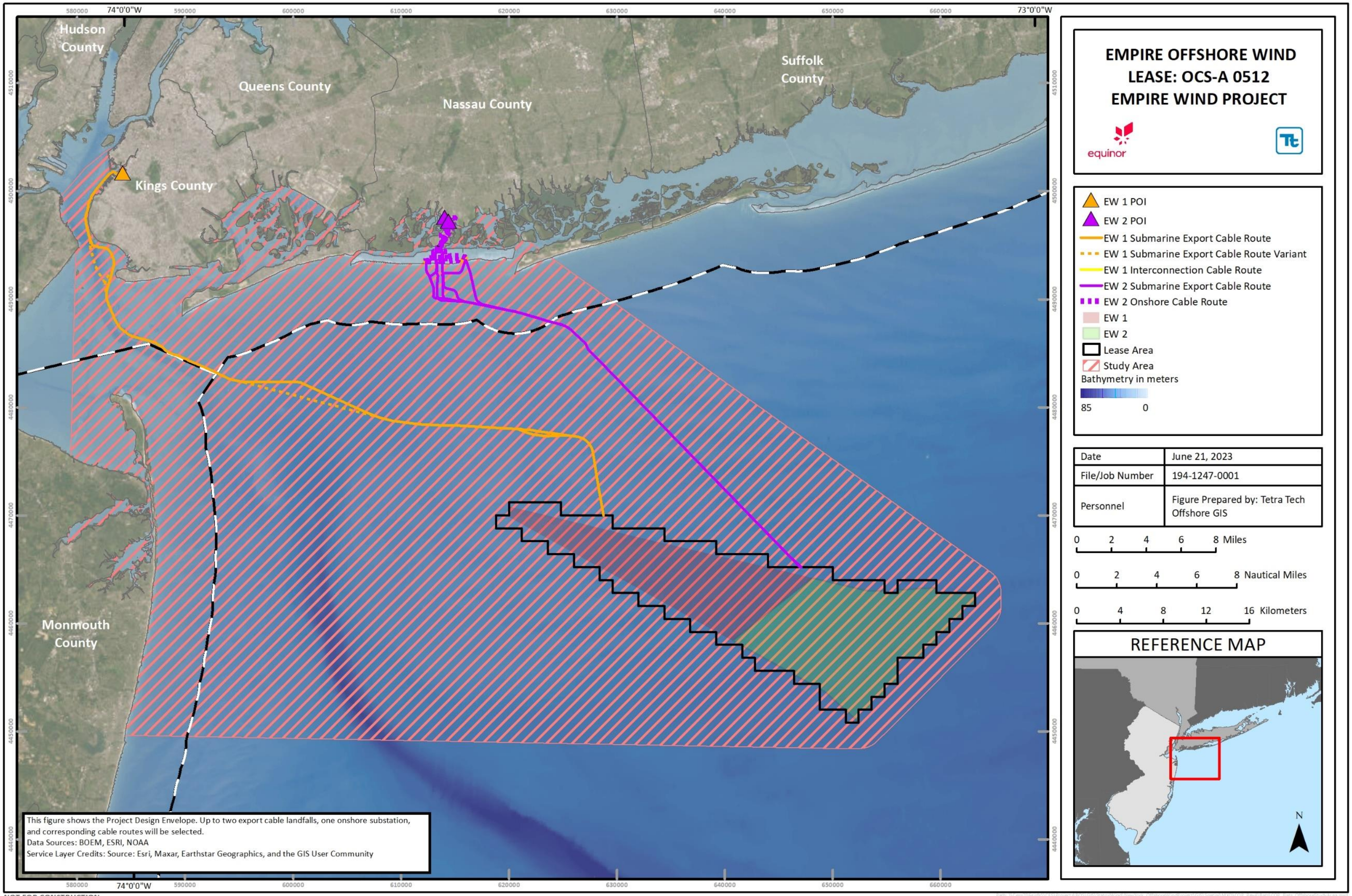

Figure 5.4-1 Bat Species Offshore Study Area

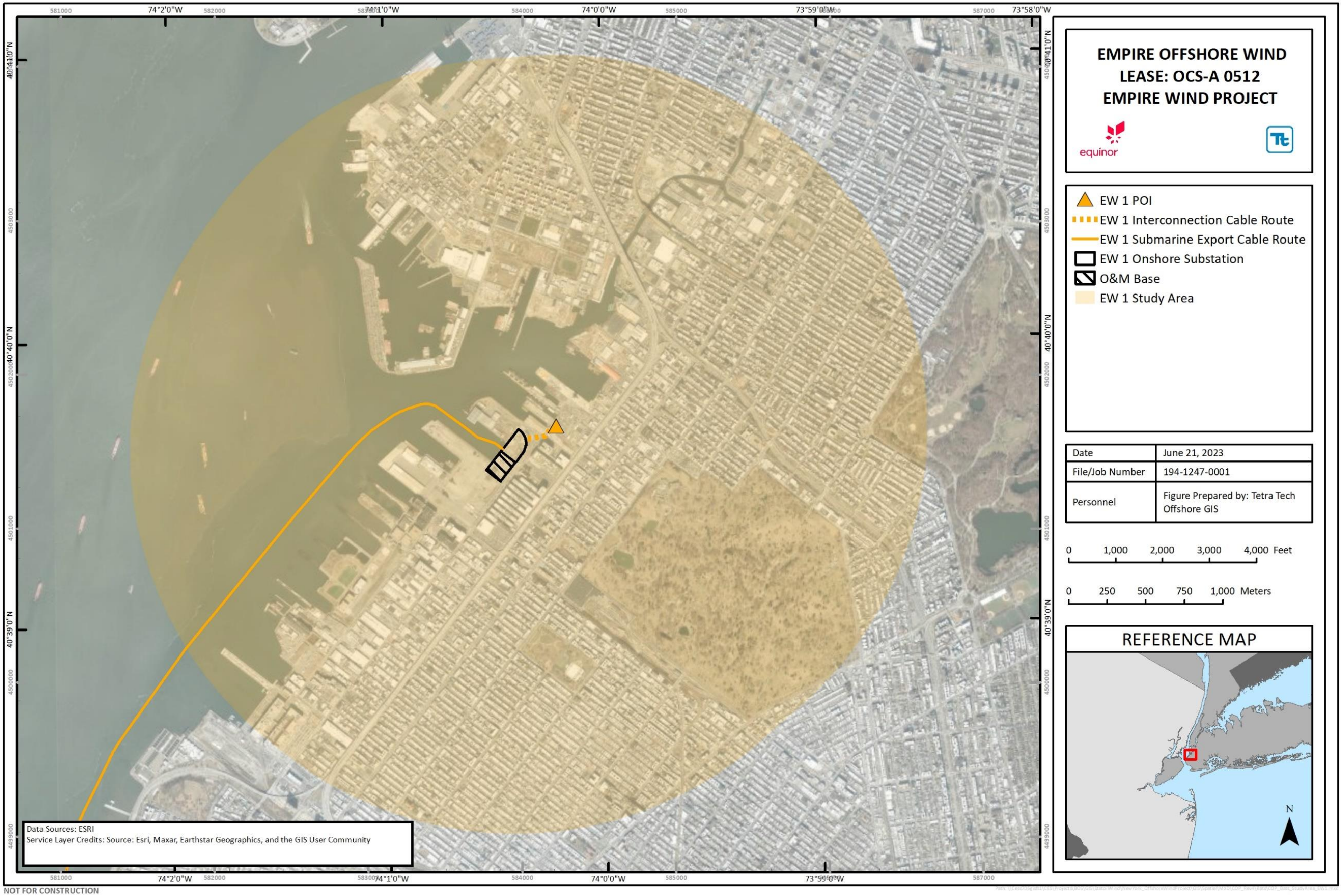

Figure 5.4-2 EW 1 Bat Species Onshore Study Area

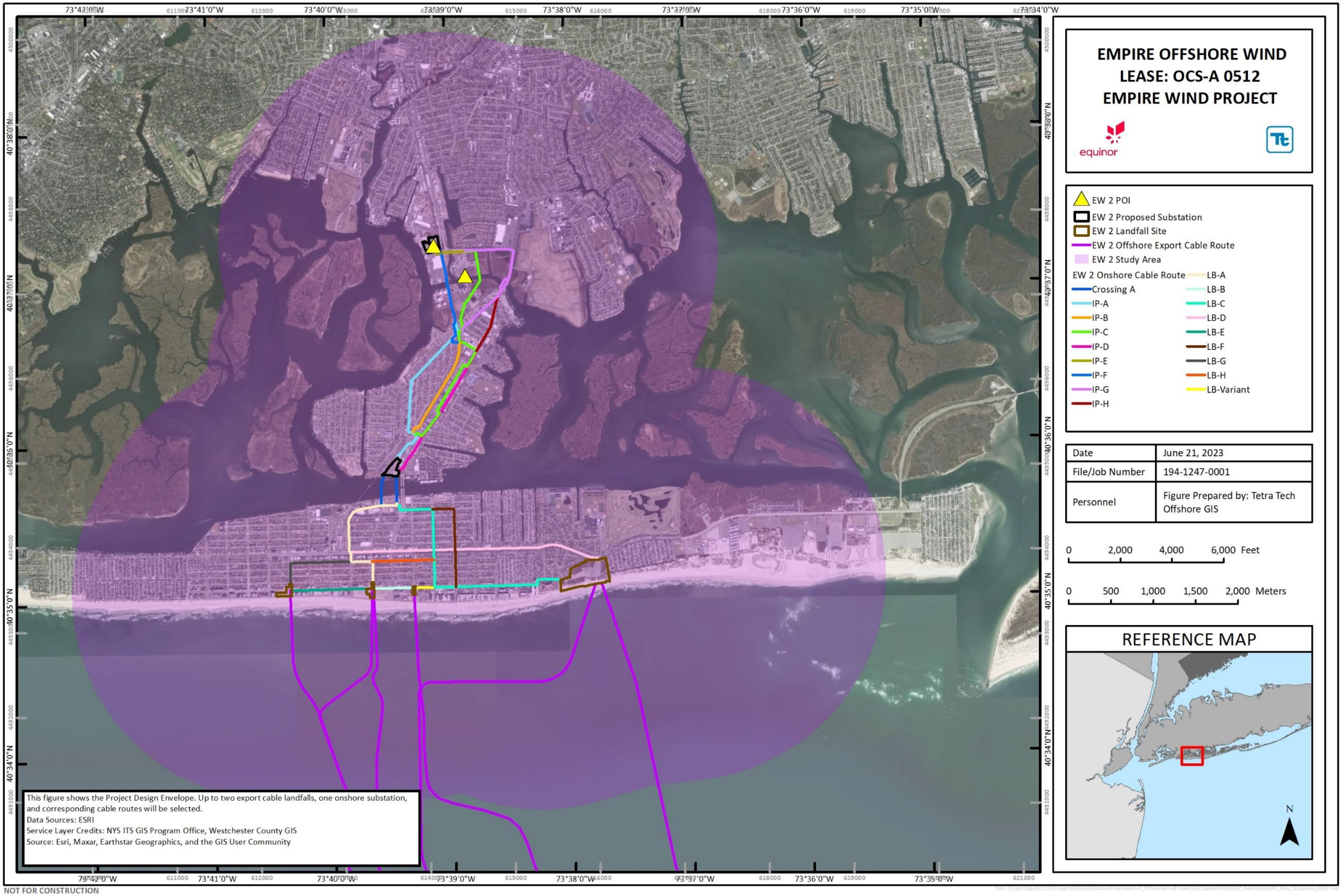

Figure 5.4-3 EW 2 Bat Species Onshore Study Area

5.4.1.1 Baseline Characterization

Bat species within the Project Area can be categorized into two major groups based on their wintering strategy; cave-hibernating bats and long-distance migratory tree bats. Long-distance migrators are at higher risk of collision with operating turbines during migration, while cave hibernating bats are at higher risk of displacement by onshore habitat alterations. Both groups of bats are nocturnal insectivores, active during March to November, and occur in forested and open land habitats. Cave-hibernating bats are non-migratory or migrate regionally between summer breeding habitat and winter hibernacula (typically a cave) in the northeastern U.S., and are generally not observed offshore (over 3.5 mi [5.6 km] from shore). Cave hibernating bats known to occur in the northeastern U.S. include big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), Indiana bat (*Myotis sodalis*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*). As the northern long-eared bat and the Indiana bat are both federally and state (New York) protected, these species are discussed in Section 5.4.1.4, Section 5.4.1.5, and Section 5.4.1.6. Long-distance migratory tree bats known to occur in the northeastern U.S. include eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). Rather than hibernating in the winter months, these species fly to the southern parts of the United States and Mexico (Cryan 2003), and have been observed offshore during fall migration and summer.

Of the nine species of bats present in New York and New Jersey, eight are known to occur in the Study Areas and could be exposed to Project development (BCI 2018; **Table 5.4-1**).

Table 5.4-1 Bat Species that May Occur in the Study Area

Common Name	Scientific Name	Winter Strategy	Confirmed Presence in the Lease Area
Big brown bat	*Eptesicus fuscus*	Cave hibernating	Yes
Eastern small-footed bat	*Myotis leibii*	Cave hibernating	No
Little brown bat	*Myotis lucifugus*	Cave hibernating	No
Northern long-eared bat	*Myotis septentrionalis*	Cave hibernating	No
Tri-colored bat	*Perimyotis subflavus*	Cave hibernating	No
Eastern red bat	*Lasiurus borealis*	Long-distance migratory	Yes
Hoary bat	*Lasiurus cinereus*	Long-distance migratory	No a/
Silver-haired bat	*Lasionycteris noctivagans*	Long-distance migratory	Yes

Sources: BCI 2018; **Appendix R**

Notes:
a/ Presence was confirmed offshore during 2018 Acoustic Bat Survey, but outside the Lease Area (see Appendix R for additional information).

5.4.1.2 Cave Hibernating Bats

Onshore

Cave-hibernating (regionally migratory) bat species hibernate in caves, mines, and other structures, and feed primarily on insects in terrestrial and freshwater habitats. Bat active periods extend from April 1 to October 31 and maternity roosting periods extend from June 1 to July 31. During the summer, cave-hibernating bats roost under bark, in tree crevices, and foliage of both dead and live trees, and forage within forests, along forest edges, forest openings, and in riparian areas (Harvey et al. 2011). Within the Onshore Study Area, big brown bats are the most likely cave-hibernating bat to be present, due to their large population and ability to co-exist in buildings and disturbed areas (NYSDEC 2019a). In areas of suitable summer roosting habitat (i.e., forest) located in proximity to hibernacula, other species may occur. A summary of the likelihood for cave-hibernating bat species to occur along each onshore export and interconnection cable route and onshore substation parcel is described below.

EW 1: The EW 1 interconnection cable route and onshore substation is highly developed with no forested habitat (**Figure 5.4-4**). The closest forest is Green Wood Cemetery, approximately 0.6 mi (1 km) to the east and consists of 450 ac (182 ha) of mowed fields and intermittent trees. Prospect Park, located approximately 1.9 mi (3 km) to the east, consists of 550 ac (223 ha) of forest, fields, and Prospect Park Lake. Some species of bats, such as the big brown bat, will hibernate in buildings and manmade structures. However, without surrounding foraging habitat such as forests, this is unlikely to occur. Therefore, due to the high level of development and lack of trees, the EW 1 interconnection cable route, onshore substation, and O&M Base areas are unlikely to support cave-hibernating bat species during any period of their lifecycle and are not discussed further. Additionally, no endangered, threatened, or Special Concern bat species have been documented by the New York Natural Heritage Program database within the EW 1 Onshore Study Area (N. Conrad, personal communication, July 30, 2019).

EW 2: The EW 2 onshore export and interconnection cable routes follows heavily developed roads and are unlikely to contain suitable bat habitat, with the exception of portions of the Oceanside POI parcel that exhibit undeveloped land with sparse tree cover (**Figure 5.4-5**). The undeveloped portions of the Oceanside POI parcel, which are characterized by scrub shrub, may support cave-hibernating bat species for foraging and roosting, but are unlikely to provide important bat habitat. The EW 2 Onshore Substation A site is previously developed and currently supports a recycling facility. The proposed EW 2 Onshore Substation C site occurs in a highly developed area bordered by commercial and residential developments. Only a small portion of the site contains vegetation, which may be cleared during construction of the site. Although undeveloped areas onsite may have the potential to provide some habitat for certain species of bats, this area is not expected to be important habitat for any species. The EW 2 onshore export and interconnection cable route and Onshore Substation A site will likely have very limited tree removal and is not discussed further. Additionally, no endangered, threatened, or Special Concern bat species have been documented by the New York Natural Heritage Program database near the EW 2 Onshore Study Area (N. Conrad, personal communication, September 20, 2019).

Offshore

Cave-hibernating bats generally exhibit lower activity offshore than long-distance migratory tree bats (Sjollema et al. 2014), with their migratory movements occurring primarily in the fall (Sjollema et al. 2014). Acoustic studies indicate that the greatest percentage of migration activity for cave-hibernating bats takes place between July and October (Peterson et al. 2014). In addition, acoustical monitoring at Block Island, Rhode Island, identified *Myotis* species during the summer and fall of 2009 and spring of 2010, indicating cave-hibernating bats were active in the nearshore and onshore areas; however, calls were not identified to species (Svedlow et al. 2012). Based on these data and existing information in the literature, *Myotis* bats are not expected to be present in the Lease Area, as the maximum distance *Myotis* bats have been detected offshore in the mid-Atlantic is 7.2 mi (11.5 km; Sjollema et al. 2014). Overall, acoustic studies indicate limited use of the offshore environment by cave-hibernating bats, and any use of the Lease Area by this group is likely limited to fall migration.

Figure 5.4-4 Potential Bat Habitat in the EW 1 Onshore Study Area

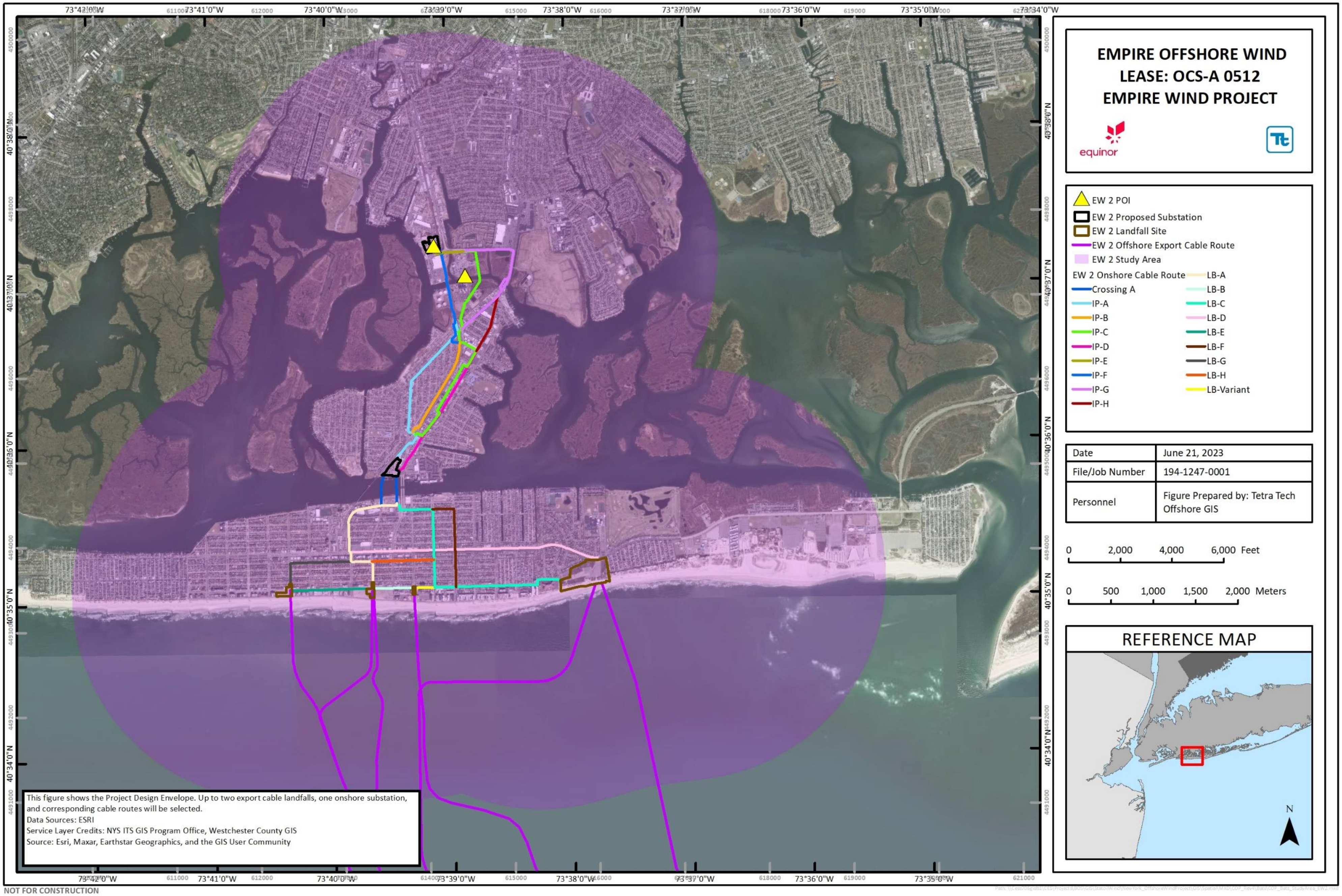

Figure 5.4-5 Potential Bat Habitat in the EW 2 Onshore Study Area

Of the cave-hibernating bats that have the potential to occur in the Offshore Study Area, only big brown bats were acoustically detected in the Lease Area during the 2018 Offshore Bat Acoustic Survey. Three big brown bat calls were recorded on June 25, 2018, suggesting very low levels of activity in the spring. No big brown bat calls were recorded from June 26 to September 14, 2018, suggesting very low to no use during summer. Thirteen big brown bat calls were recorded on September 15, 2018, suggesting low levels of fall migratory activity (see **Appendix R** for additional information). Additionally, 21 unidentified low frequency bat calls, which could have been from big brown bats, were recorded during the late summer and fall migration period.

5.4.1.3 Long-distance Migratory Tree Bats

Onshore

Long-distance migratory tree bats are less dependent on contiguous forest for foraging than cave hibernating bats; however, they depend on forest for foliage roosts. A summary of the likelihood for migratory tree bat species to occur along each onshore export and interconnection cable route and onshore substation parcel is described below.

EW 1: Due to the high level of development and lack of trees, the EW 1 interconnection cable route, onshore substation, and O&M Base areas are unlikely to support migratory bat species during any period of their lifecycle and is not discussed further. Additionally, no endangered, threatened, or Special Concern bat species have been documented by the New York Natural Heritage Program database within the EW 1 Onshore Study Area (N. Conrad, personal communication, July 30, 2019).

EW 2: The undeveloped portions of the Oceanside POI parcel may provide suitable habitat for roosting and foraging for long-distance migratory tree bats. Only a small portion of the EW 2 Onshore Substation C site contains vegetation, which is not expected to be important habitat for any species. The EW 2 onshore export and interconnection cable route and the EW 2 Onshore Substation A site will likely have very limited tree removal and are not discussed further. Additionally, no endangered, threatened, or Special Concern bat species have been documented by the New York Natural Heritage Program database near the EW 2 Onshore Study Area (N. Conrad, personal communication, September 20, 2019).

Offshore

Offshore, long-distance migratory bats have been documented in the U.S., though there is uncertainty regarding the specific movements of these species (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; Hatch et al. 2013; Pelletier et al. 2013; Dowling et al. 2017). In Maine, bats have been detected on islands located up to 25.8 mi (42 km) from the mainland (Peterson et al. 2014). Long-distance migratory tree bats found in New York and New Jersey leave in the winter months and journey to warmer parts of the southern U.S. and Central America to overwinter between December and March. These bats have been documented most often in the offshore environment during fall migration (August–November; BOEM 2014). Eastern red bats, for example, have been detected migrating from Martha's Vineyard in the late fall (October–November), with one bat tracked as far south as Maryland before records ceased (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore, as well as recent acoustic and survey results where migrating bats have been observed temporarily roosting on structures, such as lighthouses and on nearshore islands (Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014; Biodiversity Works 2016; Dowling et al. 2017). Eastern red bats were also detected up to 27.3 mi (44 km) offshore in the mid-Atlantic by high-definition video aerial surveys (Hatch et al. 2013). In a study of bat acoustical detections offshore in the mid-Atlantic, eastern red bats comprised 78 percent of all identified calls, with a maximum distance offshore of 13.6 mi (22 km) offshore and a mean distance of 5.2 mi (8 km) offshore (Sjollema et al. 2014).

Both silver-haired and hoary bats have been recorded off the coast of New Jersey (NJDEP 2010). All three tree bat species known to occur in the region, eastern red, hoary, and silver-haired bats, were also detected in low numbers at Block Island, though mainly during migration (May; August–October; Svedlow et al. 2012). The 2018 acoustic survey in the Lease Area corroborates these findings (**Appendix R**). In the Lease Area, 39 percent of all bat passes recorded during 2018 were eastern red bats and 31 percent were silver-haired bats, (**Figure 5.4-6**; **Appendix R**). Hoary bats were detected at very low numbers during the survey, but not within the Lease Area, with the farthest location from shore being approximately 8.4 mi (13.5 km) from shore. While migratory tree bats were detected at low levels offshore from May through November, 99 percent were recorded from August 10 to November 15, indicating exposure is likely greatest during fall migration, and conversely is very low at other times of the year (**Figure 5.4-7**; **Appendix R**).

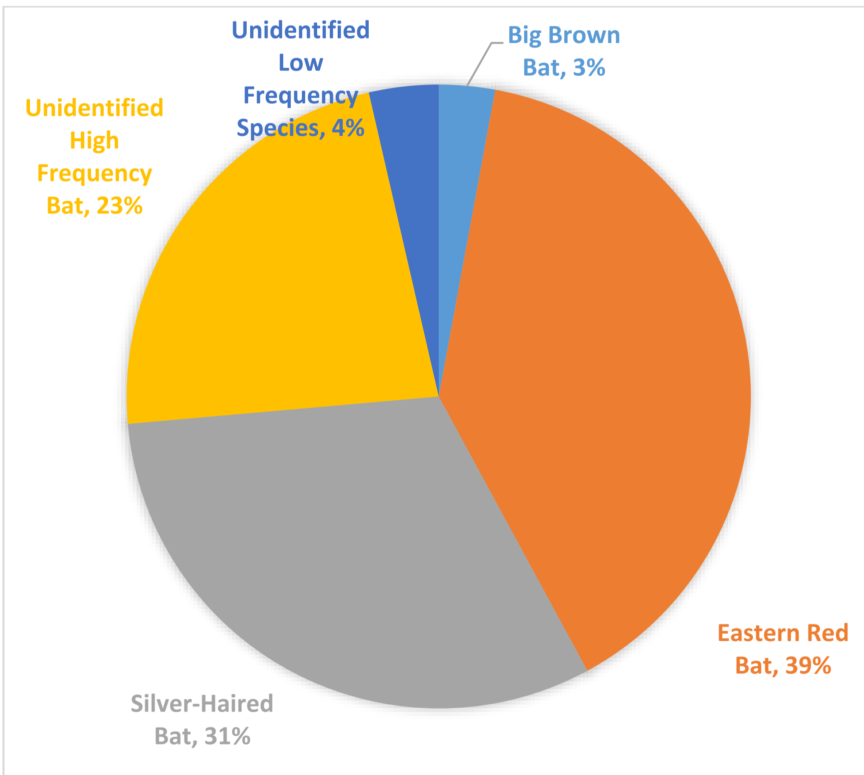

Figure 5.4-6 Percent Distribution of Bat Species or Group Activity observed from May to November 2018 in the Lease Area

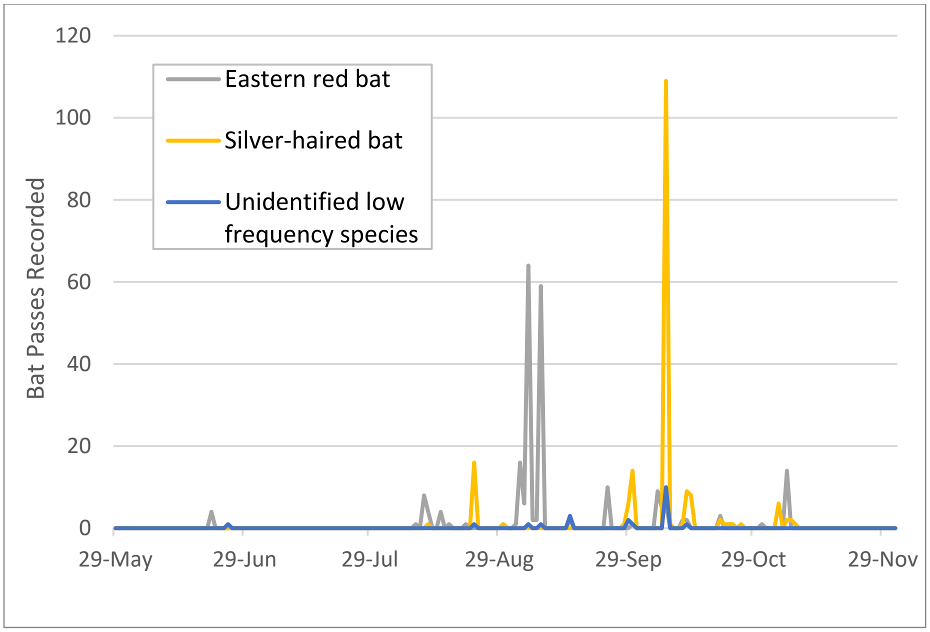

Figure 5.4-7 Migratory Tree Bat Passes Recorded by Date in the Lease Area

5.4.1.4 Threatened and Endangered Species

Of the nine bat species present in New York and New Jersey, two are federally listed; the northern long-eared bat is listed as threatened and the Indiana bat is listed as endangered (**Table 5.4-2**). The northern long-eared bat is proposed to be reclassified as endangered, but the rule has not yet been finalized (87 FR 16442). As the Indiana bat range is located outside of the Study Area (USFWS 2015; Solari 2018; USFWS 2019), and no Indiana bat calls were documented during the 2018 Bat Study, this species is not discussed further due its unlikelihood of occurrence in the Offshore or Onshore Study Areas. In addition, five bat species in New York are afforded additional state protection. **Table 5.4-2** summarizes the listed bat species and species of concern within the Project Area.

Table 5.4-2 Listed Bat Species and Species of Concern with Potential Occurrence Within the Project Area

Common Name	Scientific Name	Federal Status a/	NY Status a/
Cave Hibernating			
Big brown bat	*Eptesicus fuscus*	-	-
Eastern small-footed bat	*Myotis leibeii*	-	SSC
Little brown bat	*Myotis lucifugus*	-	SGCN
Northern long-eared bat	*Myotis septentrionalis*	T b/	T, SGCN
Tri-colored bat	*Perimyotis subflavus*	P	SGCN
Migratory Tree			
Silver-haired bat	*Lasionycteris noctivagans*	-	-
Hoary bat	*Lasiurus cinereus*	-	-
Eastern red bat	*Lasiurus borealis*	-	-

Common Name	Scientific Name	Federal Status a/	NY Status a/

Source: USFWS 2019

Notes:
a/ Species Status: T =threatened; P = Under petition to be listed on the ESA (USFWS 2017); SSC = Species of Special Concern (NYSDEC 2015a); SGCN = Species of Greatest Conservation Need (NYSDEC 2015b)

b/ The northern long-eared bat is proposed to be reclassified as endangered, but the rule has not yet been finalized (87 FR 16442).

5.4.1.5 Federally Listed Species

A review of the USFWS IPaC system indicates that the only federally listed bat species with potential to occur within the Onshore Study Areas is the northern long-eared bat. Under the ESA, the northern long-eared bat is listed as threatened. The northern long-eared bat is proposed to be reclassified as endangered, but the rule has not yet been finalized (87 FR 16442). The northern long-eared bat hibernates in caves, mines, and other locations (e.g., possibly talus slopes) in winter, and spends the remainder of the year (March–November) in forested habitats (Brooks and Ford 2005; Menzel et al. 2002). During the non-winter hibernation, the species prefer to roost in clustered stands of large trees with living and/or dead trees that have shelter (loose bark, crevasses, large cavities), and forage under the forest canopy above freshwater, along forest edges, and along roads (MA NHESP 2015). At summer roosting locations, the bats form maternity colonies. These consist of aggregations of females and juveniles and are where females give birth to young in mid-June (USFWS 2016). Roosting tree selection varies and the size of tree and canopy cover changes with reproductive stage (USFWS 2016). Adult females and juveniles able to fly remain in maternity colonies until mid-August, at which time the colonies begin to break up and individuals begin migrating to their hibernation sites (Menzel et al. 2002). Bats will continue to forage around the hibernacula site and mating occurs prior to entering hibernation in a period known as the fall swarm (Broders and Forbes 2004; Brooks and Ford 2005). Throughout the summer months and during breeding, the species have small home ranges of less than 25 ac (10.1 ha) (Silvis et al. 2016). Migratory movements, however, can be up to 170 mi (274 km; Griffin 1945).

Due to impacts from white-nose syndrome (WNS), a fungal pathogen that leads to high mortality in hibernating bats, the species has declined by 90 to 100 percent in most locations where the disease has occurred, and declines are expected to continue as the disease spreads throughout the remainder of the species' range (USFWS 2016; WNSRT 2019). The devastating and ongoing impact of WNS on the northern long-eared bat resulted in the species being listed as threatened under the ESA in 2015. WNS was first detected in New York in 2006 and New Jersey in 2008 (WNSRT 2019).

Presence of northern long-eared bats is possible at the Oceanside POI parcel due to the forested land, fragmented nearby suitable habitat, and known populations of northern long-eared bats on Long Island. Long Island has a persistent federally threatened northern long-eared bat population that appears to have some resistance to WNS (Fishman 2013; Young 2019; WNSRT 2019). Presence is very unlikely at the EW 1 onshore substation and O&M Base site due to lack of suitable habitat. No known hibernacula or maternity roost trees are located near either site in New York (USFWS NYFO 2019).

Offshore, use of the Lease Area by northern long-eared bats is unlikely, resulting in very limited risk; this is corroborated by the lack of acoustic detection during the 2018 bat acoustic survey (**Appendix R**). While there is little information available regarding the offshore movements of this species, a tracking study on Martha's Vineyard did not indicate movements of the bats offshore (Dowling et al. 2017).

5.4.1.6 State Listed Species

In New York State, the northern long-eared bat is listed as state threatened. In addition, the eastern small-footed bat is listed as a Species of Special Concern in New York, which means that the welfare of this species is a concern or at risk of endangerment (NYSDEC 2015a). The northern long-eared bat, little brown bat, and the tri-colored bat have also been identified as high-priority Species of Greatest Conservation Need (SGCN), which asserts a need for conservation action in the next ten years (NYSDEC 2015b). The NYSDEC is currently proposing changes to its list of endangered and threatened species, which would include status changes of the tri-colored bat to a state threatened species and little brown bat to Species of Special Concern (NYSDEC 2019b).

5.4.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For bat species, the maximum design scenario is the full build-out of both the offshore and onshore components, as described in **Table 5.4-3**. The maximum design scenario for assessments associated with full build-out of EW 1 and EW 2 incorporates a total of up to up to 149 foundations at any of 176 locations within the Lease Area (made up of up to 147 wind turbines and 2 offshore substations, with two submarine export cable routes to EW 1 and EW 2 (New York) and the associated onshore structures. This design concept also incorporates the full build-out of onshore structures, including the onshore export and interconnection cable routes, the onshore substations, and O&M Base.

Table 5.4-3 Summary of Maximum Design Scenario Parameters for Bat Species

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of EW 1 and EW 2 (147wind turbines and two offshore substations). EW 1: 57 wind turbines and one offshore substation. EW 2: 90 wind turbines and one offshore substation.	Representative of the maximum number of structures for EW 1 and EW 2.
Duration Offshore construction	Based on full build-out of EW 1 and EW 2. EW 1: 57 wind turbines and one offshore substation. EW 2: 90 wind turbines and one offshore substation.	Representative of the maximum period required to install the offshore components, which has the potential to have Project-related vessels and associated lighting in the Project Area.
Onshore substations	Based on EW 1 and EW 2. EW 1: 10.8-ac (4.4-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the onshore substation(s).
O&M Base	6.5-ac (2.6-ha) area.	Representative of the maximum area to be utilized to facilitate the construction of the O&M Base.

Table 5.4-3 Summary of Maximum Design Scenario Parameters for Bat Species (continued)

Parameter	Maximum Design Scenario	Rationale
Staging and construction areas, including port facilities, temporary mooring, work compounds and lay-down areas	Based on EW 1 and EW 2. Maximum number of work compounds and lay-down areas required. Ground disturbing activities are not anticipated. Independent activities to update or modify staging, construction areas, and ports prior to Project use will be the responsibility of the facility owner.	Representative of the maximum area required to facilitate the offshore and onshore construction activities.
Operations		
Wind turbines	Based on full build-out of EW 1 and EW 2. EW 1: 57 wind turbines. EW 2: 90 wind turbines.	Representative of the maximum number of wind turbines (176), which would result in the greatest overall total rotor swept area and potentially increase collision risk.
Offshore substations	Based on full build-out of EW 1 and EW 2. EW 1: one offshore substation. EW 2: one offshore substation.	Representative of the maximum number of offshore substations, which has the potential to increase attraction of bats that may be travelling offshore.
Project-related O&M vessels	Based on the full build-out of the Lease Area (EW 1 and EW 2).	Representative of the maximum condition for the peak number of O&M vessels affecting the area.
Onshore substations	Based on EW 1 and EW 2. EW 1: 4.8-ac (1.9-ha) area. EW 2: 6.4-ac (2.6-ha) area.	Representative of the presence of a new structure in an area where there was previously none, which would result in the maximum habitat loss and introduction of Project-related lighting.
O&M Base	4.5-ac (1.8-ha) area	Representative of the presence of a new structure in an area where there was previously none, which would result in the maximum habitat loss and introduction of Project-related lighting.

5.4.2.1 Construction

During construction, the potential impact-producing factors to bat species may include:

- Construction of the onshore components, including the export cable landfalls, onshore export and interconnection cables, onshore substations, and O&M Base;
- Staging activities and assembly of Project components at applicable facilities or areas; and
- Construction of the offshore components, including foundations, wind turbines, offshore substations, and submarine export and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Short-term alteration of terrestrial habitat; and
- Short-term disturbance and displacement.

Terrestrial habitat alteration: During construction, the onshore export and interconnection cables and onshore substations will require varying amounts of tree removal at EW 2. The majority of the onshore export and interconnection cable routes are located in already disturbed areas. However, tree clearing on the Oceanside POI parcel may be required for onshore cable installation if EW 2 Routes IP-C and IP-E are used. Tree clearing and habitat alteration is not anticipated to be required for EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation. Live tree and snag removal eliminates potential roosting opportunities for both cave and migrating bat species (Harvey et al. 2011). Removal of roost trees during the maternity season risks injuring juveniles that are unable to fly. Forest and forest edges provides a protected foraging environment that reduces the chances of bat predation. Forested habitat is also an important insect breeding ground to provide prey items for all bat species (Burford et al. 1999). If trees are entirely removed there is a risk of eliminating habitat that may be important for insect richness and abundance (Didham 1997).

Due to the known presence of the northern long-eared bat on Long Island, Empire will comply with the New York State tree clearing restriction between March through November on Long Island, unless further agency coordination or studies indicate an exception to this restriction would not adversely impact these species. No tree clearing is anticipated to be required at the EW 1 onshore substation and O&M Base site. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project-related activities.

Empire proposes to implement the following measures to avoid, minimize, and mitigate these potential impacts to bat species:

- Onshore components have been sited in previously disturbed areas, existing roadways, or otherwise unsuitable bat summer habitat and/or ROWs, to the extent practicable;
- Avoid tree-clearing at the onshore Project components, unless otherwise determined acceptable by the USFWS and NYSDEC from March through October, to minimize risks to bats; and
- Work with the applicable agencies to develop an appropriate tree clearing window if tree clearing is required within the restriction windows at the Oceanside POI parcel and the EW 2 Onshore Substation C site. Tree clearing is not anticipated to be required at EW 1, EW 2 Onshore Substation A site, or the O&M Base.

Disturbance and displacement: Offshore, indirect effects of wind turbine construction on bat species is poorly studied or understood. Wind turbines and other structures present, including equipment and Project components, during construction may provide stopover resting/roosting sites, and the structures or lighting may either attract bats already flying offshore, or impede movement through the area (Pelletier et al. 2013). If construction attracts or impedes bat movements during migration, migratory routes may be altered or flight distances increased. This may lead to increased energetic demands, and may lead to decreased survival during migration (Pelletier et al. 2013).

Onshore, bat species may be temporarily displaced from roosting or foraging habitat due to noise, vibrations, and general human activity, even if permanent habitat alteration is not experienced. Bats are most at risk of disturbance during hibernation, which is not anticipated to occur with this Project given that no hibernacula are located near Project-related activities. Bats are also likely to return to the area once construction is complete if intact habitat remains. Species have different levels of tolerance of human disturbance. For example, big brown bats often co-exist with humans in urban areas. Given the limited bat habitat of marginal quality present onshore and the timing constraints planned for tree removal, disturbance or displacement of bats is unlikely to result from construction, except possibly in localized areas for a short-term period. Activities at staging and construction facilities will be consistent with the established and permitted uses of these facilities, and Empire will comply with applicable permitting standards to limit environmental impacts from Project-related activities.

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction (or attraction of insect prey).

5.4.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to bat species may include:

- Presence of new permanent structures offshore (i.e., wind turbines and offshore substations);
- Presence of new permanent structures onshore (i.e., onshore substations and O&M Base);
- Operations and maintenance activities associated with the onshore export and interconnection cables, onshore substations, and O&M Base; and
- Operations and maintenance activities associated with the offshore components of the Project.

With the following potential consequential impact-producing factors:

- Attraction to offshore operations and maintenance vessels;
- Long-term increased risk of attraction to and collision with wind turbines; and
- Long-term conversion of terrestrial habitat.

Attraction to and collision with wind turbines: During operations, bats have the potential to collide with the operating wind turbines, resulting in mortality. Stationary objects are not generally considered a collision risk for bats because they are able to detect objects with echolocation. However, data regarding bat interactions with and fatalities from offshore wind turbines in North America is currently not available, and there is difficulty of searching for carcasses in the ocean (BOEM 2014; Horn et al. 2008; Pelletier 2013; Thaxter et al. 2017). In offshore European studies, bats were found to roost and rest directly on turbines and forage in close proximity as insects accumulated around the turbines (Ahlén et al. 2007; 2009; Rydell et al. 2010). While limiting the number of lights, using lower intensity lights, using light colors other than white, or using strobing instead of steady lights, and using downward facing or motion sensor lights where appropriate, may help reduce bat species attraction to light, onshore wind surveys found no difference in bat foraging rates between lit and unlit turbines or differences between strobing and steady lights (Horn et al. 2008; Hein 2012 as cited in Orr et al. 2013; Orr et al. 2016). Furthermore, bats were found to be attracted to red light during migration along the European coastline and not white light, even though red light is less likely to attract insects (Voigt et al. 2018).

Although bat mortality has not been documented at offshore wind farms, collision mortalities have been detected at terrestrial wind farms, particularly during the fall migration period (Kunz et al. 2007; Arnett et al. 2008; Strickland et al. 2011; Arnett et al. 2016; AWWI 2018). The level of mortality observed with onshore turbines is not necessarily transferable to offshore turbines due to the different use of habitats, different behaviors, different species composition, and differing levels of bat abundance and activity offshore.

As discussed in Section 5.4.1.3, eastern red, silver-haired, and big brown bats were detected offshore in the Lease Area and therefore the Project may pose risks of attraction to and collision with wind turbines for these species (**Appendix R**). In this study, no migratory tree bats (eastern red and silver-haired bats) were documented offshore during spring migration. Although some were recorded at low levels on June 21, 2019 (n=4 calls), none were documented from June 22 through August 8, 2019, and very few big brown bats were documented during this period as well (n=3 on June 25). Migratory tree bats and big brown bats were recorded more commonly within the Lease Area in late summer and fall, with several peaks in detection rates from late August to early November 2019. These data suggest very low risk to these species in spring and early summer, with some risk apparent during fall migration. Overall, bat detection rates recorded in the Lease Area were positively correlated with warmer temperatures and lower wind speeds (**Appendix R**), with fewer bat calls detected above windspeeds of 8 m/s (23 percent of all bat passes in the Lease Area). Although hoary, eastern red and silver haired bat represent a large percentage of all bat fatalities at land-based wind projects in the northeastern U.S. (AWWI 2018), this is from land-based surveys and may not apply to offshore wind energy environments. Furthermore, no hoary bats were recorded within the Lease Area, suggesting very low risk to this species. Cave-hibernating *Myotis* species were not detected within the Lease Area and they are not expected to utilize the offshore environment where turbines are proposed, due to the distance from shore. Thus, operation of the offshore portion of the Project presents very low risk to these species.

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey) and possibly collision of bats with wind turbines.

Attraction to Project-related O&M vessels: During operations and maintenance activities, bats may be attracted to equipment and/or vessel lighting. Overall, stationary objects are not generally considered a collision risk for bats (BOEM 2012) because of bats' use of echolocation (Johnson and Arnett 2014; Horn et al. 2008). Thus, collision with equipment is expected to be minimal. However, bats are known to use islands, ships, and other offshore structures as stopover points during travel (Pelletier et al. 2013). Vessels may also provide roosting opportunities offshore for rest (Carter 1950; Norton 1930; Nichols 1920). As discussed in Section 5.4.2.1 for the construction period, such lighting and structures may either attract bats already flying offshore, or impede movement through the area (Pelletier et al. 2013). If these attract or impede bat movements during migration, migratory routes may be altered or flight distances increased, leading increased energetic demands (Pelletier et al. 2013).

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey).

Conversion of terrestrial habitat. Naturally vegetated lands, including those woody wetlands and deciduous forest, may be converted to permanent Project structures, such as an onshore substation, throughout the lifetime of the Project. The impacts of habitat alteration are discussed in detail in Section 5.4.2.1 and are expected to be negligible for EW 1 and the O&M Base. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Temporarily disturbed areas at EW 2 will be revegetated with native species, as needed. This is not anticipated to be required at EW 1 or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation.

5.4.2.3 Decommissioning

Impacts during decommissioning are expected to be similar to or less than those experienced during construction, as described in Section 5.4.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.4.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in Section 5.4.2, Empire is proposing to implement the following avoidance, minimization, and mitigation measures.

5.4.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.4.2.1:

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable bat habitat and/or ROWs to the extent practicable;
- Empire Wind will be conducting acoustic bat surveys for the EW 2 Project in accordance with the Service's Range-Wide Indiana Bat & Northern Long-eared Bat Survey Guidelines (USFWS 2023);
- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction (or attraction of insect prey);
- Lighting not required during offshore construction by the FAA and the USCG, and for safety, during construction will be limited to the minimum required by regulation and for safety, to reduce attraction of insect prey for bats;
- An annual report will be submitted to DOI and USFWS by January 31, accounting for any dead or injured bats found on vessels or Project structures during construction, O&M, and decommissioning. The following information will be included: species name, date found, location, photo (if available), other relevant information. Any carcasses that have federal or research bands will be reported to the U.S. Geological Survey Bird Band Laboratory, BOEM, and USFWS; andThe development and enforcement of an OSRP (**Appendix F**).

If the USFWS-proposed reclassification of the Northern long-eared bat from threatened to endangered becomes final, the Project will cooperate with the USFWS to comply with any new applicable requirements.

5.4.3.2 Operations and Maintenance

During operations, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.4.2.2:

- Development of an offshore monitoring program to answer specific questions, including identifying key species of interest, and when possible, to contribute to the understanding of long-term, Project-specific impacts and larger scale efforts to understand cumulative impacts;
- Implement an Avian and Bat Post-Construction Monitoring Plan in coordination with the USFWS. The goals of the Avian and Bat Post-Construction Monitoring Plan may include, (1) to advance understanding of how the target species utilize the offshore airspace and do (or do not) interact with the wind farm; (2) to improve the collision estimates from SCRAM

(Stochastic Collision Risk Assessment for Movement) (or its successor) for listed bird species; and (3) to inform any efforts aimed at minimizing collisions or other project effects on target species;

- Temporarily disturbed areas at EW 2 will be revegetated with native species as appropriate. This is not anticipated to be required at EW 1, the EW 2 Onshore Substation A site, or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation;
- Offshore lighting during operations will be limited to the minimum required by regulation and for safety, therefore minimizing the potential for attraction (or attraction of insect prey);
- Use an FAA-approved ADLS on wind turbines and offshore substations, which will only activate the FAA hazard lighting when an aircraft is in the vicinity of the wind facility, to reduce the visibility of nighttime lighting and nighttime visual impact; and
- The development and enforcement of an OSRP (**Appendix F**).

5.4.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in Section 5.4.2.1 and Section 5.4.2.2. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be evaluated at that time.

5.4.4 References

Table 5.4-4 Data Sources

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A

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5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat

This section describes the benthic and pelagic habitats and species known or expected to be present, to transit through, or to occur incidentally in the waters within and surrounding the Project Area, which includes the Lease Area and submarine export cable routes. Potential impacts to benthic and pelagic habitats and resources resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures intended to avoid, minimize, and/or mitigate potential impacts to benthic and pelagic habitats and species are also described.

Other resources and assessments detailed within this COP that are related to benthic and pelagic habitats include:

- Water Quality (Section 4.2);
- Commercial and Recreational Fishing (Section 8.8);
- Marine Site Investigation Report (Appendix H);
- Sediment Transport Analysis (Appendix J);
- Underwater Acoustic Assessment (Appendix M-1 and Appendix M-2);
- Benthic Resource Characterization Reports (Appendix T); and
- Essential Fish Habitat Assessment (Appendix U).

In the United States, fisheries are managed within a framework of overlapping international, federal, state, interstate, and tribal authorities. Most individual states and territories have jurisdiction over fisheries in marine waters within 3 nautical miles (3.5 mi [5.6 km]) of their coasts. Federal jurisdiction includes fisheries in marine waters inside the U.S. Exclusive Economic Zone, which encompasses the area from the State boundary to 200 nautical miles (230 mi [370 km]) from the U.S. coastline. In addition to the regional Fishery Management Councils (FMCs) created under the Magnuson-Stevens Fisheries Conservation and Management Act (MSA), an array of multi-state fishery commissions coordinates conservation and management of the common interstate nearshore fishery resources (marine finfish, shellfish, and anadromous fish) for sustainable commercial and recreational use. Together with NOAA Fisheries, the FMCs regulate commercial and recreational fishing through fishery management plans (FMPs) for one or more species. NOAA Fisheries' Highly Migratory Species (HMS) Division is responsible for tunas, sharks, swordfish, and billfish in the Atlantic Ocean (NOAA Fisheries 2017a). FMCs and NOAA Fisheries' HMS Division are required to identify EFH for each managed species. EFH is defined as the waters and seafloor necessary for spawning, breeding, or growth to maturity (16 U.S.C. § 1802[10]) of finfish, mollusks, crustaceans, and other managed invertebrates. "Fish" is defined as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds." The role of benthic habitat as a fisheries resource is fundamental to the identification of EFH, as reflected in the emphasis on EFH in BOEM's benthic survey guidance. The guidance recommends that the NOAA Fisheries EFH mapper tool (NOAA Fisheries 2018a) be used for species identification and habitat characterization at particular locations (BOEM 2019a).

Preliminary Resource Characterization

For the purposes of this section, the Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the EW 1 and EW 2 submarine export cable routes (see **Figure 5.5-1**).

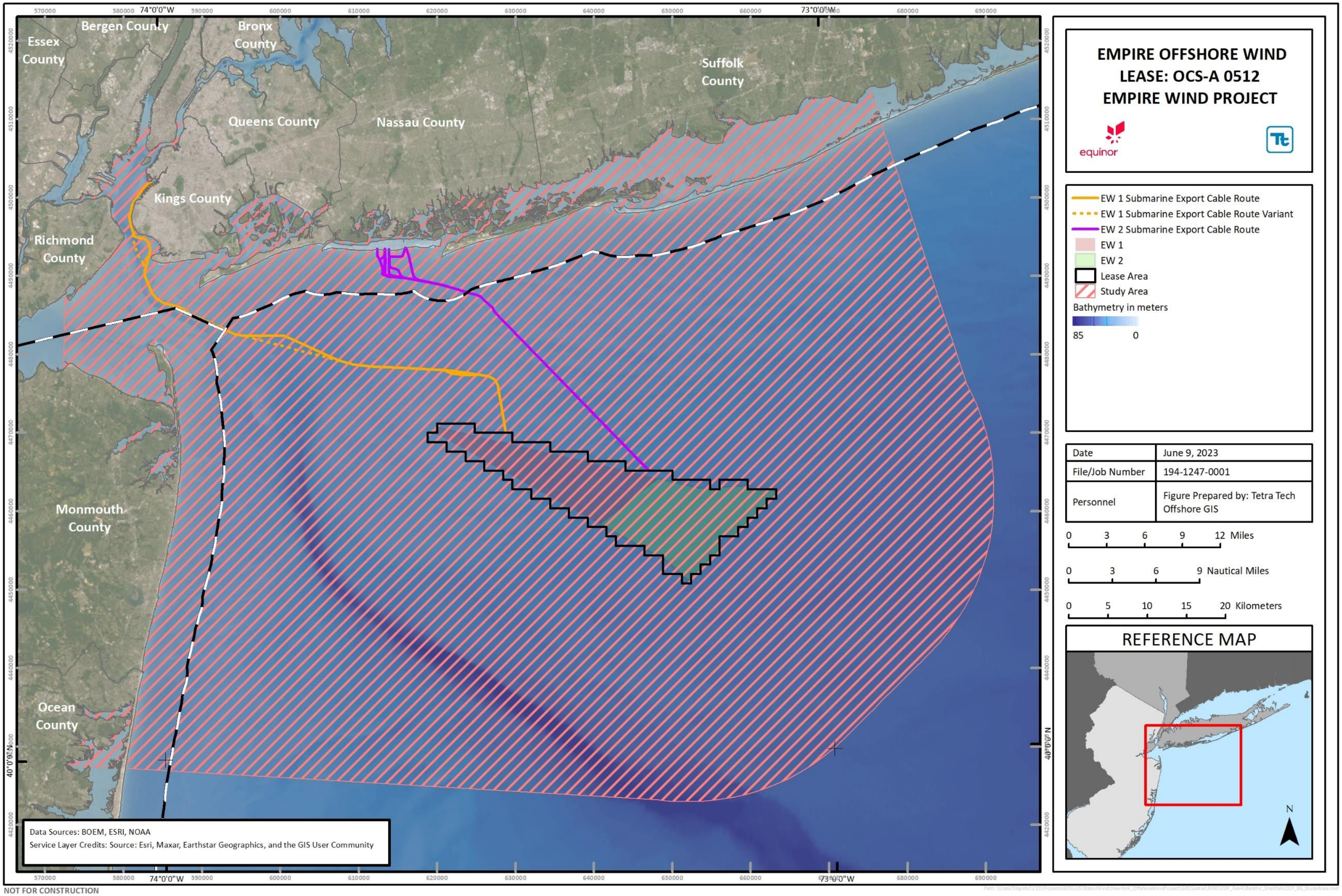

Figure 5.5-1 Benthic and Pelagic Habitats and Resources Study Area

This section was prepared in accordance with the following guidelines:

- BOEM's site characterization requirements in 30 CFR § 585.626;
- BOEM's *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019b);
- BOEM's *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019a); and
- The NOAA Fisheries Greater Atlantic Regional Fisheries Office's *Updated Recommendations for Mapping Fish Habitat* (NOAA Fisheries 2021).[7]

To support the characterization of fish and invertebrate resources, Empire conducted extensive site-specific surveys, compiled data from publicly available databases (e.g., NOAA Fisheries 2021 [EFH Mapper]; Northeast Regional Ocean Council 2019; Mid-Atlantic Regional Ocean Council 2019), regional surveys, and resource reports (e.g., Battista et al. 2019; NYSERDA 2017; Guida et al. 2017; NEFMC 2017; NOAA Fisheries 2017a; MAFMC 2016, 2017), and incorporated relevant peer-reviewed literature.

Empire conducted six site-specific geophysical, geotechnical, and benthic surveys across the Lease Area and the submarine export cable siting corridors from March 2018 to May 2021. As shown in **Table 5.5-1**, Empire contracted Alpine Ocean Seismic Survey Inc. to perform the site assessment and benthic habitat characterization surveys in the Lease Area from March 18, 2018 to December 2, 2018.

In July 2019, Empire contracted Inspire Environmental LLC (Inspire) to conduct a benthic assessment survey of the submarine export cable corridors proposed at that time. Sampling methods differed from the 2018 survey in that sediment profile imagery (SPI), rather than grab sampling, was used to characterize benthic habitats. The interpretation of benthic substrate indicated by backscatter was well-correlated with SPI results. Grain size distribution was analyzed in 15 sediment grab samples to ground-truth the SPI results; no infauna or epifauna were sampled.

Following refinement of the submarine export cable corridors, Empire conducted additional surveys to groundtruth existing data and characterize previously un-surveyed portions of the submarine export cable siting corridors. Empire contracted Alpine Ocean Seismic Survey, Inc. (Alpine) and RPS Group plc (RPS) to perform additional high-resolution geophysical and benthic surveys in the EW 1 submarine export cable corridor in late 2020 (**Appendix T, Attachment T-4**), and Gardline Limited (Gardline) to characterize surficial sediment and provide benthic habitat classifications within the EW 2 submarine export cable corridor in winter 2020 to spring 2021 (**Appendix T, Attachment T-5**). Empire contracted Alpine/RPS to conduct additional benthic surveys near the EW 2 landfall in spring 2021 (**Appendix T, Attachment T-6).** The benthic survey campaign provided 100 percent coverage of the Project Area using multi-beam echo sounder (MBES); side scan sonar (SSS); magnetometer; and shallow- and medium-penetration sub-bottom profilers. Additional benthic substrate and characterization data were collected using modified Van Veen and Day grab samplers, water quality profilers, and digital camera systems (drop down still cameras and towed video). The specific equipment and methods used in each survey are described in the individual survey reports in **Appendix T.**

[7] This guidance was released in May 2020 and updated in March 2021; therefore, it was referenced only for the 2020 and 2021 surveys.

Table 5.5-1 Empire's Site-Specific Benthic Surveys

Project Subarea	Sediment Grabs (Grain Size)	Sediment Grabs (Benthic Infauna) Method a/	Sediment Grabs (Benthic Infauna) Sample Number	Benthic Imagery Method	Benthic Imagery Sample Number	Description of Survey Sample Dates	Description of Survey Surveyor
Lease Area							
Site Assessment Report (Attachment T-1)	15 (3 grabs at 5 stations)	0.1-m^2 Day grab	15 (3 grabs at 5 stations)	Drop-down still images	80	2018 Mar-Apr	Alpine/ Gardline
COP Benthic Habitat Characterization Report (Attachment T-2)	67	0.04-m^2 Ted Young modified van Veen sampler; 0.5 µm sieve; CMECS	67	Drop-down still images and 600-m towed video transects	3,082 images (2,469 still images and 613 video snapshots)	2018 Jun- Dec	Alpine/ Gardline
Offshore Export Cable Corridors							
Benthic Assessment Survey Report (EW 1 and EW 2) (Attachment T-3) b/	16	no organisms collected		SPI/PV	172	2019 July	Inspire
2020 Benthic Survey Report (EW 1) (Attachment T-4)	74 (3 grabs at 26 stations)	0.1-m^2 Modified Van Veen Sampler	26	600-m towed video transects	26 transects; 18 hours of video; 2,222 still images and 370 video snapshots	2020 Nov-Dec	Alpine/ RPS
Habitat Characterization Report (EW 2) (Attachment T-5)	37	Modified Day Grab/Van Veen	37	Drop-down still images and 600-m towed video transects	15 transects; 1,683 still images and 227 video snapshots)	2020 Nov-Dec	Gardline
2021 Benthic Survey Report (EW 2) (Attachment T-6)	36 (3 grabs at 12 stations)	0.1-m^2 Modified Van Veen Sampler	36 (3 grabs at 12 stations)	Drop-down still images and 600-m towed video transects	12 transects (5 with useable images); ~3 hours of video; 712 still images	2021 Apr-May	Alpine/ RPS

Notes:
a/ All surveys except the Site Assessment Report Survey (**Attachment T-1**) used a 0.5-m sieve to separate benthic infauna from sediment in the grab sample; samples in **Attachment T-1** were sieved using a 1.0 mm sieve
b/ The survey described in Attachment T-3 includes sample locations along submarine export cable routes previously considered, which are no longer included in the PDE.
SPI/PV = Sediment profile image/plan view image

Empire's site-specific surveys are listed in **Table 5.5-1**. Survey results were used to describe the Affected Environment (Section 5.5.1), and the full survey reports are included in **Appendix T**. Digital imagery is available upon request.

Empire's geophysical survey data (MBES backscatter and SSS) were used to support the characterization of seabed conditions, as recommended by the NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) (2021). Grab samples were analyzed for grain size distribution, total organic carbon, and benthic infauna (identified and classified according to the Coastal and Marine Ecological Classification Standard [CMECS; FGDC 2012, modified by NOAA Fisheries 2021]). Digital imagery was reviewed to aid in identification of benthic substrate types, macroinvertebrates, and fish. Details of the survey campaigns are provided in **Appendix H Preliminary Marine Site Investigation Report** and **Appendix T Benthic Resource Characterization Reports**.

Empire augmented their site-specific HRG and benthic surveys with the following data sources to characterize the distribution and relative abundance of fishes and invertebrates in the Project Area:

- Beam trawls and grab samples collected in 2016 by BOEM for preliminary characterization of the Lease Area (Guida et al. 2017);
- Northeast Fisheries Science Center (NEFSC) seasonal trawls and beam trawls (NEFSC 2007, 2009);
- Video and still images collected by National Ocean Service, National Centers for Coastal Ocean Science for BOEM at almost 400 locations in the Lease Area (Battista et al. 2019);
- NEFSC Sea Scallop Dredge and Habitat Camera Surveys, NEFSC Clam Survey, NEFSC Ecosystem Monitoring Cruises (ichthyoplankton and zooplankton), NJDEP Division of Fish and Wildlife Ocean Trawl Survey, NEAMAP Nearshore Trawl Survey (summarized in NYSERDA 2017), NEFSC Multispecies Bottom Trawls (2018, 2019); and
- Other reports and publications (e.g., NAS 2018; Walsh and Guida 2017; Hare et al. 2016; Walker et al. 2016 [scallop survey]; and others).

Results of Empire's benthic surveys described in **Table 5.5-1** were evaluated in combination with data collected by others within and surrounding the Study Area, including descriptions of sediment type and epifauna in the Lease Area (Battista et al. 2019); analysis of USGS sediment data, grab samples with infauna, and beam trawl surveys for regional habitat mapping of the New York WEA (Guida et al. 2017), FMPs (Mid-Atlantic Fisheries Management Council [MAFMC] 2017; New England Fisheries Management Council [NEFMC] 2017; Atlantic States Marine Fisheries Commission [ASMFC] 2015, 2018a,b,c), and regional analyses of species assemblages (e.g., Walsh et al. 2015; Hare et al. 2016; Selden et al. 2018). Empire reviewed available fisheries, fish habitat, and non-fisheries datasets, surveys, and reports to identify key species and life stages of fish and invertebrates potentially occurring in the Project Area. The commercial and recreational fishing community provided site-specific information to Empire during numerous engagement events, as detailed in **Section 8.8 Commercial and Recreational Fishing**. Data sources include federal and state fisheries agencies (NOAA Fisheries, NEFMC, MAFMC, ASMFC, NYSDEC, NJDEP, and others); expert reviews (Guida et al. 2017 and others); reports from commercial and recreational fishing representatives; the NOAA Fisheries EFH Mapper tool; and source documents to identify fish and invertebrate species likely to occur in the Project Area.

5.5.1 Affected Environment

The affected environment is defined as the coastal and offshore acreage in the Lease Area, and the submarine export cable routes where benthic and pelagic habitats and associated fish and invertebrates – including softbottom and hardbottom benthic habitat, pelagic habitat, plankton, benthic infauna and epifauna, managed fish, and macroinvertebrates – are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

The Project Area lies just on the border between Southern New England and the Mid-Atlantic Bight, with the Hudson Canyon as the nominal boundary between the two ecoregions (Cook and Auster 2007). The Lease Area and submarine export cable routes to New York are geographically within Southern New England. However, the Mid-Atlantic Bight begins just south of the Lease Area. Ecologically, these geographic distinctions have little meaning because dominant species assemblages from both ecoregions are resident in or transient through the Project Area. With sea temperatures increasing, historically southern species are moving north, further blurring the ecoregion boundary (Hare et al. 2016). While site-specific data are given the greatest weight in this section, recent regional reports of conditions in Southern New England and the Mid-Atlantic Bight are considered representative of the Project Area as appropriate.

Harvested fishes and macroinvertebrates managed under the MSA or other fisheries programs occur throughout the Project Area. Most of the managed species have designated EFH in the Project Area. Additional information on managed species and designated EFH found within the Project Area are presented in **Appendix U Essential Fish Habitat Assessment**. The 2018, 2019, and 2020/2021 surveys in the Lease Area and submarine export cable siting corridors corroborate the species identified by the EFH Mapper desktop assessment, depicting habitat suitable for temperate, softbottom-associated species and life stages (**Appendix U, Attachment U-1**).

This section consists of two parts. The first part describes baseline conditions, including typical habitats and life stages of species known or expected to occur within the Project Area:

- Benthic habitat;
- Pelagic habitat;
- Benthic-pelagic coupling;
- Demersal species and life stages; and
- Pelagic species and life stages.

The second part details the fish and macroinvertebrates in the Project Area, grouped into three categories based on regulatory status, as described in Hare et al. (2016):

- Managed and exploited species;
- Ecologically important unmanaged forage species; and
- Species protected under the ESA.

5.5.1.1 Baseline Conditions

Benthic Habitat

Sediments in the Project Area are typical of the Mid-Atlantic Bight, dominated by medium-sized sand and gravel; mean grain size generally diminishes with distance from shore (MAFMC 2016). Softbottom substrate includes unconsolidated material ranging from gravel (> 2000 micrometers [μm]) to sand (62.5 to 2,000 μm), silt (4 to 62.5 μm), and clay (< 4 μm) (Williams et al. 2006), as well as empty shells and shell fragments of various sizes. Grab samples from all surveys were analyzed for particle size distribution, total organic carbon, and benthic infauna to ground-truth the sediment types observed in digital imagery (see **Appendix T**). Empire's geophysical and geotechnical surveys confirmed that the Lease Area is predominantly flat with low rugosity and slope; rippled sand and broken shells mixed with sand cover large areas, and there is a high occurrence of faunal beds.

Lease Area

Empire conducted focused benthic surveys during site assessment activities to characterize locations where Metocean buoys were planned to be deployed (**Figure 5.5-3**). The sediment and biotic characterization of these locations were consistent with the larger survey completed in 2019. Sand dollar beds and soft-sediment fauna dominated these locations (**Table 5.5-2**). The complete report is in **Appendix T, Attachment T-1**.

Table 5.5-2 CMECS Biotic Characterization of Metocean Buoy Locations

Sampling Location ST18904-	CMECS Biotic Group Based on Observed Epifauna	CMECS Biotic Community Based on Sieved Infauna
ENV-1	Small Tube-building Fauna	Sand Dollar/Sea Pansy/Mobile Mollusk Bed (Large Megafauna)
ENV-2	Sand Dollar Bed	*Echinarachnius parma* Bed
ENV-3	Sand Dollar Bed	*Echinarachnius parma* Bed
ENV-4	Larger Tube-Building Fauna	Robust *Ampelisca* Bed
ENV-6	Small Tube-Building Fauna	Lumbrinerid Bed

Empire's geotechnical and geophysical survey of the Lease Area from March to November 2018 showed that habitat in the Lease Area is generally homogenous, with unconsolidated sediment grain sizes ranging from gravelly muddy sand to sandy gravel. Depths gradually increased from 82 to 135 ft (25 to 41 m) with distance from shore. Sessile and slow moving epifauna observed along transects in the Lease Area are characteristic of this type of habitat (e.g., sand dollars, mobile crustaceans, burrowing anemones, tube-building fauna). Of the managed species with EFH designated in the Lease Area, the ocean quahog, winter skate, and various flounder and hake species were observed throughout the Lease Area in video and image assessments (**Appendix T, Attachment T-2**); more individuals of these species were observed in the deeper waters of the southeastern portion of the Lease Area.

Representative images of benthic substrate and organisms are shown on **Figure 5.5-2**: aggregations of broken shells on a sandy bottom at ENV10; winter skate (*Leucoraja ocellata*) on a sandy bottom at ENV72; ray egg cases on pebbly sand at ENV26; and sand dollars and pagurid crab on sand with shell hash at ENV71. The full benthic habitat characterization report is in **Appendix T, Attachment T-2 (Habitat Characterization Report Lease Area).** Additional interpretation of the seismic data and description of bottom types is in the Marine Site Investigation Report (**Appendix H**).

Empire's geophysical surveys corroborated the characterization of the Lease Area in other reports as relatively flat, unconsolidated softbottom dominated by sand and ripples, with small areas of sandy mud and pebbles (**Figure 5.5-3**; NYSERDA 2017; Guida et al. 2017; Battista et al. 2019). Benthic surveys by Battista et al. (2019) confirmed the expected softbottom, low rugosity, and limited habitat variability in the Lease Area (see **Appendix H** for additional information). Three composite habitat types were identified based on the approximately 400 samples collected and analyzed by NOAA to support benthic characterization; most of the Lease Area was characterized as rippled sand or megaripple sand with high occurrence of faunal beds (**Figure 5.5-4**; Battista et al. 2019). Independently derived visual characterization of sediment by UMASS SMAST supported these findings (Guida et al. 2017).

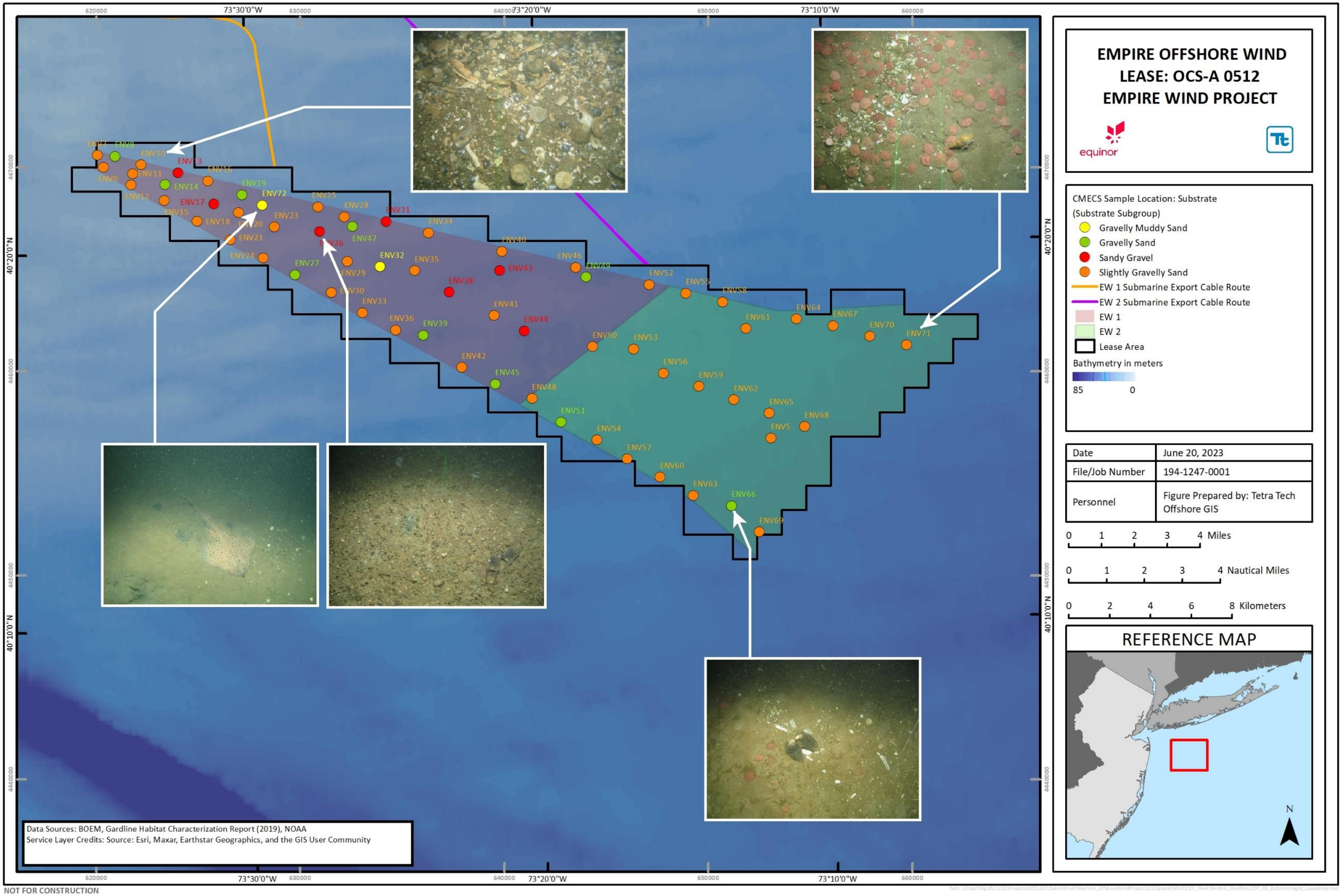

Figure 5.5-2 Representative Plan View Bottom Images in Lease Area

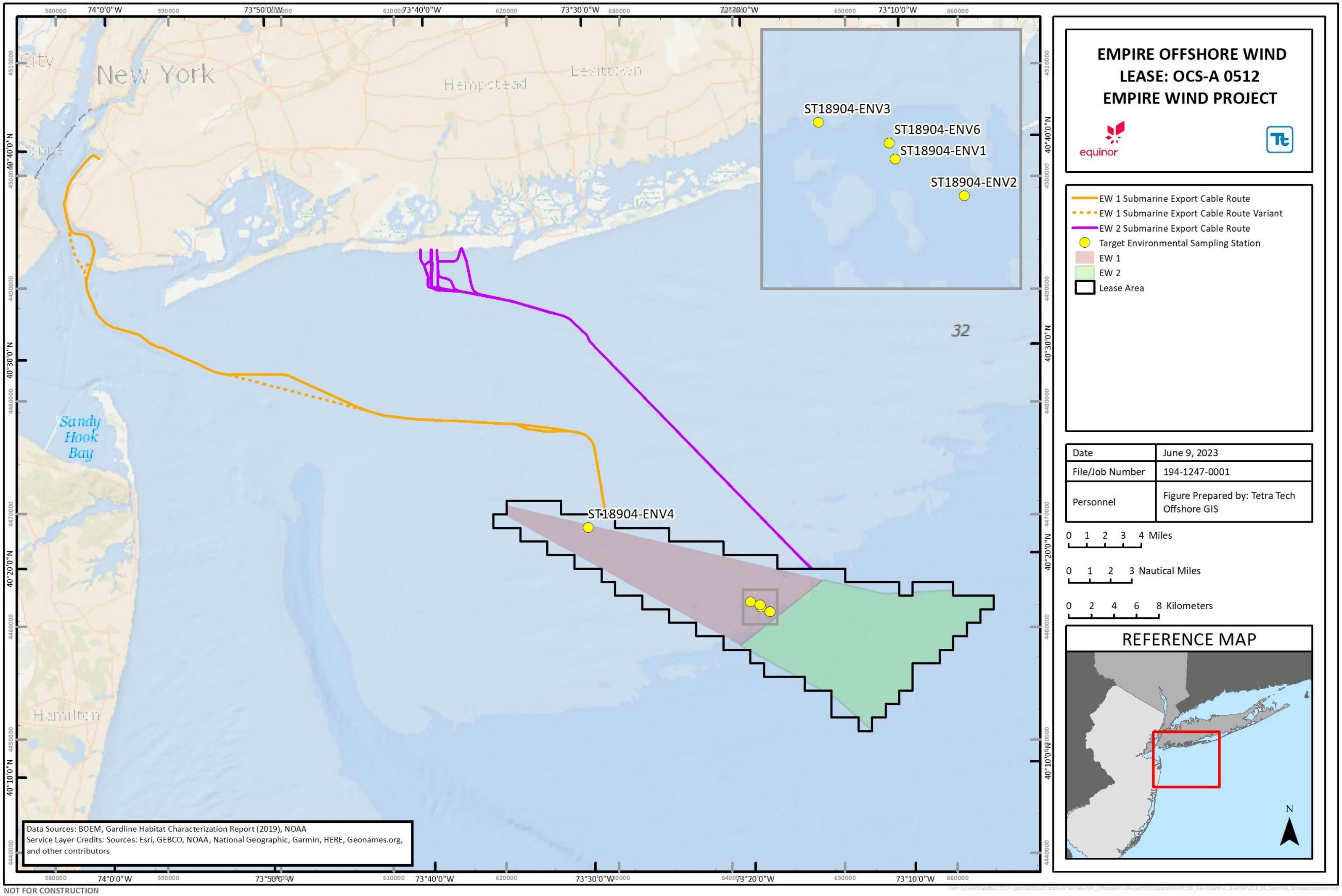

Figure 5.5-3 Focused Benthic Sampling for Site Assessment Plan

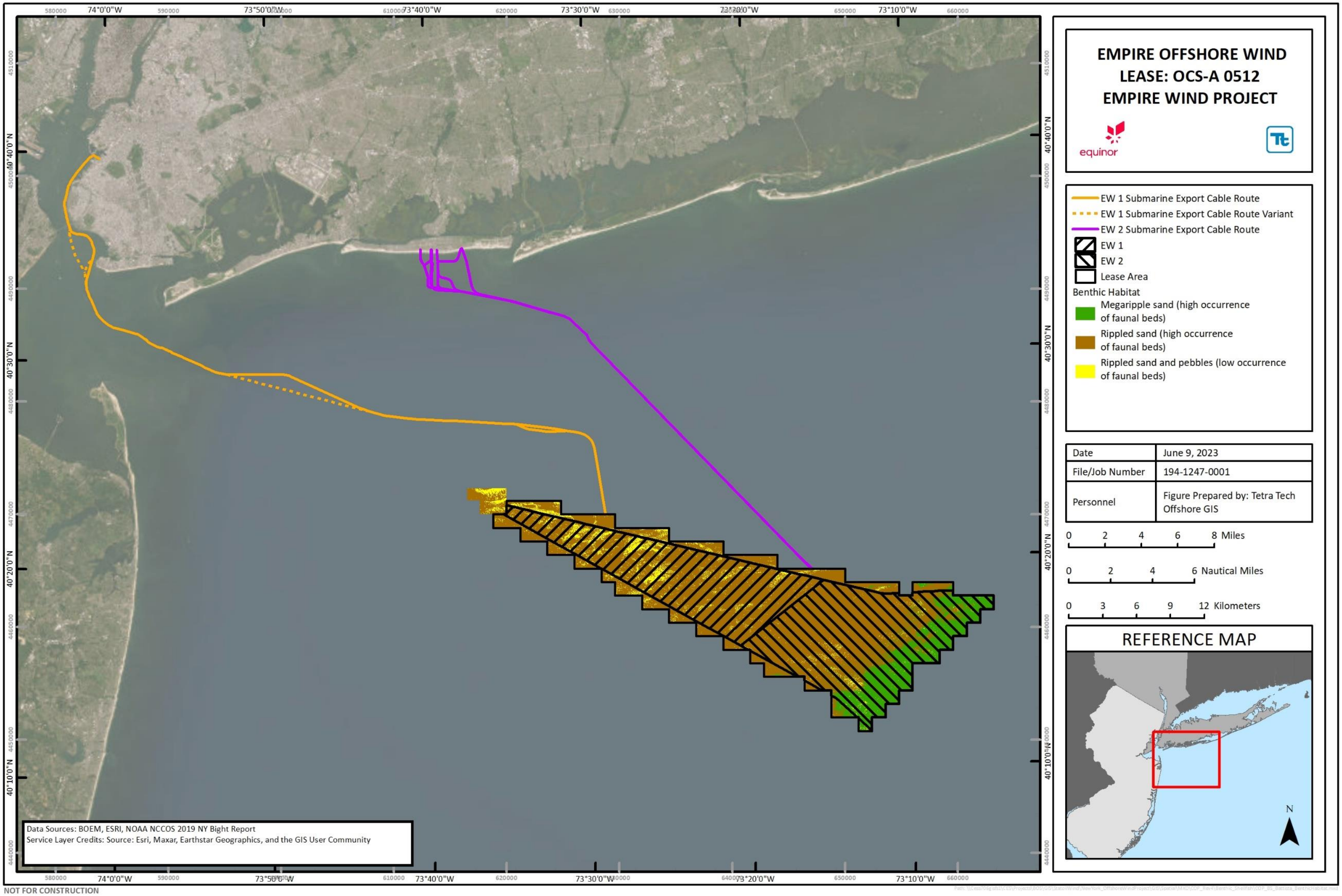

Figure 5.5-4 Benthic Habitat Types in Lease Area (Battista et al. 2019)

Submarine Export Cable Corridors

In spring 2019, Empire conducted initial benthic surveys in the submarine export cable siting corridors proposed at that time using sediment profile imaging (SPI) and plan view (PV) imaging supplemented by grab samples analyzed for grain size distribution at 157 locations in the submarine export cable siting corridors and 15 reference locations adjacent to the corridors (**Figure 5.5-5**), as shown in **Table 5.5-1**. At each station, SPI/plan view imagery was reviewed in real time to identify sensitive, rare, or unexpected species (including non-indigenous species) and note any hardbottom habitat requiring additional imagery. Preliminary results are summarized below; the full report is in **Appendix T, Attachment T-3**.

Throughout the submarine export cable siting corridors, plan view and SPI images were in general accord with backscatter values. Most stations were dominated by mobile sands; sand ripples were visible across the survey area. Gravels were distributed unevenly. No soft coral, lobster, seagrass, or squid eggs were observed during the survey. Preliminary results are summarized below; the full report is in **Appendix T, Attachment T-3**. Habitat in the EW 1 and EW 2 submarine export cable siting corridors is similar to the Lease Area; however, sediment grain size is finer in the shallower, nearshore portions of the corridors. Depths gradually decreased from 98 to 23 ft (30 to 7 m) from the Lease Area to the cable landfall; grain size ranged from silt/clay and very fine sand to gravelly sand (**Appendix T, Attachment T-3**). Sessile and slow moving epifauna observed within the corridors included sand dollars and mussel beds, mobile crustaceans, burrowing anemones, attached hydroids, and tube-building fauna. The only managed species observed during the 2019 surveys was the Atlantic sea scallop in EW 1.

Only one area of hardbottom was encountered, to the north of the Lease Area along the EW 1 submarine export cable siting cable corridor at Station 50. These findings are consistent with other descriptions of the regional geology, which report that most of the natural rocky subtidal bank habitat of the United States Atlantic coast occurs north of Massachusetts (Aquarone and Adams 2018; Davis 2009; Roman et al. 2000). Numerous solitary star coral (*Astrangia poculata*) were observed attached to rocks and boulders at this location (**Figure 5.5-6**). This temperate star coral occurs in shallow subtidal waters from Cape Cod to northern Florida and in the Gulf of Mexico. In Southern New England, the star coral is abundant on hard bottom substrates, where it does not form reefs but encrusts boulders and forms finger-like colonies on vertical substrates; it may attach to small cobbles and pebbles in sandy substrates (Grace 2017; Dimond and Carrington 2007). Substantial aggregations of star coral may enhance habitat value for other benthic organisms (Guida et al. 2017). The star coral becomes quiescent in winter when subtidal water temperature drops below 40 °F (4.3 °C); although the organisms may appear to be dead, they become active feeders when water temperature increases to the same degree in the spring (Grace 2017). The Atlantic sea scallop (*Placopecten magellanicus*) was observed at Locations 57 and 58 just to the west of the hardbottom area, where NOAA has identified a potentially dangerous area where unexploded ordnance may occur (NOAA Office for Coastal Management 2019).

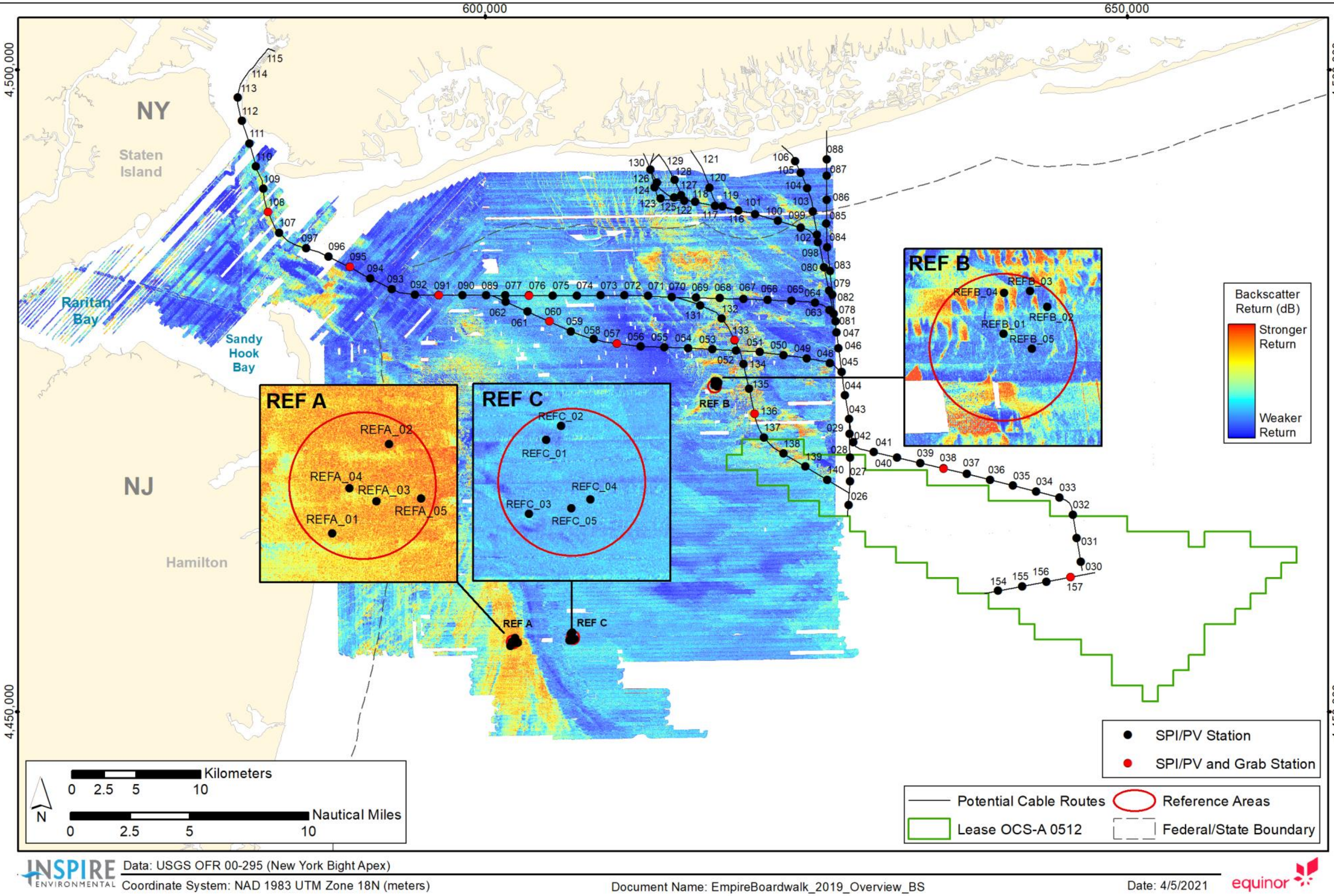

Figure 5.5-5 Empire Wind's Benthic Characterization Sampling in Submarine Export Cable Siting Corridors (2019)

Note: The submarine export cable route option exiting south from the Lease Area and to Jones Beach, New York, as reflected in this figure, has been removed from the PDE since Inspire collected this data and prepared its analysis.

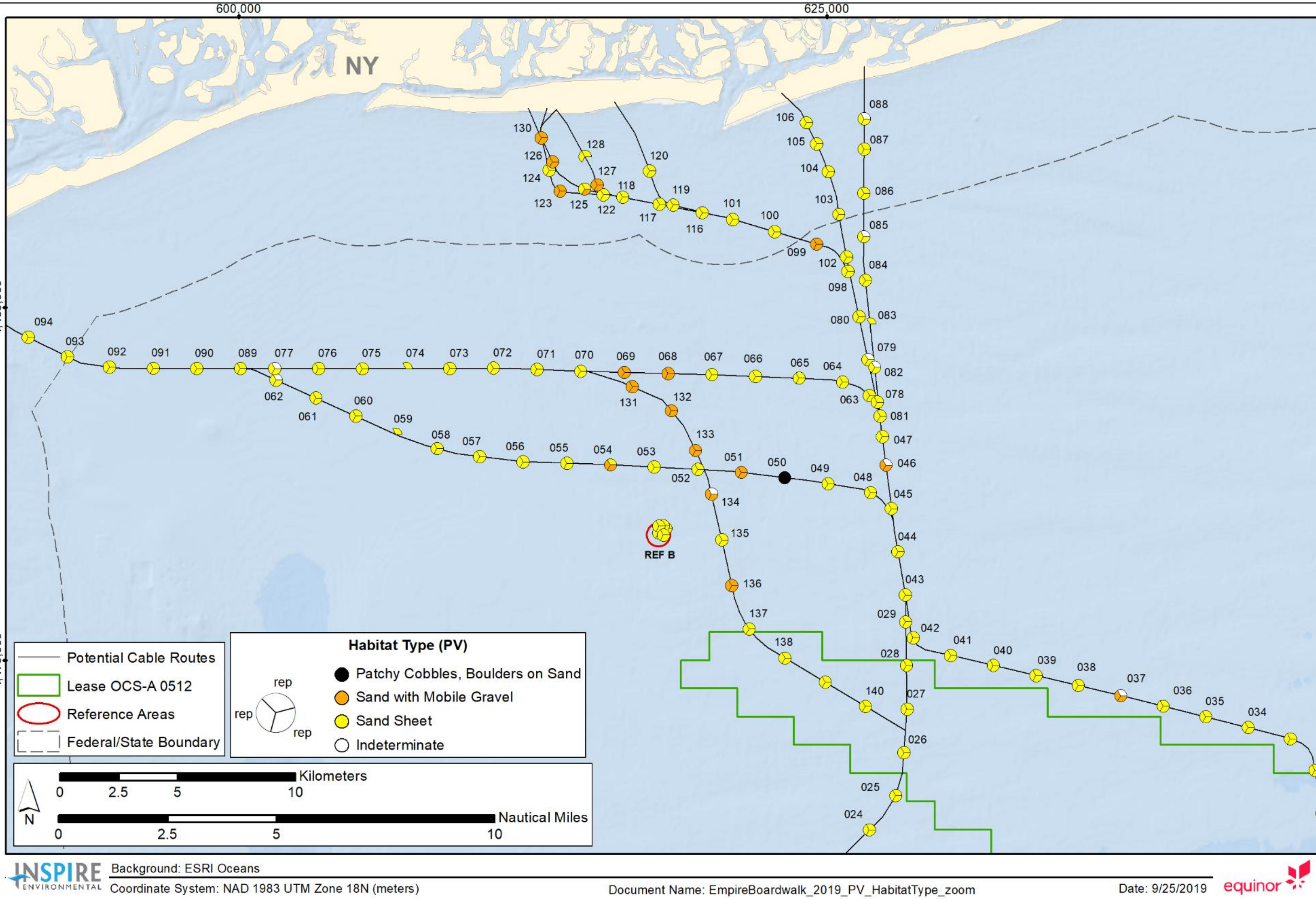

Figure 5.5-6 Limited Occurrence of Hardbottom Habitat Along the EW 1 and EW 2 Submarine Export Cable Siting Corridors

Note: The submarine export cable route option exiting south from the Lease Area and to Jones Beach, New York, as reflected in this figure, has been removed from the PDE since Inspire collected this data and prepared its analysis.

No hardbottom or sensitive species were observed in the 2019 EW 2 submarine export cable siting corridor survey. No black sea bass (*Centropristis striata*), Atlantic cod (*Gadus morhua*), ocean quahog (*Arctica islandica*), or Atlantic surfclam (*Spisula solidissima*) were observed in either corridor. Likewise, the NEFSC Fall Atlantic clam/ocean quahog survey reported no surfclam or ocean quahog at the single station within the EW 1 submarine export cable siting corridor (NEFSC 2018).

The USACE New York District surveyed portions of the New York/New Jersey Harbor in 2005 as part of a pre-dredging baseline characterization. Most of the samples were collected from within or adjacent to the channel, which had not been dredged for 22 years (USACE NYD 2006). Ambrose Channel, the main vessel route in the Lower Bay, contained mostly sand with some fine sand. Samples were also collected from the Bay Ridge Channel, which overlaps with the inshore portion of the EW 1 submarine export cable siting corridor. The sediments near the terminus of the EW 1 submarine export cable siting corridor consisted of very fine-grained particles (mud, clay, and silt) (USACE NYD 2006).

Several of Empire's 2019 SPI samples were collected in the EW 1 submarine export cable siting corridor to the north of the USACE channel sampling locations; both surveys were conducted during summer (**Figure 5.5-7**). Although collected 13 years apart and using different methods, the two datasets supported similar benthic characterization. This portion of the EW 1 submarine export cable siting corridor was dominated by relatively stable sand inhabited by soft-bodied infauna (e.g., polychaetes), hard-bodied mollusks (e.g., blue mussel), and mobile crustaceans (crabs). Both surveys identified blue mussel beds in the area just outside the Lower Bay (**Table 5.5-3**). Overall, benthic habitat and species assemblages were stable across years, showing little interannual variability.

In 2020, Empire conducted additional surveys of the EW 1 submarine export cable corridor combined grab sampling with towed video along 600-m transects to provide more detailed characterization of the substrate. Empire selected sample locations to ground-truth acoustic data, fill spatial gaps from prior surveys, and investigate known or expected complex habitat. The acoustic data showed benthic substrates in the EW 1 submarine export cable siting corridors as predominantly rippled sand with unevenly distributed gravels. All grab samples were classified as fine unconsolidated substrate of geologic origin, although grain size distribution varied among samples. Some nearshore locations were up to 99 percent silt/clay, while some locations farther offshore were less than 1 percent silt/clay. Slightly more than half of the grab samples (58 percent) were classified as sand or finer; 24 percent of the samples were gravelly sand. Of the 31 samples designated as complex habitat under the NOAA Fisheries (2021) modified CMECS guidelines (≥ 5 percent gravel), 5 samples had ≥ 30 percent gravel (**Appendix T, Attachment T-4, Table 3.8**). All grab samples were classified as CMECS Biotic Subclass soft sediment fauna. Three samples, all of which were dominated by fine sand, were also reported as CMECS Biotic Subclass Attached Fauna (**Appendix T, Attachment T-4, Table 4.6**).

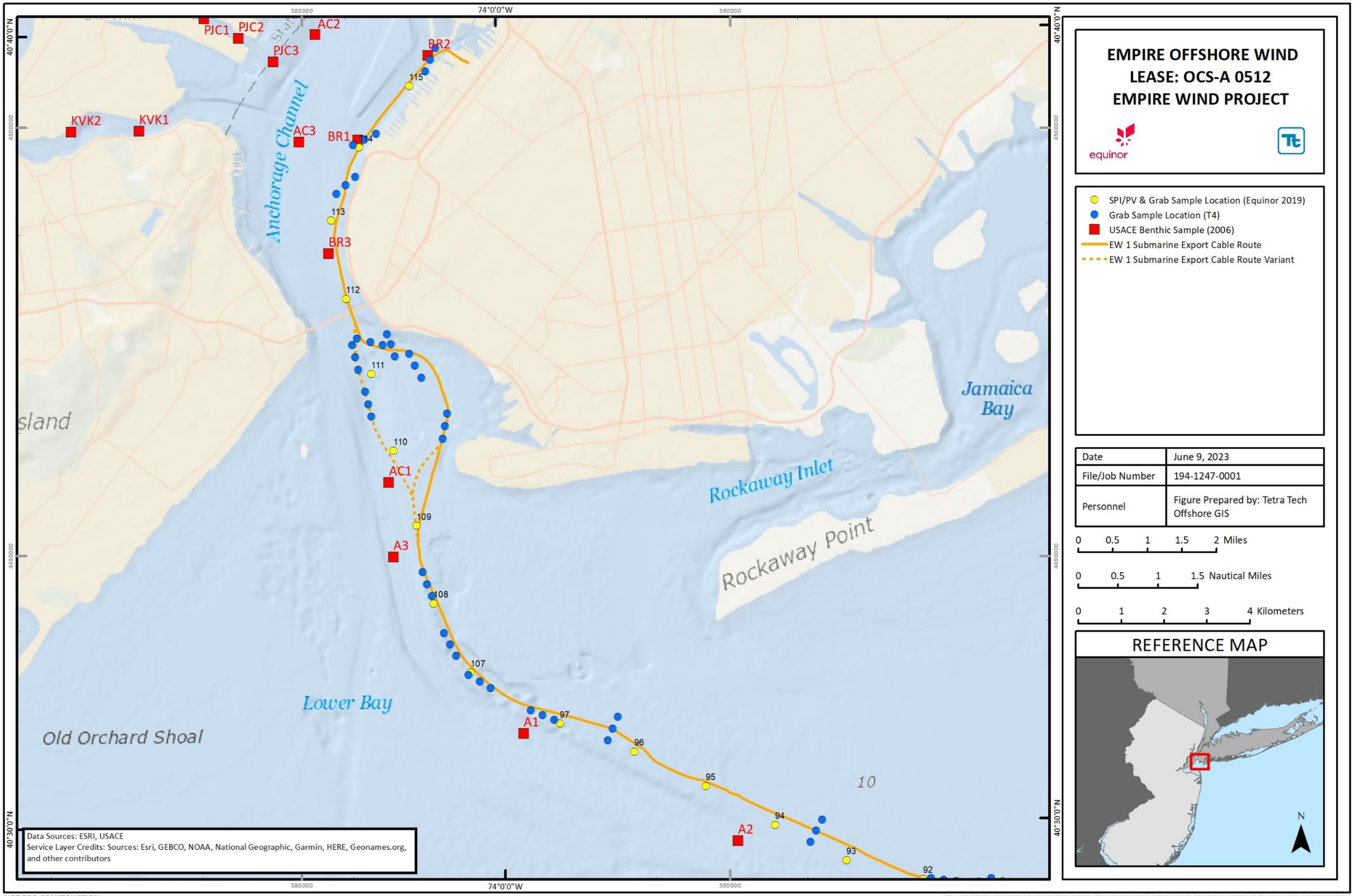

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Figure 5.5-7 Benthic Sample Locations in EW 1 Submarine Export Cable Siting Corridor (Empire's Characterization Sampling [2019 and 2021] and USACE NYD 2006)

Table 5.5-3 Benthic Characterization Data from USACE NYD (2006) and Empire (2019)

Sample Locations in or Adjacent to EW 1 Submarine Export Cable Siting Corridor	Number of Taxa	Dominant Taxa	Dominant Species	Notes	Grain Size
Ambrose					
USACE: A1, A2, A3	33	Annelids (52%); Arthropods (21%); Mollusks (21%)	Blue mussel (41% of total catch); amphipods; polychaetes; northern dwarf tellin	Pollution-sensitive taxa more common than pollution-tolerant tax (indicating relatively clean sediment)	Mostly sand, with some fine sand at A1; patches of fine and coarse sediments scattered in area
Empire: 095	--	Larger tube-building fauna; diverse soft sediment epifauna; small surface-burrowing fauna	Anemones; gastropods; hermit crabs	Indeterminate	Sand sheet
Empire: 097	--	Smaller tube-building fauna; small surface-burrowing fauna	Anemones; gastropods; hermit crabs; sand dollars	Indeterminate	Sand sheet
Empire: 108	--	Mussel beds; attached hydroids, attached sea urchins	Hydroids; spider crabs; sea urchins	Succession stage: 2 on 3	Indeterminate
Anchorage					
USACE: AC1	42	Annelids (55%); arthropods (19%); mollusks (21%)	Blue mussel (79% of total catch); amphipods; northern dwarf tellin; polychaete *Spio setosa*	Fewer pollution-tolerant taxa than other locations (indicating potential sediment constituents of concern)	Sand and rock; some patches of fine and coarse sediment
Empire: 109 and 110	--	Mussel beds; attached hydroids	Hydroids; mussels	Succession stage: 2 on 3	Sand sheet/indeterminate

Table 5.5-3 Benthic Characterization Data from USACE NYD (2006) and Empire (2019) (continued)

Sample Locations in or Adjacent to EW 1 Submarine Export Cable Siting Corridor	Number of Taxa	Dominant Taxa	Dominant Species	Notes	Grain Size
Bay Ridge					
USACE: BR1, BR2, BR3	20	Annelids (50%); arthropods (20%); mollusks (30%)	Dwarf surfclam (16% of total catch), northern dwarf tellin polychaeta (*Neptys* sp.)	More than half of all taxa were pollution-tolerant.	Mud, clay, silt at BR1 and BR2; shell at BR3; some fine and coarse sediments
Empire: 114	--	--	Indeterminate	Successional stage: 2 on 3	--
Empire: 115	--	--	Indeterminate	Successional stage: 2 on 3	--
Empire: 113	--	Indeterminate	Indeterminate	Successional stage: 2	Sand sheet

Sources:

USACE data are from Harborwide Benthic Monitoring Program Final Report, USACE NYD (2006).
Empire (2019) data are from Table 3-3b in **Attachment T-3** (Benthic Characterization)

Notes:
All sampling occurred in summer.
-- No data available

Video transects were analyzed to provide a broader spatial context in which to interpret the findings of the 26 grab samples. More than 2,200 still images were analyzed for percent cover of substrate types to characterize the transect areas using the NOAA Fisheries (2021) GARFO modified CMECS substrate classification. In addition, images were analyzed for features such as the density of shell and other biotic elements (e.g., algae, large macroinvertebrates, burrows and other signs of larger infauna) to characterize habitat complexity. Visible organisms covered only 21.5 ft^2 (2 m^2)of substrate in the 2020 EW 1 survey area, which is less than 1 percent of the bottom cover (**Appendix T, Attachment T-4, Table 3.6**). Complex substrate in the form of gravel, shell hash, and shell rubble was identified as the main CMECS classification in 786 ft^2 (73 m^2)of the analyzed area (26 percent). The grab samples from locations EW1-04-A1 and EW1-05-L1 illustrate complex habitat identified as gravelly sand using NOAA Fisheries (2021) GARFO modified CMECS substrate classification (**Figure 5.5-8**), corroborated by analysis of video images; this location is in the export cable corridor route variant offshore of Gravesend Bay (**Figure 5.5-7**).

Figure 5.5-8 Grab sample showing complex habitat at (a) EW1-04-A1 (left image) and (b) EW1-05-L1 (right image)

Empire conducted additional benthic surveys in EW 2 the submarine export cable corridor in 2020-2021. Methods were similar to those described for EW 1 (grab sampling with towed video along 600-m transects).

Grab samples were collected along 15 transects in water depths ranging from approximately 30 to 98 ft (9 to 38 m) in the EW 2 submarine export cable corridor; all 37 samples were classified as fine unconsolidated substrate slightly gravelly to gravelly sand. Megaripples present throughout the site were considered part of a wider area classified as Bedforms/Mobile Seabed. About 600 cobbles and boulders (approximately 0.1 to 1.9 m wide and 0.9 m above the seafloor) were detected along the survey route, with highest densities nearer to shore (**Appendix T, Attachment T-5**). All grab samples were classified as CMECS Biotic Subclass soft sediment fauna. The most common CMECS Biotic Subclass was Mobile Crustaceans on Soft Sediments (**Appendix T, Attachment T-5, Table 2.15**). The infaunal species assemblage in the survey area suggests a reasonably diverse community that has been subjected to relatively little disturbance or contamination. The grab samples were generally corroborated by acoustic data. Locations with higher SSS reflectivity were associated with fine sand with shell fragments and gravel and locations with medium SSS reflectivity were associated with fine to medium sand with occasional shell fragments and gravel. Stations with fine silty sand were associated with areas of lower SSS reflectivity.

Video transects were analyzed to provide a broader spatial context in which to interpret the findings of the 15 grab samples. More than 1,680 still images were analyzed for visible macroinvertebrates and fish. Sand dollars were observed in 77 percent of the photographs, invertebrate tubes in 42 percent, and mud snails (Nassariidae) in 30 percent. Siphons and dead shells of the ocean quahog were frequently sighted, especially in Transect EW2-14; the grab sample from this location contained two quahogs. Anthozoans (mostly burrowing anenomes) were encountered in most transects, with the highest density in Transect EW2-3. Winter skate were observed in 10 of the 15 transects above both fine sand and coarse substrate Skate egg cases were observed in all transects, but were most numerous in Transect EW2-5 where the substrate was characterized as slightly gravelly muddy sand (**Appendix T, Attachment T-5, Table 2.1**).

In addition, Empire conducted a focused survey of benthic habitats near the EW 2 landfall, collecting triplicate grab samples at 12 locations within about 4 km of the shoreline. One-third of the grab samples contained the ≥ 5 percent gravel that categorized complex habitat under the NOAA Fisheries (2021) GARFO modified CMECS guidelines. Ten of the complex samples had ≥ 30 percent gravel (**Appendix T, Attachment T-5, Table 3.8**). Polygordid polychaetes were the most common organisms in grab samples; more than 700 individuals were observed in 18 grab samples. Amphipods and mussels were also common. In 69 percent of the grab samples, the CMECS Biotic Group was classified as small-surface dwelling fauna, which included annelid worms, amphipods, and isopods. The Biotic Group in four grab samples was classified as mussel beds, which often also included with an assemblage of surface burrowing and small-tube building organisms (**Appendix T, Attachment T-5, Table 4.6**).

Empire had planned to collect approximately 1,969 ft (600 m) of towed video at each station, but shallow water, strong currents, high seas, and influences from the nearby Jones inlet interfered with video quality at the seven locations nearest shore. CMECS substrate classifications were derived from 370 still images. About 30 percent of the 2,260 ft^2 (210 m^2) of seafloor analyzed (approximately 678 ft^2 [63 m^2]) was classified as CMECS Substrate Group Sand/Mud. All transects were classified as CMECS Biotic subclass Soft Sediment Fauna, with mostly Mobile Mollusks as the Biotic Group.

Video and still images were analyzed for percent cover of substrate types to characterize the transect areas using the NOAA Fisheries (2021) GARFO modified CMECS substrate classification. The CMECS biotic component based on towed video data was determined using a combination of the still image biological element percent cover data and video review enumeration data. The percent cover data were considered first to determine the appropriate CMECS biotic classifications with enumeration data used to determine which megafauna species were most dominant when megafauna covered the first or second largest area within the transect. Megafauna (organisms larger than 4 mm) were observed in all five videos; moon snails were the most common organisms recorded (**Appendix T, Attachment T-6, Table 3.2)**. Visible organisms were sparse, covering less than 0.1 percent of the seafloor in the survey area; algae was the most dominant group.

The 2020/2021 surveys in the EW 2 submarine export cable siting corridor recorded maximum depths of 115 ft (35 m), relatively stable spring bottom temperatures (42.3 to 45.5 °F [5.7 to 7.5 °C]), salinities of 32 to 33 Practical Salinity Units, and unconsolidated sediment ranging from fine sand to gravelly sand. The EW 2 submarine export cable siting corridor was dominated by mobile sand, with slightly gravelly sand in topographic lows between bedforms. Of the managed species with EFH designated in the EW 2 submarine export cable siting corridor, the ocean quahog, spiny dogfish, and winter skate were observed in video and image assessments (**Appendix T, Attachments T-5 and T-6**). These species were primarily observed in the offshore portion of the EW 2 submarine export cable siting corridor at depths of 92 to 112 ft (28 to 34 m), fine sand to gravelly sand, and a mix of sand dollar beds and soft sediment fauna. No soft coral, lobster, seagrass, or squid eggs were observed during any of the benthic surveys.

Artificial hardbottom in the form of shipwrecks and intentionally placed artificial reefs provide the only substantial hard structure in the Project Area, other than the few small locations mentioned above. Six known shipwrecks are mapped in the deeper two-thirds of the Lease Area and numerous others are scattered within the submarine export cable siting corridors (**Figure 5.5-5**; see **Section 6.1 Marine Archaeological Resources** for additional information). New York and New Jersey have programs to place and manage artificial reefs in state waters to enhance fish habitat, largely for recreational anglers and divers. Four of New York's 12 artificial reefs are located near enough to the Project Area to serve as demonstrations of potential reef effects of the wind turbine foundations (NYSDEC 2019a). New Jersey's 17 artificial reefs cover about 25 square miles (65 km^2) of sea floor that supports recreational harvest of black sea bass, blackfish (*Tautoga onitis*), scup (*Stenotomus chrysops*), and American lobster (*Homarus americanus*; NJDEP 2019a). Artificial reefs in coastal New York waters are known for these species as well as summer flounder (*Paralichthys dentatus*), cod, and several species of edible crab. The distribution of charted recreational diving shipwrecks and state-managed artificial reefs within or adjacent to near the Project Area is shown on **Figure 5.5-9**.

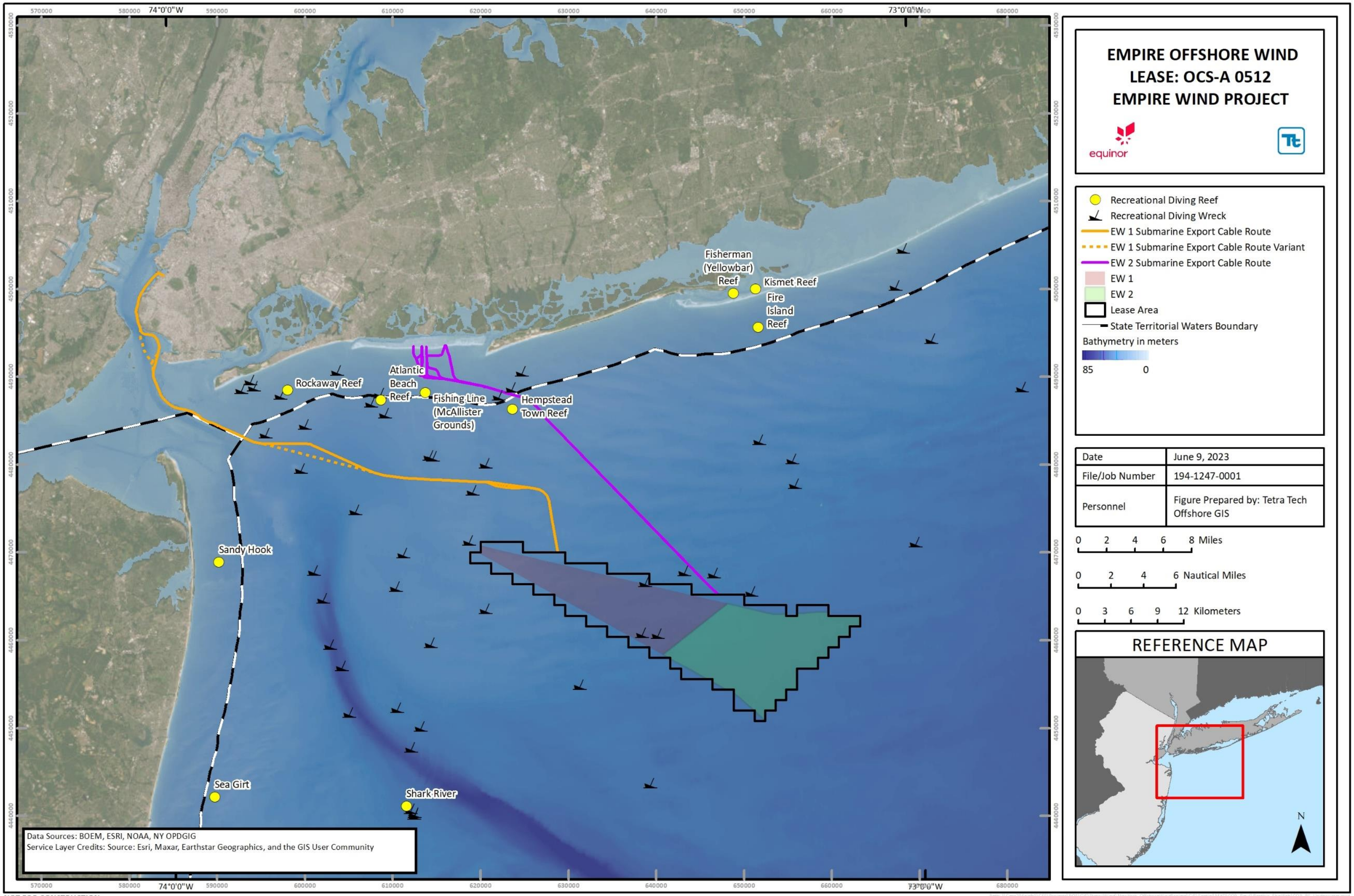

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Figure 5.5-9 Shipwrecks and Artificial Reefs in Project Vicinity

Pelagic Habitat

As described above, benthic habitats are strongly influenced by the overlying ocean, especially the top 600 ft (200 m) of the ocean known as the photic zone, where sunlight supports photosynthetic phytoplankton (Karleskint et al. 2006). The water column is particularly important for planktonic eggs and larvae of demersal species and all life stages of planktivorous species (NEFMC 2017; NOAA Fisheries 2017a). Oceanic currents, temperature, conductivity, pH, dissolved oxygen, and other features of the water column influence the occurrence and abundance of marine species in the Project Area (Pineda et al. 2007). Oceanic conditions in the Project Area are described in **Section 4.1 Physical and Oceanographic Conditions** and briefly summarized here.

Pelagic habitats extend from the sea surface to near the seafloor; habitats vary by depth, temperature, light penetration, distance from shore, turbidity, and other physical and chemical characteristics. Dynamic water quality parameters such as dissolved oxygen, pH, and conductivity are influenced by currents, human activities onshore, climate and weather, and other processes (see **Section 4.2 Water Quality**). Water depth is a key feature that affects the horizontal and vertical distribution of fish and macroinvertebrates within pelagic habitats. Other important features, such as light penetration, temperature, and dissolved oxygen, generally co-vary with depth, although the relationships can be complex and dynamic (see Section 5.5.1.4 on climate change). Waters on the continental shelf generally have adequate dissolved oxygen (more than 5 mg/L) to support marine organisms, although hypoxic conditions (less than 2.5 mg/L) occasionally occur in coastal waters during summer phytoplankton blooms (Slesinger et al. 2019). In the relatively confined waters of Upper and Lower Bays, dissolved oxygen was reported to exceed 5 mg/L consistently during several years of monitoring (USACE NYD 2015a).

Water depths within the Lease Area are relatively uniform, ranging from 65 to 147 ft (20 to 45 m); about 76 percent of the Lease Area is between 98 and 131 ft (30 and 40 m) deep. The federal portions of the submarine export cable siting corridors are in water from 36 to 92 ft (11 to 28 m). About 78 percent of the EW 1 submarine export cable siting corridor is less than 49 ft (15 m) deep. Approximately 92 percent of the EW 2 submarine export cable siting corridor is less than 49 ft (15 m) deep. Bathymetric contours are shown on **Figure 5.5-10**.

Water temperatures in the Lease Area vary seasonally and with depth. As described in **Section 4.1.1 Physical Oceanography and Meteorology**, surface waters fluctuate by as much as 32 °F (18 °C) and bottom temperatures by at least 14 °F (8 °C) throughout the year. Interannual variability in water temperatures is high, but general patterns are predictable: waters are always warmer at the surface and cooler at the bottom, with the magnitude of vertical difference greatest in spring and summer. Annual and vertical variability in temperatures are strong triggers of seasonal migrations that lead to changes in the distributions of adult benthic organisms and settlement of recruits from the plankton. The Lease Area is not markedly affected by any ocean fronts (Guida et al. 2017).

Benthic-Pelagic Coupling

As discussed above, the benthic habitats in the Project Area are dominated by unconsolidated soft-bottom sediments (e.g., sand, clay, mud) with small areas of gravel and pebbles. The pelagic habitats include the vertical extent of the water column from sea floor to the water's surface. Together, the benthic substrate and overlying water provide supportive habitat for demersal (associated with the sea floor) and pelagic (associated with the water column) fish and invertebrates.

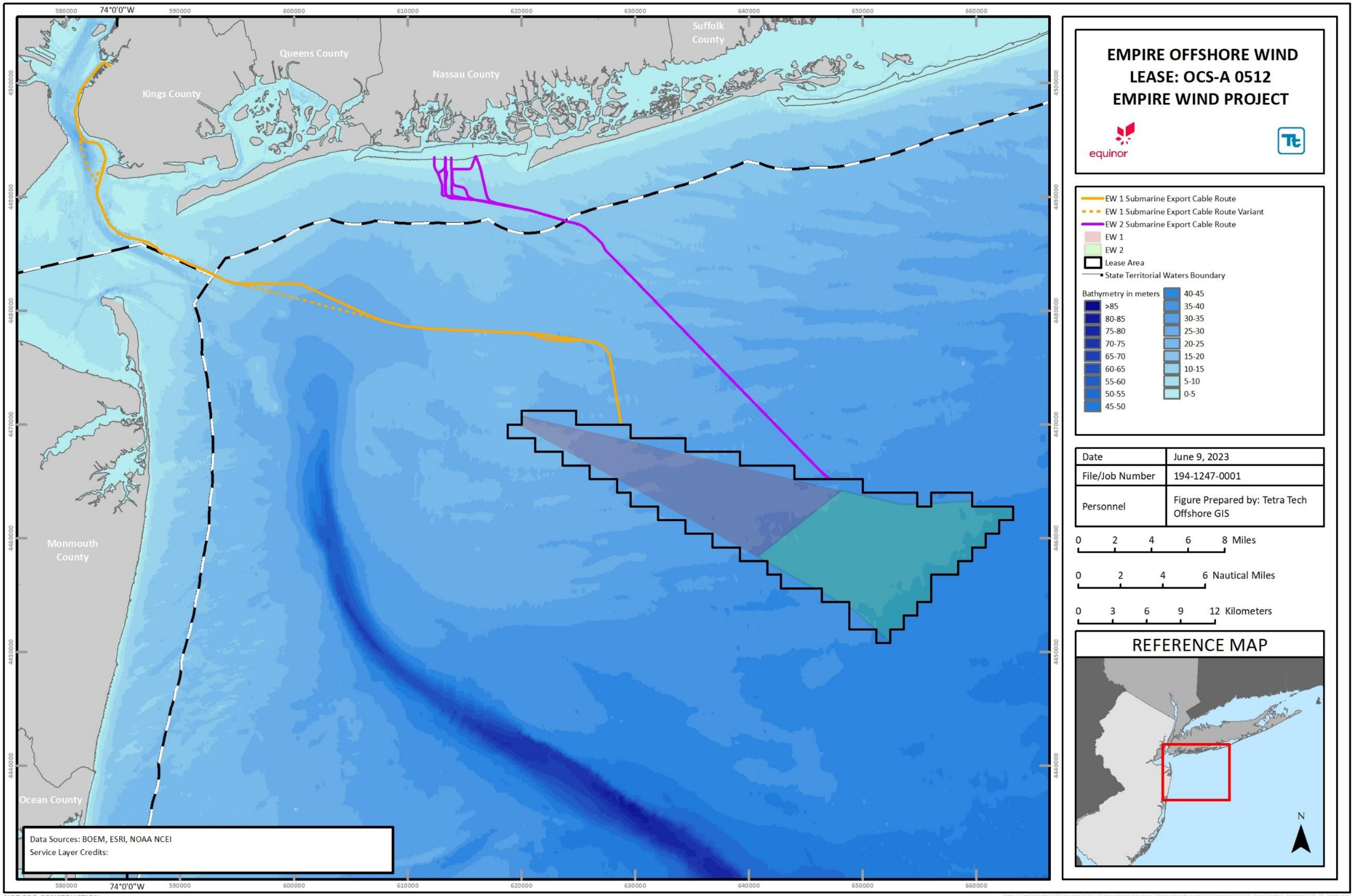


Figure 5.5-10 Bathymetry in the Study Area

Marine communities are supported by phytoplankton (diatoms, dinoflagellates, and others) that thrive where nutrients and sunlight are abundant. The coast of the New York Bight is known for abundant phytoplankton, sustained by nutrients carried to the well-lit surface waters by upwelling. Phytoplankton are essential food for zooplankton (tiny animals such as copepods and larval forms of crustaceans, bivalves, and other invertebrates) and ichthyoplankton (fish larvae).

Although benthic and pelagic habitats are often discussed separately, most marine species are associated with both habitats. Marine communities are sustained by benthic-pelagic coupling in which energy is continuously transferred between the seafloor and water column through foraging, animal waste, and decomposition. For example, many invertebrates live relatively sedentary lives buried or burrowed into the softbottom sea floor. These organisms are collectively known as infauna because they live within the top layer of sediment, with only their respiratory or feeding appendage extended into the water column. Infaunal organisms such as amphipods, polychaetes, and clams feed on plankton and nutrient-rich detritus in the overlying water. Organisms that live on or attached to the seabed or submerged objects are known as epifauna; common examples include sponges, sea stars, hermit crabs, and moon snails.

Benthic-pelagic habitat coupling is essential for the sustainability of a healthy ecosystem that supports the species of interest in the Project Area. Many key benthic life stages depend on pelagic habitats for feeding and/or reproducing. For example, the Atlantic sea scallop's eggs are fertilized on the seafloor, then transform within 24 hours to planktonic larvae. After drifting as planktonic larvae for five to six weeks (generally southward), juvenile scallops recruit to the substrate where they filter-feed on plankton, enrich the sediment with their wastes, and release the next generation to the overlying water (Munroe et al. 2018). The Atlantic surfclam life history is similar, with a three to four week planktonic larval stage during which the larvae may be transported far to the south (Cargnelli et al. 1999a). After recruiting to the bottom, adult surfclam live out their lives as infauna buried in soft sediment and feeding on plankton filtered from the water column.

The designation of EFH explicitly recognizes the joint contribution of benthic and pelagic habitat components in designating specific bottom types, water depths, and prey sources as essential to managed species (NEFMC 2017). Although many managed fish and invertebrate species are discussed in this section, detailed descriptions and analysis of impacts to EFH are in **Appendix U**.

Demersal Species and Life Stages

Demersal organisms and/or life stages are those that are oriented physically and behaviorally toward the seafloor; including the infaunal and epifaunal invertebrates described previously and fishes that preferentially forage on the bottom. Burrowing infaunal organisms (e.g., amphipods, clams, polychaetes, sand lances) create a complex microhabitat at the sediment-water interface as they filter water, mix and redistribute sediment, oxygenate subsurface sediment, and recycle nutrients (Rutecki et al. 2014). The infaunal assemblage is eaten by demersal fish and invertebrates such as gastropods (whelks, moon snails), sea stars, horseshoe crab (*Limulus polyphemus*), lobster, swimming crabs, fish (especially flatfish and skates), and other demersal predators.

Commercially valuable demersal fish and invertebrates in the Project Area include haddock (*Melanogrammus aeglefinus*), flounders, hakes, scup, black sea bass, bluefish (*Pomatomus saltatrix*), spiny dogfish (*Squalus acanthias*), skates, species managed under multispecies groundfish plans, horseshoe crab, ocean quahog, surfclam, scallop, and others (Guida et al. 2017, Petruny-Parker et al. 2015). Although demersal fishes and invertebrates are closely associated with benthic habitats as adults, many species interact with overlying pelagic habitats through predator-prey interactions, early life stage dispersal, or seasonal migrations (Malek et al. 2014).

For example, the ecologically important adult sand lances (*Ammodytes* spp.) burrow in sand but forage on zooplankton carried on currents. Adults are present year-round in the Project Area and are heavily preyed upon by demersal fishes (cod, silver hake [*Merluccius bilinearis*], yellowtail flounder [*Pleuronectes ferrugineus*]) as well as more pelagic predators (bluefish, Atlantic mackerel [*Scomber scombrus*], bluefin tuna [*Thunnus thynnus*], and whales) (MAFMC 2017; NOAA Office of National Marine Sanctuaries 2017). The sand lance lays demersal eggs that hatch into planktonic larvae (Able and Fahay 1998). Similarly, the winter flounder (*Pleuronectes americanus*) is demersal during the adult and egg stages, but planktonic during the larval stage.

Other fishes are demersal only as adults, releasing pelagic eggs that hatch into planktonic larvae. Examples in the Project Area include hakes, windowpane flounder (*Scophthalmus aquosus*), yellowtail flounder, summer flounder, winter flounder, monkfish (*Lophius* spp.), black sea bass, and others (NEFMC 2017 and references within; Able and Fahay 1998). Many of these species, notably black sea bass, hakes, and some flounders, spawn elsewhere, but their planktonic larvae drift or juveniles recruit to the bottom within the Project Area.

The fishes in the Project Area with the most consistent demersal exposure are skates, which have no pelagic or planktonic life stage. The little skate (*Leucoraja erinacea*), which dominates the fish fauna year-round in the Project Area, forages almost exclusively on benthic amphipods, crabs, shrimp, and polychaetes, taking a few fish only in later years. The winter skate also eats burrowing sand lance (Smith and Link 2010). Winter skate were observed during Equinor's benthic surveys in the Lease Area (**Appendix T, Attachment T-2**) and the EW 2 submarine cable corridor (**Appendix T, Attachment T-5).**

The longfin inshore squid (*Doryteuthis pealeii*) illustrates the reverse of the demersal adult-pelagic larvae life cycle. Adult squid live in the water column but attach their eggs (known as squid mops) to hardbottom, empty shells on sandy bottoms, and artificial structures; the squid mops remain on the bottom for up to four weeks before hatching into paralarvae that migrate to the sea surface, where they feed on copepods and other zooplankton (Cargnelli et al. 1999b). Squid mops have been observed in the Project Area, as discussed in Guida et al. (2017) and elsewhere in this Section.

Pelagic Species and Life Stages

The most numerically abundant component of the pelagic fish community in the open waters of the Project Area is the ichthyoplankton assemblage. Buoyant eggs and larvae of most marine fishes in Southern New England can remain in the plankton stage for weeks to months (Walsh et al. 2015). Plankton were prevalent in acoustic surveys in the Lease Area in 2018, where strong evidence of diel vertical migrations of both plankton and small fish were reported (Battista et al. 2019). The assemblage of species represented in the ichthyoplankton varies seasonally and is strongly influenced by water temperature; patterns of ichthyoplankton assemblages have changed in recent decades, likely in response to climate change (discussed below; MAMFC 2017; Walsh et al. 2015).

Some species in the Project Area are truly pelagic, living in the water column throughout their lives. Planktivorous coastal pelagic forage species are typically small and shiny, with schooling tendencies, as characterized by the Atlantic menhaden (*Brevoortia harengus*), Atlantic herring (*Clupea harengus*), Atlantic saury (*Scomberesox saurus*), and smaller mackerels (MAFMC 2017). The forage species tend to be short-lived, fast-maturing, and highly fecund, with wide fluctuations in abundances from year to year. Species abundances do not necessarily rise and fall in synchrony, so migratory predators target whichever prey is available in a given place (Suca et al. 2018). Squid and butterfish (*Peprilus triacanthus*) function as forage as juveniles then shift to a predatory niche as they mature. Interannual variability in recruitment in many species can drive peaks in abundance for a given species unrelated to standing stock (Bethoney et al. 2016). These small pelagic forage fishes transfer energy from zooplankton to top predators such as shortfin mako shark (*Isurus oxyrinchus*), porbeagle shark, thresher shark, Atlantic mackerel, tunas, bluefish, mahi-mahi, and sharks (Suca et al. 2018). For example, the bluefin tuna feeds predominantly on Atlantic mackerel and squid in the Mid-Atlantic Bight (Chase 2002). Most of the highly migratory species migrate to nearshore waters of New York as waters warm in the spring (Able and Fahay 1998; NOAA Fisheries 2017a).

5.5.1.2 Fish and Macroinvertebrates

Managed and Exploited Species: Essential Fish Habitat and Habitat Area of Particular Concern

In the Project Area, NEFMC and MAFMC share authority with NOAA Fisheries to manage and conserve fisheries in federal waters. Together with NOAA Fisheries, the councils maintain FMPs for specific species or species groups to regulate commercial and recreational fishing within their geographic regions (**Table 5.5-4**). NOAA Fisheries' HMS Division is responsible for tunas and sharks in the Project Area (NOAA Fisheries 2017a). The ASMFC manages more than two dozen fish and invertebrate species in cooperation with the states and NOAA Fisheries. Coastal Migratory Pelagic species are managed jointly by the Gulf of Mexico and South Atlantic Fishery Management Councils from the Mexico/Texas border to New York.

Managed finfish with designated EFH in the Project Area were identified using the EFH data inventory in each FMP and the online EFH Mapper. EFH habitat categories were based on the EFH descriptions within each of the EFH source documents, as summarized in **Appendix U**.

Table 5.5-4 Summary of Fisheries Management in the Project Area

<table>
<tr><th>Managing Agency or FMC</th><th>Fishery Management Plan</th><th>Reference</th></tr>
<tr><td rowspan="6">NEFMC</td><td>Atlantic Herring FMP</td><td rowspan="6">NEFMC (2017). Omnibus Essential Fish Habitat Amendment 2
• Amendment 14 to the Northeast Multispecies FMP
• Amendment 14 to the Atlantic Sea Scallop FMP
• Amendment 4 to the Monkfish FMP
• Amendment 3 to the Atlantic Herring FMP
• Amendment 2 to the Red Crab FMP
• Amendment 2 to the Skate FMP
• Amendment 3 to the Atlantic Salmon FMP
Including a Final Environmental Impact Statement</td></tr>
<tr><td>Atlantic Salmon FMP</td></tr>
<tr><td>Monkfish FMP</td></tr>
<tr><td>Northeast Multispecies FMP (large mesh and small mesh groundfish)</td></tr>
<tr><td>Northeast Skate Complex FMP</td></tr>
<tr><td>Atlantic Sea Scallop FMP</td></tr>
</table>

Table 5.5-4 Summary of Fisheries Management in the Project Area (continued)

Managing Agency or FMC	Fishery Management Plan	Reference
MAFMC	Atlantic Mackerel, Squid, and Butterfish FMP Bluefish FMP Spiny Dogfish FMP Summer Flounder, Scup, Black Sea Bass FMP Surf Clam and Ocean Quahog FMP	MAFMC (2017). Unmanaged Forage Omnibus Amendment: • Amendment 20 to the Summer Flounder, Scup, and Black Sea Bass FMP • Amendment 18 to the Mackerel, Squid, and Butterfish FMP • Amendment 19 to the Surf Clam and Ocean Quahog FMP • Amendment 6 to the Bluefish FMP • Amendment 5 to the Tilefish FMP • Amendment 5 to the Spiny Dogfish FMP Including an Environmental Assessment, Regulatory Impact Review, and Regulatory Flexibility Act Analysis
NOAA Fisheries	Atlantic Highly Migratory Species	NOAA Fisheries (2017a). Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat.
ASMFC	American Lobster, Atlantic Croaker, Atlantic Herring, Atlantic Menhaden, Atlantic Striped Bass, Atlantic Sturgeon, Black Sea Bass, Bluefish, Coastal Sharks, Horseshoe Crab, Jonah Crab, Scup, Shad & River Herring, Spanish Mackerel, Spiny Dogfish	ASMFC (2018d). Annual Report. Amendment 31 to the Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Coastal Migratory Pelagics Resources in the Gulf of Mexico and Atlantic Region (2019) Numerous stock assessments
Gulf of Mexico and South Atlantic FMCs	Coastal Migratory Pelagics	Coastal Migratory Pelagic (Mackerel) FMP for the Gulf of Mexico and South Atlantic regions

The spatial overlap of EFH and Project components was evaluated initially using plan-view maps in the EFH Mapper and habitat descriptions in EFH source documents, as described in **Appendix U**. Managed species in the Project Area are listed in **Table 5.5-5**. Species profiles and maximum acreages of designated EFH for each life stage of managed species in the Project Area are provided in **Appendix U, Attachment U-1**.

Table 5.5-5 Managed Species in the Project Area a/

New England Fishery Management Council	Mid-Atlantic Fishery Management Council	Gulf of Mexico and South Atlantic FMCs (Coastal Migratory Pelagics)	NOAA Fisheries (Highly Migratory Species)	Atlantic States Marine Fisheries Commission
Atlantic Cod	Atlantic Butterfish	King Mackerel	Atlantic Albacore Tuna	American Eel
Atlantic Herring b/	Atlantic Mackerel	Spanish Mackerel b/	Atlantic Bluefin Tuna	American Lobster
Atlantic Sea Scallop	Atlantic Surf Clam		Atlantic Skipjack Tuna	Atlantic Menhaden
Clearnose Skate	Black Sea Bass b/		Atlantic Yellowfin Tuna	Atlantic Striped Bass
Haddock	Bluefish b/		Blue Shark	Atlantic Sturgeon
Little Skate	Longfin Inshore Squid		Common Thresher Shark	Cobia
Monkfish c/	Ocean Quahog		Dusky Shark	Horseshoe Crab
Ocean Pout	Scup b/		Sand Tiger Shark	Jonah Crab
Pollock	Spiny Dogfish b/ c/		Sandbar Shark	Shad & River Herring
Red Hake	Summer Flounder b/		Shortfin Mako Shark	Tautog
Silver Hake			Smoothhound Shark/Smooth Dogfish	Weakfish
White Hake			Tiger Shark	
Windowpane Flounder			White Shark	
Winter Flounder b/				
Winter Skate				
Witch Flounder				
Yellowtail Flounder				

Notes:
a/ See **Appendix U** for distribution of EFH and species profiles
b/ Joint management with ASMFC
c/ Joint management by NEFMC and MAFMC

Fisheries Management Councils and NOAA Fisheries may also designate Habitat Areas of Particular Concern (HAPC), defined as a subset of the habitats that a species is known to occupy, to conserve fish habitat in geographical locations particularly critical to the survival of a species. All seagrass is designated as HAPC for summer flounder. There is no designated HAPC in the Project Area (NOAA Fisheries 2018a; NYSDEC 2018). The nearest HAPC to the Project Area is for summer flounder and consists of seagrass beds located inshore of Jones Beach on Long Island, which is 5 nm (9.3 km) from the EW 2 submarine export cable siting corridor (**Figure 5.5-11**).

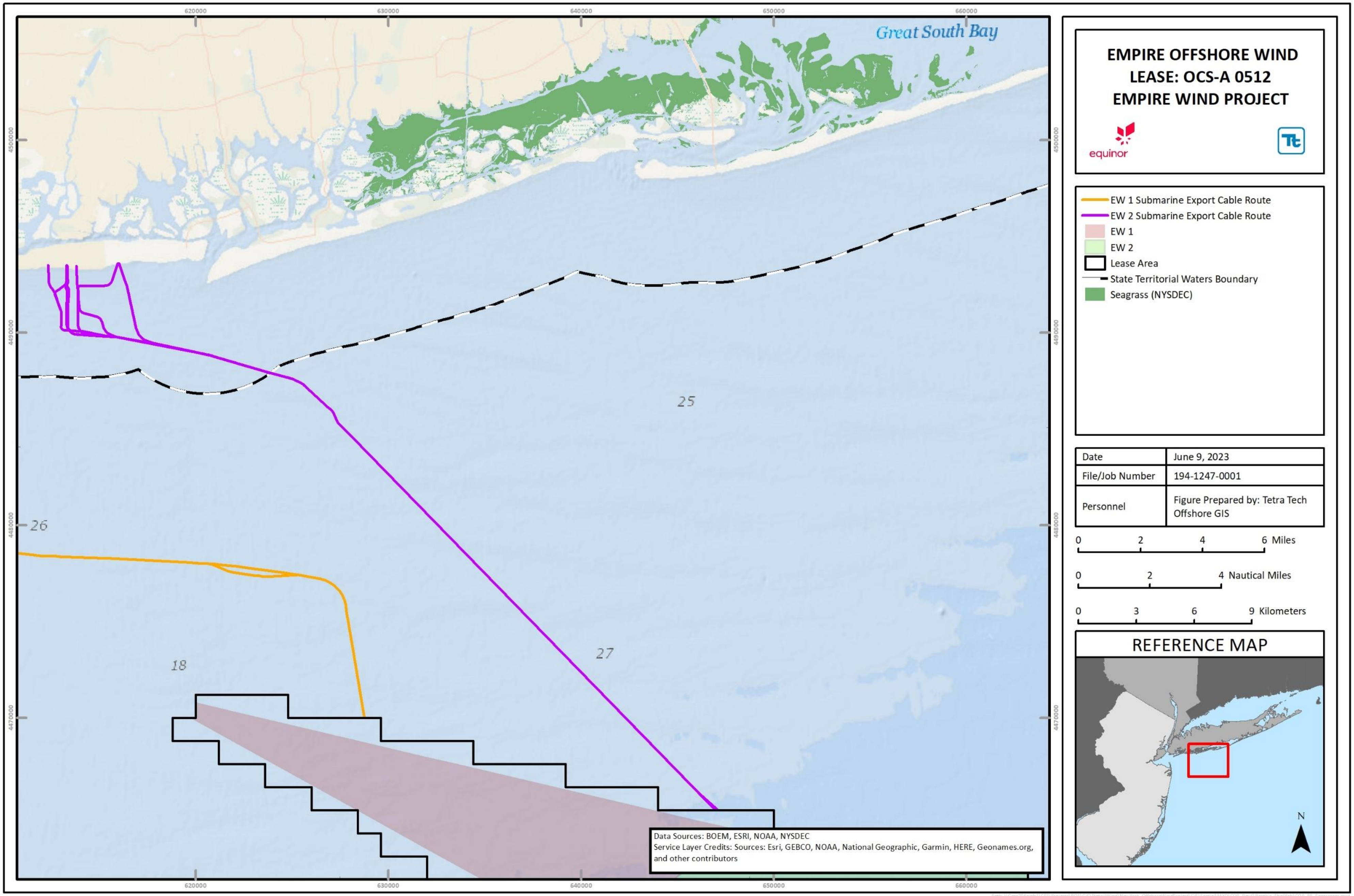


Figure 5.5-11 NYSDEC Statewide Seagrass Map (2018) and EW 2 Submarine Export Cable Siting Corridor

Commercial and recreational fisheries in state waters are further managed by state regulatory bodies. Each coastal state has its own structure of agencies and plans governing fisheries resources. Additionally, the New York and New Jersey offices of Coastal Zone Management are responsible for managing impacts to coastal habitat and living resources, including fish and invertebrates.

In New York, the NYSDEC Division of Marine Resources administers all laws relating to marine fisheries (NYCRR § 6:1 Subchapter C - Fishing) and is responsible for the development and enforcement of regulations pertaining to Marine Fisheries, Shellfisheries, and Marine Habitat. NYSERDA's (2017) summary report of fish and fisheries resources in the New York WEA identified scallop, squid, monkfish, mackerel, summer and winter flounder, skates, herring, clams, crabs, lobster, whelk, bluefish, black sea bass, spiny dogfish, scup, cod, pollock (*Pollachius virens*), striped bass, tunas, and sharks as important to commercial and recreational fishing interests in the state, although scallop abundance is greatest in waters farther offshore and deeper than the Lease Area (Stokesbury et al. 2014). The goal of the NYSERDA studies was to review areas off New York that may be suitable for future wind development. The Area of Analysis evaluated in NYSERDA (2017) included about 85 percent of the Lease Area. No part of the EW 1 or EW 2 submarine export cable siting corridors were included in the NYSERDA summary reports.

In New Jersey, the NJDEP Bureau of Marine Fisheries administers all laws relating to marine fisheries (§ 7:25, Subchapter 18 – Marine Fisheries) and is responsible for the development and enforcement of regulations pertaining to marine fish and fisheries in New Jersey waters. Additionally, New Jersey recently passed the Shore Tourism and Ocean Protection from Offshore Oil and Gas Act to direct policies of New Jersey's federally approved Coastal Management Program aimed at protecting sensitive coastal habitats from offshore oil and gas development while promoting offshore wind energy. Supporting documents specifically call out the importance of surfclam, ocean quahog, Atlantic scallop, scup, summer flounder, and black sea bass to New Jersey's economy and culture (NJDEP 2018). The NJDEP Division of Fish & Wildlife lists the Atlantic and shortnose sturgeon as endangered[8].

Numerous long-term fisheries surveys and geophysical datasets support the characterization of baseline fisheries resources in the Project Area. Multi-year regional surveys can provide greater certainty than brief site-specific surveys and may support temporal analysis across seasons or years. For example, analysis of the effects of fishing pressure and water temperatures on summer and winter flounder populations were supported by decades of commercial landing data and fisheries-independent surveys (Bell et al. 2014). However, fisheries distributions in Southern New England are undergoing marked changes in response to ocean warming (Hare et al. 2016). In light of the large regional shifts of numerous species, the most recent 10 to 15 years of long-term trawl data may be more representative of "current" conditions (Guida et al. 2017); locations of recent NEFSC seasonal trawl surveys in the Lease Area are shown on **Figure 5.5-12**.

In anticipation of the development of offshore wind projects, a Benthic Habitat Team comprised of experts from NOAA Fisheries and BOEM characterized fisheries resources within the New York WEA using long-term regional datasets and site-specific surveys within the WEA. The resulting habitat assessment highlighted several features of the Project Area relevant to finfish and macroinvertebrates: (1) the rarity of cod in the Lease Area; (2) the affinity of black sea bass with structures; (3) the presence of longfin squid egg mops on hard surfaces; (4) the substantial seasonal shift in dominant species; and (5) the near-ubiquitous presence of prey (sand shrimp [*Crangon septemspinosa*], common sand dollar, and juvenile fishes of many species) in sandy habitat in the Lease Area (Guida et al. 2017).

[8] https://nj.gov/dep/fgw/tandespp.htm

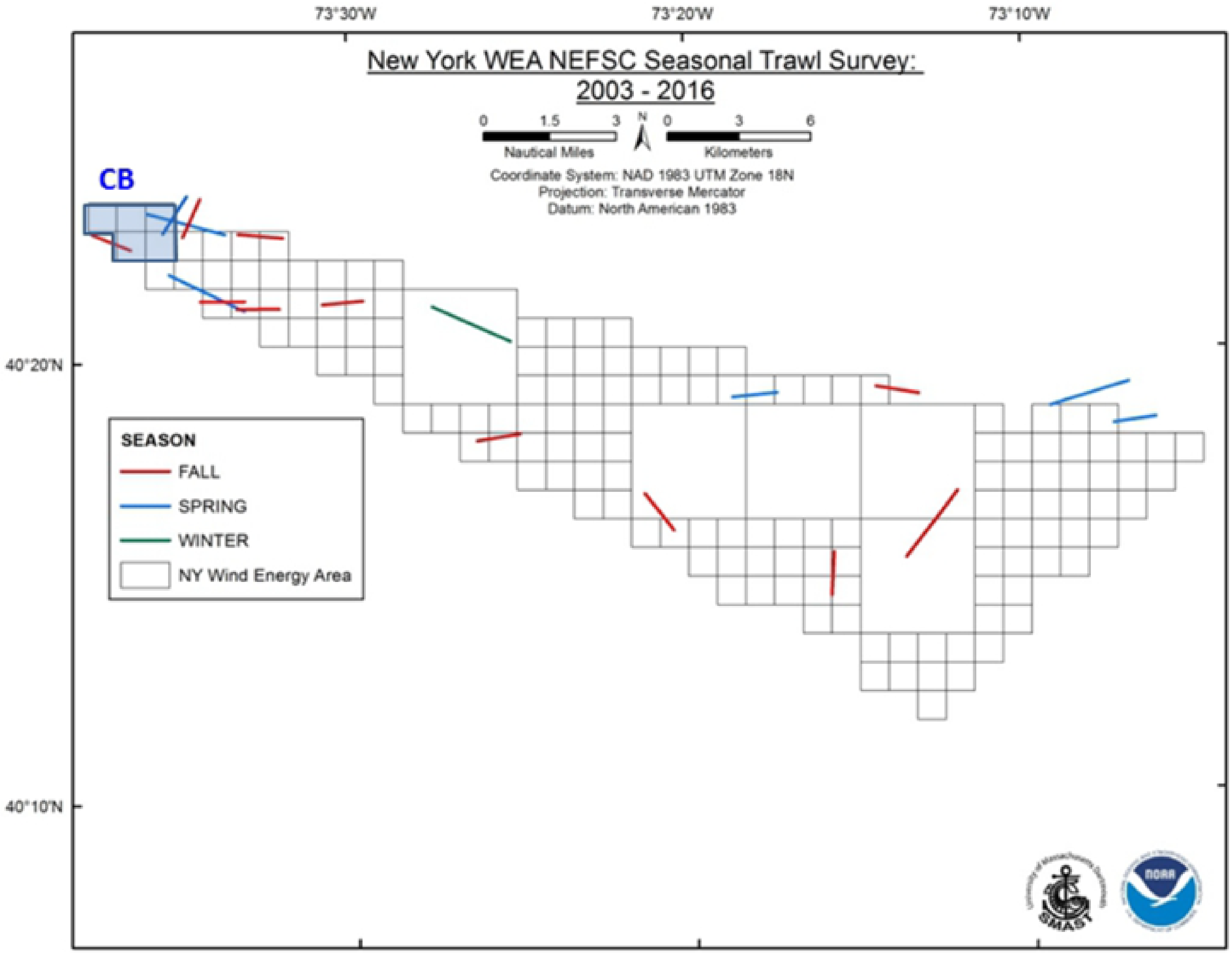


Figure 5.5-12 Locations of NEFSC Seasonal Trawl Surveys in the Lease Area (2003-2016) (from Guida et al. 2017)

Note: CB indicates Cholera Bank, which was excluded from the Lease Area and is no longer part of the BOEM OCS-A 0512 Lease Area

Dominant commercially important species collected in NEFSC seasonal trawls (2003–2016) in the Lease Area were identified as Atlantic herring, little skate, and winter skate in the cold season and butterfish, little skate, longfin squid, and sea scallop in the warm season (Guida et al. 2017). Atlantic herring, butterfish, and squid are seasonal migrants; the others are year-round residents. Of the 44 taxa collected in cold-season NEFSC trawls, the little skate was dominant by all measures: percent catch by number (greater than 25 percent), percent catch by weight (greater than 50 percent), and frequency of catch (100 percent). Little skate was also the only species to occur in all cold-season trawls in the Lease Area (Guida et al. 2017). Warm-season NEFSC trawls in the Lease Area yielded 58 taxa. The longfin squid was numerically dominant (approximately 35 percent of the total catch), with river herring (alewife [*Alosa pseudoharengus*] and blueback herring [*Alosa aestivalis*]) making up the next 20 percent. In addition to little skate, fourspot flounder, summer flounder, sea scallop, longfin squid, silver hake, and spotted hake (*Urophycis regia*) were each represented in more than 60 percent of the warm-season trawls in the Lease Area (Guida et al. 2017).

Squid mops were collected in beam trawls during BOEM's baseline characterization study of the Lease Area in August 2016; many were attached to empty surfclam shells (Guida et al. 2017). Spawning squid and squid mops are typically most abundant nearshore from May through August (Hendrickson 2018). While approximately 19 percent of the Lease Area (14,902 acres [6,030.6 ha]) is designated EFH for squid eggs, Guida et al. (2017) reported that squid mops were distributed widely across the Lease Area, outside of EFH boundaries, and suggested that the EFH for squid eggs should be expanded. The submarine export cable siting corridors also broadly intersect with squid egg EFH (see **Appendix U, Attachment U-1**).

During Empire's 2018 benthic survey in the Lease Area, the most abundant fish in the digital imagery was the winter skate (**Figure 5.5-13**); 30 individuals were observed at 20 stations within designated EFH for this species (see **Appendix U**). More than 400 skate egg cases were seen throughout the Lease Area (at all but five stations). Forty-one individual silky shark (*Carcharhinus falciformis*) were seen at 14 stations (**Figure 5.5-14**). Several northern sea robin (*Prionotus carolinus*) were also reported (see images in **Appendix T, Attachment T-2**).

Figure 5.5-13 Winter Skate and Sand Dollar at Lease Area Location ENV54

Figure 5.5-14 Silky Shark, Skate Egg Case, and Sand Dollar at Lease Area Location ENV40

Fish were rarely observed in images collected by NOAA during the 2018 habitat mapping survey of the Lease Area (Battista et al. 2019). The only vertebrates reported were skates (*Leucoraja* spp.), which were observed at about 2.4 percent of the 300 stations (**Figure 5.5-15**). In acoustic surveys, which detect pelagic but not demersal species, fish were observed more often in the nearshore than the offshore portion of the Lease Area. Small pelagic fish were reported to make nightly vertical migrations toward the sea surface, possibly chasing plankton or avoiding predators in deeper waters (Battista et al. 2019).

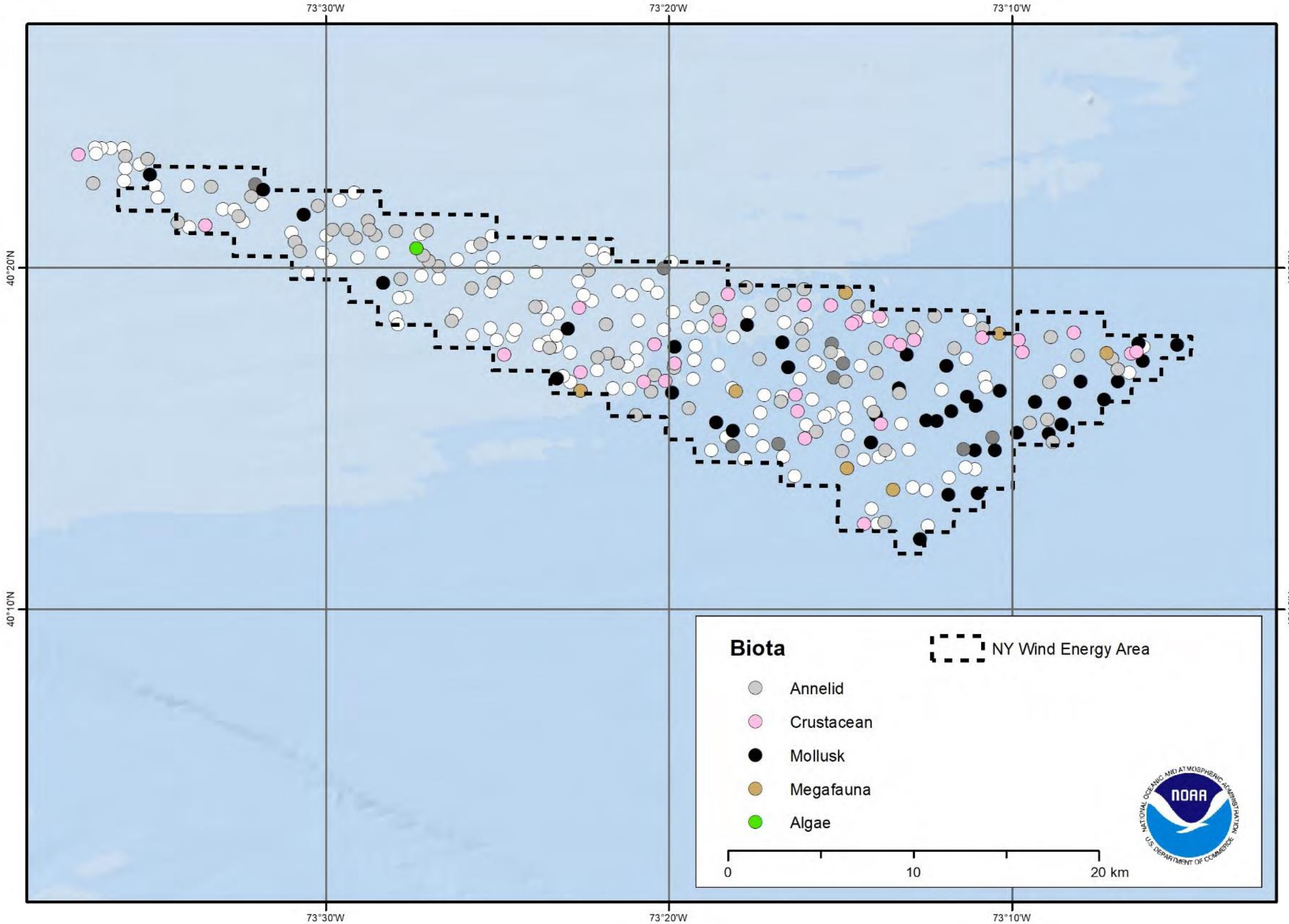


Figure 5.5-15 Epifauna, Megafauna, and Algae Observed in 2018 Surveys (Battista et al. 2019)

Note: All megafauna (brown dots) consisted of skates

In a review of numerous published data sources, NYSERDA (2017) identified the following important species in the Lease Area: scallops, squid, monkfish, mackerel, summer and winter flounder, skates, herring, clams, crabs, lobster, whelk, bluefish, black sea bass, spiny dogfish, scup, cod, pollock, striped bass, and highly migratory species such as tunas and sharks. Representatives from the fishing industry also identified tautog, cod, and bluefish as important in the Southern New England region overall, but did not distinguish relative importance in the New York WEA (NAS 2018). Marine fisheries staff from NJDEP identified tautog, menhaden, river herring, surfclam, and ocean quahog as species of interest in the Project Area (Meeting with NJDEP February 26, 2019).

These results were congruent with the summary of resources in the Lease Area in Guida et al. (2017), NYSERDA (2017), Battista et al. (2019), and other sources, which reported the dominance of skates, specifically the little skate and winter skate. Likewise, the one station in the Lease Area sampled during the NEFSC Cooperative Monkfish Survey (NEFSC 2009) yielded 72 percent little skate (by weight), with winter skate as the next highest contributor. Low numbers of yellowtail flounder and ocean pout (*Zoarces americanus*) were also captured.

The most recent NEFSC Spring Bottom Trawl catch report included two stations in the EW 1 submarine export cable siting corridor (NEFSC 2019). Target species made up most of the catch at these stations, which were dominated by little skate and winter skate, and included a few winter flounder and Atlantic cod. Skate egg cases were the most abundant vertebrate encountered in videos during Empire's 2021 survey of the EW 1 submarine export cable corridor (**Appendix T, Attachment T-4**). Empire's 2020 benthic surveys in the EW 2 submarine export cable corridor noted winter skate in videos in 10 of the 15 transects (**Appendix T, Attachment T-5**). Winter skate was also the most frequently observed fish in videos in the nearshore survey transects in the EW 2 corridor (**Appendix T, Attachment T-6**).

Independent surveys of shellfish conducted since the 2017 summary reports captured moderate numbers of ocean quahog (**Figure 5.5-16**) and Atlantic surfclam (**Figure 5.5-17**) in the three stations sampled in the Lease Area (NEFSC 2018). Empire's 2020 benthic surveys in the EW 2 submarine export cable corridor reported numerous ocean quahog (**Appendix T, Attachment T-5**).

The center of the surfclam stock has been shifting north and offshore for several decades, notably since early 2000, and landings of surfclam per unit effort have declined during this period in the northwestern Atlantic Ocean (Timbs et al. 2018; Hofmann et al. 2018).

RIDEM (2017) analyzed vessel monitoring system data, vessel trip reports, and landings data to characterize importance of commercial harvest of managed species in the New York WEA from 2011 through 2016. Sea scallop landings were by far the most economically valuable in all years, followed by squid, mackerel, and butterfish (combined landings). Scallop dredging is concentrated in the far southeastern portion of the Lease Area; scallops occur also in the EW 2 submarine export cable siting corridor (Walker et al. 2016). While landings demonstrate the presence of a given species in the Project Area, the data are influenced by regulatory closures and quotas as well as independent economic variables (e.g., weather, demand, fuel costs), and so are not considered representative of the underlying distribution and abundance of any given fish or invertebrate species. Moreover, scallop abundance and distribution varies substantially from year to year, for reasons such as predation pressure and water conditions, which are not well understood but are likely extrinsic to scallops (Bethoney et al. 2016). The socioeconomics of commercial and recreational fisheries resources are discussed further in **Section 8.8**.

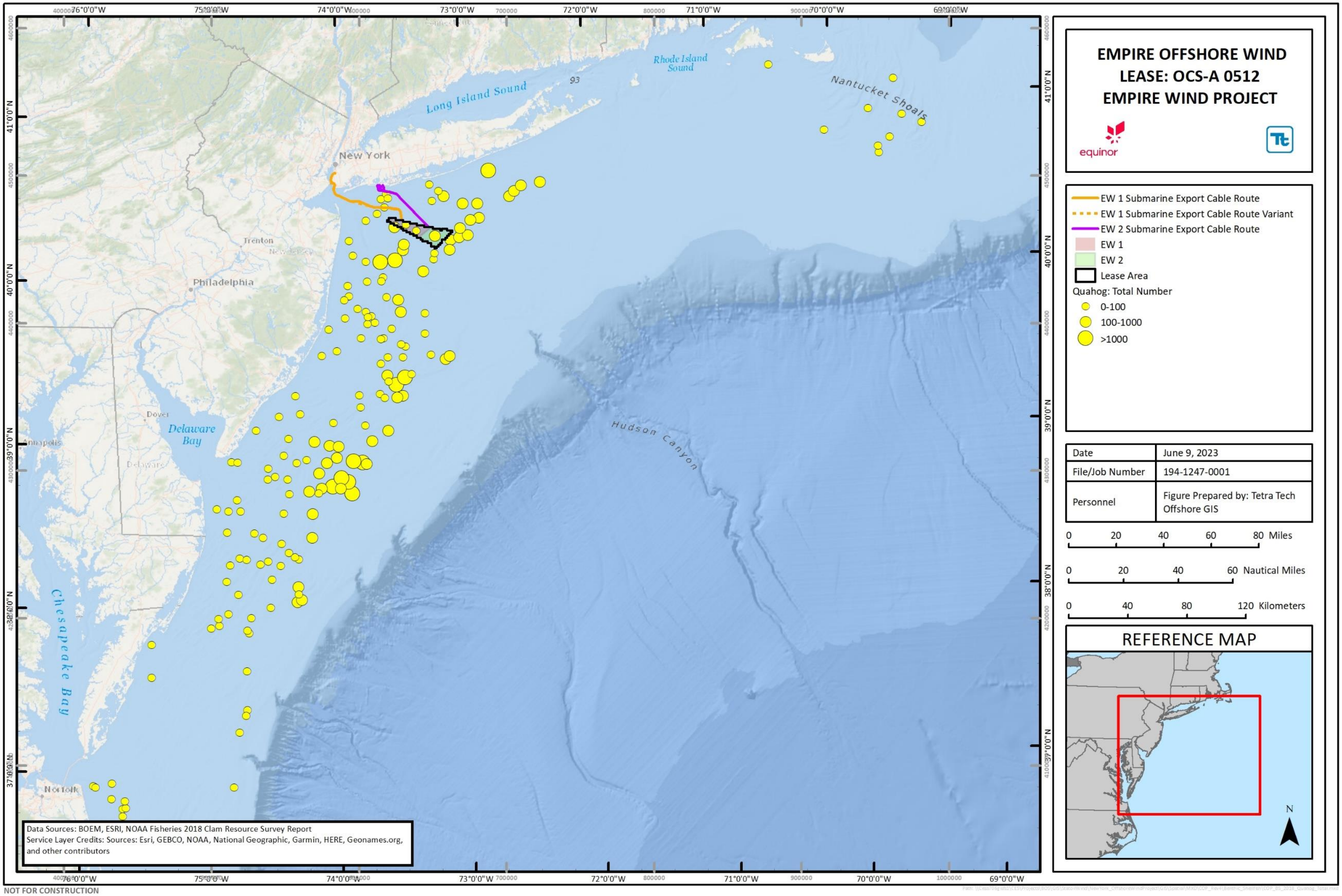


Figure 5.5-16 Number of Ocean Quahog per Sampling Station (NEFSC 2018)

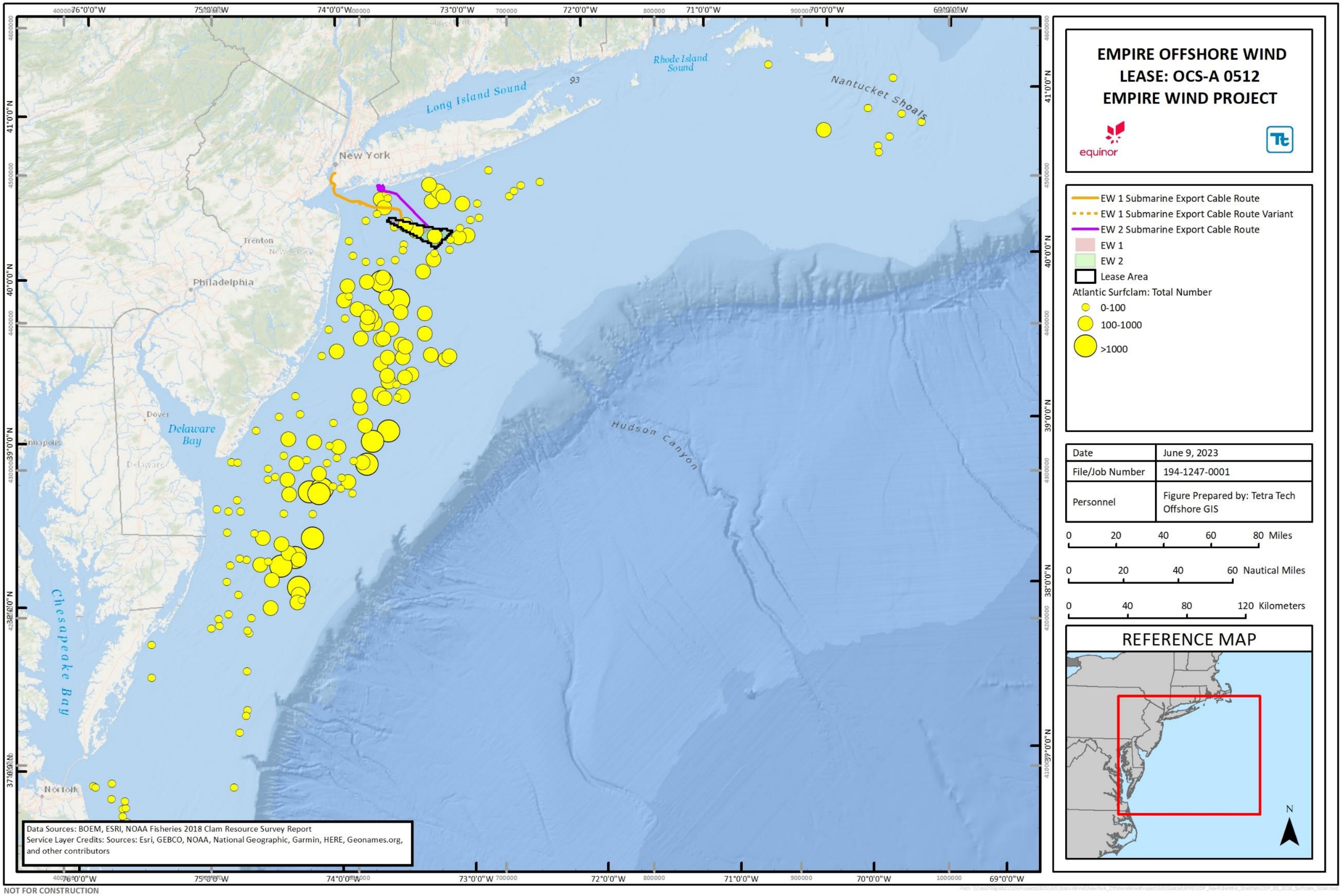


Figure 5.5-17 Number of Atlantic Surfclam per Sampling Station (NEFSC 2018)

Other Managed Species

The ASMFC manages several fish and invertebrate species separately from the MSA and ESA. Such species potentially affected by the Project include the horseshoe crab, Jonah crab, river herring, and striped bass. These species are described briefly here and in more detail throughout this section.

The horseshoe crab typically spawns in summer on sandy beaches along the U.S. Atlantic Coast. Although most spawning occurs south of the Project Area in Delaware and Chesapeake Bays (ASMFC 2019a), NYC Parks has led a monitoring program for several years in which volunteers count and tag individual horseshoe crabs and document spawning activity every May and June on beaches at Calvert Vaux Park, Conference House Park, and Kaiser Park. In 2013, NYC Parks and NYSDEC restored sandy beach habitat for horseshoe crab spawning at Calvert Vaux Park on Coney Island Creek (NYC Parks 2021). Juvenile horseshoe crabs rear in shallow inshore waters. Non-spawning adults are subtidal, most commonly at depths of less than 98 ft (30 m) (ASMFC 2019a). The Mid-Atlantic horseshoe crab stock is in neutral condition overall, but in poor condition in New York, where the state allows the harvest of just 150,000 crabs per year (ASMFC 2019a). Commercial harvest (for bait) and collection for biomedical research are the largest intentional sources of horseshoe crab mortality, but discards by commercial harvesters are considered substantial and habitat loss may also contribute to recent declines (NYC Parks 2021). Horseshoe crab were observed in videos in 12 transects in the EW 1 corridor **(Appendix T, Attachment T-4, Table 3.2).** One horseshoe crab was reported in the EW 2 offshore submarine cable corridor **(Appendix T, Attachment T-5).**

The blue crab (*Callinectes sapidus*), which is managed by NYSDEC, shares shallow coastal bay habitat with the horseshoe crab, but also ventures into the tidal Hudson River and other less saline habitats (NYSDEC 2016, 2020). Adults are associated with structures and SAV, but also occur over unvegetated sandy, clay, and mud substrates (NJ SeaGrant 2014). The New York/New Jersey Harbor Estuary supports recreational and commercial fisheries for the blue crab, although several contaminated areas of the Harbor are closed to crabbing and consumption advisories are in place for many other locations in the Harbor (NJ SeaGrant 2014). Blue crab were detected in seven of the nearshore survey transects in the EW 1 corridor **(Appendix T, Attachment T-4, Table 3.2).**

The Jonah crab is commercially and recreationally harvested in the Project Area, although site-specific data are not available. The Jonah crab is reported to be attracted to rocky habitats with crevices as well as softbottom habitats in the New York Bight, where it feeds on polychaetes and mollusks (ASMFC 2019b; NOAA Fisheries 2018d). Although its life cycle is poorly known, adult Jonah crabs are reported to move seasonally between nearshore and offshore waters (ASMFC 2020). Its population status and trends are unknown (ASMFC 2018d). Videos in the EW 1 offshore submarine cable corridor documented *Cancer* crabs (either rock crab or Jonah crab) in 17 of 26 transects; more than 250 individuals were observed **(Appendix T, Attachment T-4, Table 3.2).** A few *Cancer* crabs were also observed near landfall in the EW 2 corridor **(Appendix T, Attachment T-6, Table 3.2).**

In New York, river herring are currently harvested only from the Hudson River Estuary and tributaries, as historical fisheries in Long Island streams have become unsustainable (ASMFC 2017a). River herring stocks are considered depleted with declining trends coastwide (ASMFC 2018d), but were determined not to warrant protection under the ESA (NOAA Fisheries 2019a,b). Spawning occurs upriver of the Project Area, typically from March (alewives) through June (blueback herring). Adults return to offshore marine waters after spawning, and offspring rear in fresh riverine waters (ASMFC 2017a).

The anadromous striped bass spawns in the Hudson River Estuary. Juveniles were collected in mid-water trawls in the Upper Bay in spring, fall, and early winter; adults appeared in bottom trawls from January through May (USACE NYD 2015a). Although the striped bass was identified by NOAA Fisheries and NYSDEC as a migratory species of particular concern (USACE NYD 2015a), ASMFC determined that the Atlantic population is not overfished, nor is overfishing occurring.; however, declines in female striped bass have been noted since the mid-2000s (ASMFC 2018d). The striped bass is predicted to expand its northern range in response to rising sea temperatures (Kleisner et al. 2017). As a large predatory species, it has been implicated in the decline of winter flounder (Frisk et al. 2018).

Ecologically Important Invertebrate Forage Species

The commercially and recreationally valuable species managed under the MSA rely on prey ranging in size from single-celled plankton to large conspecifics; the diets of most managed species change throughout the life cycle as they mature and grow (Able et al. 2018 and references within). In recognition of the role of invertebrate and fish forage species in maintaining sustainable stocks of managed species, the MAFMC summarized predator-prey relationships involving unmanaged forage species and proposed management measures to protect these species from directed harvest and unintentional impacts (MAFMC 2017). Virtually all species in the Project Area function as forage at some point in their lives; however, this section focuses on those species that were identified in digital images, collected in benthic grabs and beam trawls, or otherwise reported to occur in the Project Area. The discussion below includes direct sampling by Empire as well as reports from Guida et al. (2017), Battista et al. (2019), USACE NYD (2015a,b), and others.

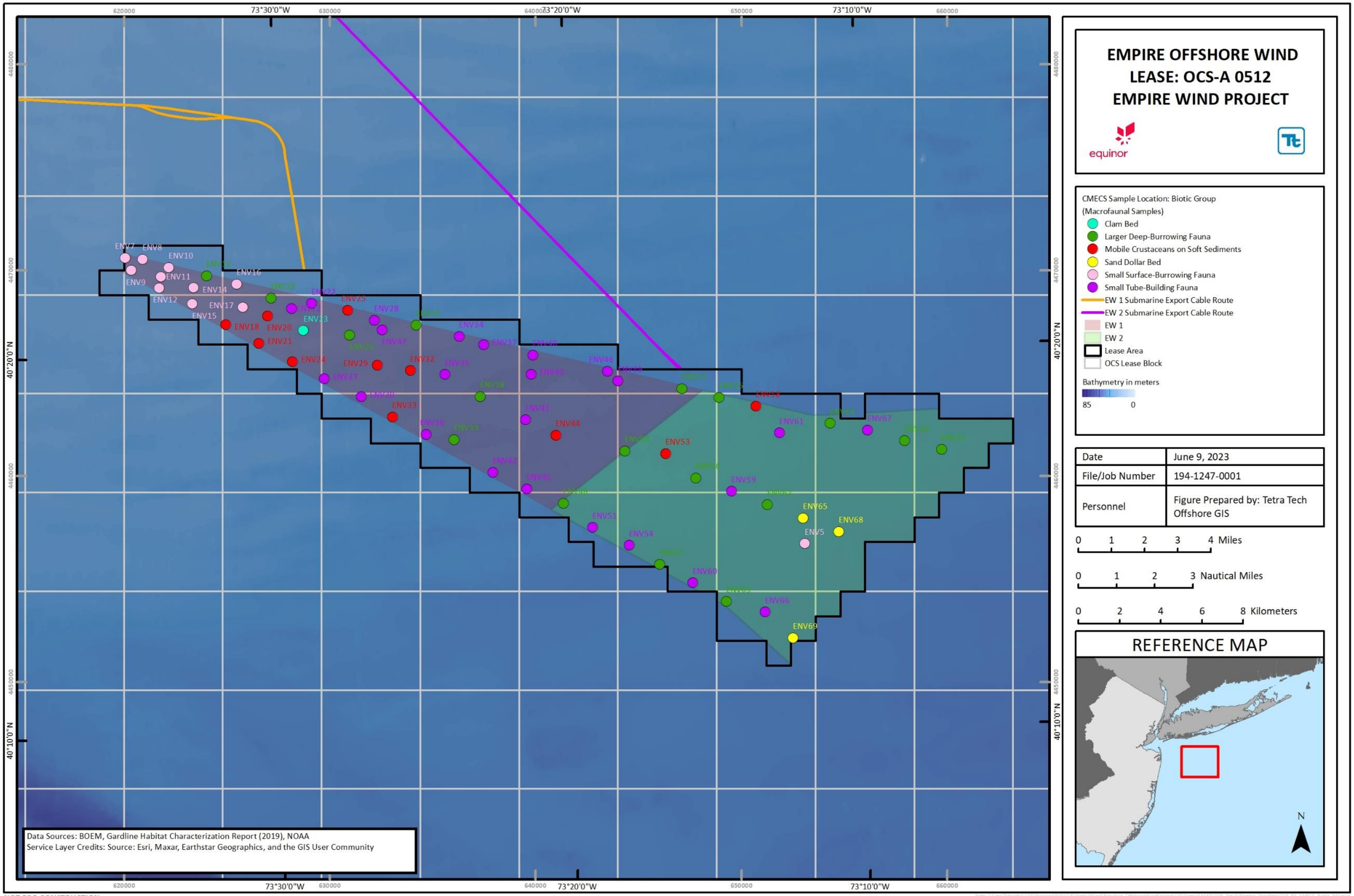
Empire conducted a series of site-specific benthic surveys in late March 2018. Sediment grab samples and associated digital imagery were collected at five locations in the Lease Area to evaluate the suitability of siting two floating LiDAR buoys and two Metocean moorings (to be referred to as the Metocean Facilities). Grab samples were analyzed for grain size distribution and organic content. Infaunal organisms retained by a 1.0 mm sieve were identified and counted; polychaetes and arthropods dominated the samples. Only one surfclam and one ocean quahog were collected. Digital imagery captured the common sand dollar, hermit crab, several bivalves, and skate egg cases (see **Appendix T, Attachment T-1** for full report).

Empire collected an additional 67 sediment grab samples along three transects in the Lease Area between August and November 2018. Sediment grab samples were analyzed for grain size distribution and organic carbon, as described above. Organisms retained by a 500 µm sieve[9] were identified and counted. A total of 186 infaunal taxa were identified; the infaunal species assemblage was characterized as relatively diverse. No taxon was ubiquitous across all stations, and most taxa were patchily distributed. One-fifth of the taxa were collected at only one station, many represented by a single individual. The species assemblage and the ranked taxonomic dominance varied across stations, indicating that stations were dissimilar from one another. About 30 percent of the taxa were arthropods and 30 percent were mollusks. The most numerically abundant taxon by a wide margin was the Polygordiidae polychaete family, which occurred in all but two samples; this family represented about 39 percent of the nearly 67,000 individuals collected in all Lease Area samples.

More than 25 mollusk taxa were collected in the 67 grab samples in the Lease Area. The surfclam was collected at 36 stations (204 individuals). One live ocean quahog and one Atlantic sea scallop (*Placopecten magellanicus*) were reported in the grab samples, and at least 58 empty ocean quahog shells were observed. At 25 stations, 35 live ocean quahogs were recorded. In addition, 47 pairs of siphons, which may have been ocean quahog, were recorded at 27 stations. One location (ENV23) near the western end of the Lease Area was classified as a clam bed based on the occurrence of 860 Atlantic nut clam (*Nucula proxima*) in the sample; however, neither the surfclam nor ocean quahog was recorded at this location.

Each sample was classified using CMECS; the distribution of Biotic Groups is shown on **Figure 5.5-18**.

[9] Note change in sieve size



NOT FOR CONSTRUCTION

Figure 5.5-18 CMECS Biotic Groups Based on Sieved Infauna (Empire Survey, Aug – Nov 2018)

Empire collected more than 3,000 digital images along 1,970-ft (600-m) transects and at each of the benthic grab locations. The most frequently observed benthic invertebrate in the images was the common sand dollar; 52 stations were categorized as *E. parma* using CMECS based on the digital images (FGDC 2012; **Figure 5.5-19**). Seven stations had relatively high densities of faunal tubes (CMECS Small Tube-Building Fauna), three stations were categorized as Burrowing Anemones, and four stations as Mobile Crustaceans on Soft Sediments. One station at the extreme western end of the Lease Area was categorized as Large Tube-Building Fauna (**Figure 5.5-19**).

Twenty adult scallops were observed in the digital images. Adult squid were seen in six images; no egg masses were recorded. The absence of squid mops in the digital images may be attributable to the late season; most spawning occurs in May/June and eggs may have hatched by the time the survey was conducted in August.

The complete record of observations by sample location is in **Appendix T, Attachment T-2**. Overall results of the Empire benthic biological surveys are consistent with the findings of previous independent studies in the New York WEA (Guida et al. 2017; Battista et al. 2019), described in the following pages.

As part of the BOEM/NOAA Fisheries Habitat Mapping conducted to characterize baseline conditions of benthic resources in the New York WEA, 48 beam trawls (10 in March 2014, 38 in August 2016) and 11 triplicate grab samples were collected in the Lease Area (**Figure 5.5-20**; Guida et al. 2017). The grab samples were sieved through a 1.0 mm mesh and infauna were classified using CMECS. The dominant classification across the Lease Area was Soft Sediment Fauna in the following Biotic Groups: Larger Deep-Burrowing Fauna, Small Surface-Burrowing Fauna, Larger Tube-Building Fauna, Scallop Bed (sea scallops), Clam Bed (*Spisula*), and Sand Dollar Bed (*Echinarachnius*) (Guida et al. 2017).

Nineteen epibenthic taxa were collected in March 2014 beam trawls; sand shrimp dominated the samples. In August 2016 samples, the common sand dollar was the most abundant of the 60 taxa collected; small recent recruits dominated the samples. Longfin squid egg mops and newly settled juveniles were common in August samples, as were skate egg cases. Overall, the epibenthic invertebrate assemblage was typical of sandy flats in this region of the shelf (Guida et al. 2017). Only one ocean quahog was reported from beam trawls samples despite the extensive designation of EFH in the Lease Area (61,947 ac [25,069 ha]). The surfclam was broadly distributed in the Lease Area, especially in waters less than 115 ft (35 m); collection locations in beam trawls closely matched areas of designated EFH (see **Appendix U**). The Atlantic sea scallop was also common, appearing in more than 50 percent of the beam trawl samples in both cold and warm seasons (Guida et al. 2017).

Benthic grab samples contained 85 taxa of infauna retained by a 1.0 mm sieve. Amphipods and polychaetes were a major component but no single species represented more than 15 percent of the assemblage; the common sand dollar was a core species in the grab samples, consistent with other surveys (Guida et al. 2017).

The assemblage of benthic macroinvertebrates observed during NOAA's surveys of the Lease Area was consistent with taxa reported in Guida et al. (2017); differences can be attributed to sampling methods. The common sand dollar dominated the Lease Area; it was present at 90 percent of the sites, with densities up to 90 percent cover in some locations. Relative abundances varied somewhat with substrate type (ripples, megaripples; **Figure 5.5-21**). Polychaetes and oligochaetes were reported at 30 percent of the sites, and bivalves/gastropods at about 11 percent of the sites (Battista et al. 2019). [Note that the sampling methods used during the NOAA survey were not suitable for collecting surfclam and ocean quahog, which can be buried up to one meter below the sediment surface.] Large crustaceans were observed in videos at about 11 percent of the stations in the Lease Area (Battista et al. 2019).

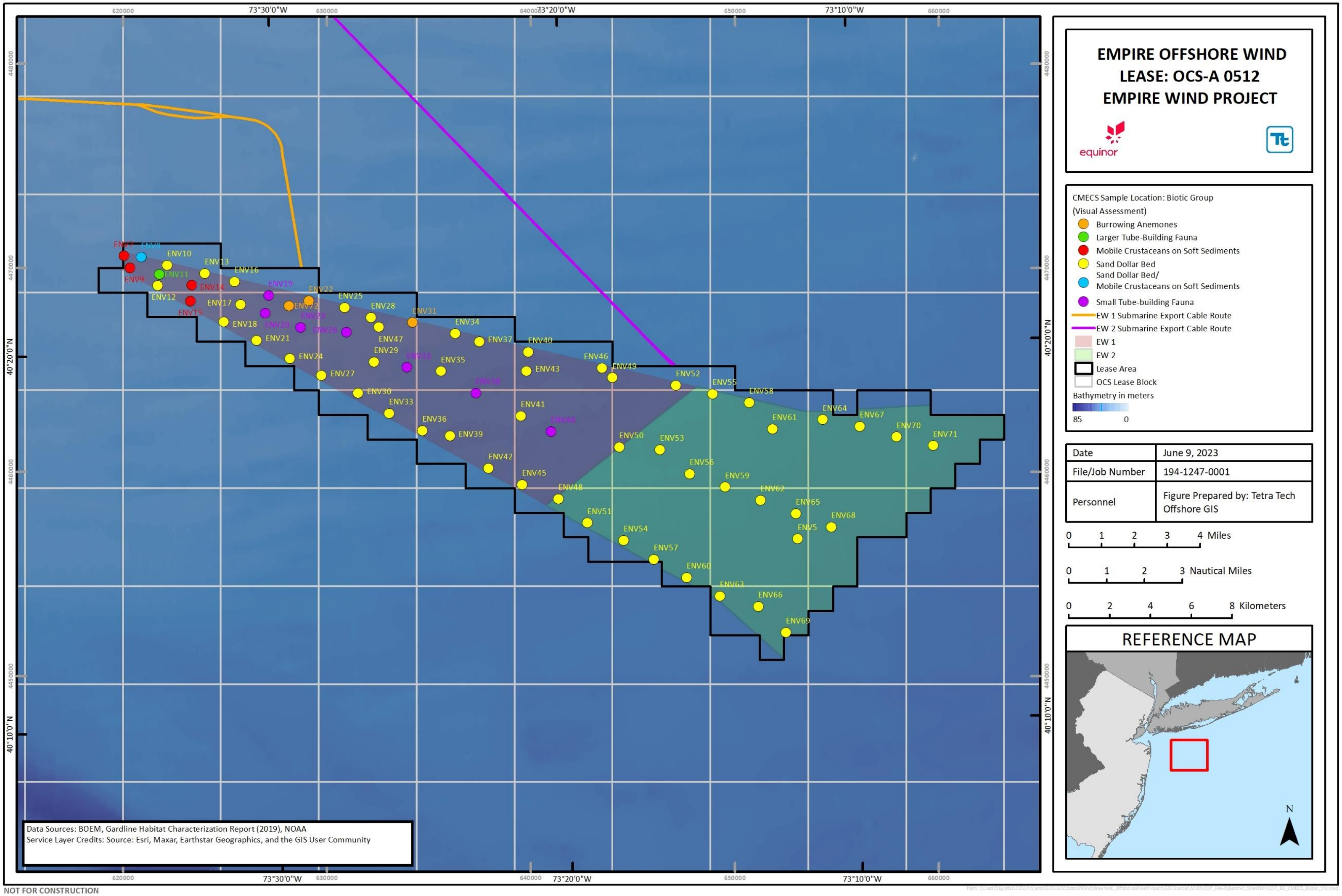


Figure 5.5-19 CMECS Biotic Groups Based on Epifauna in Digital Imagery (Empire Survey, Aug – Nov 2018).

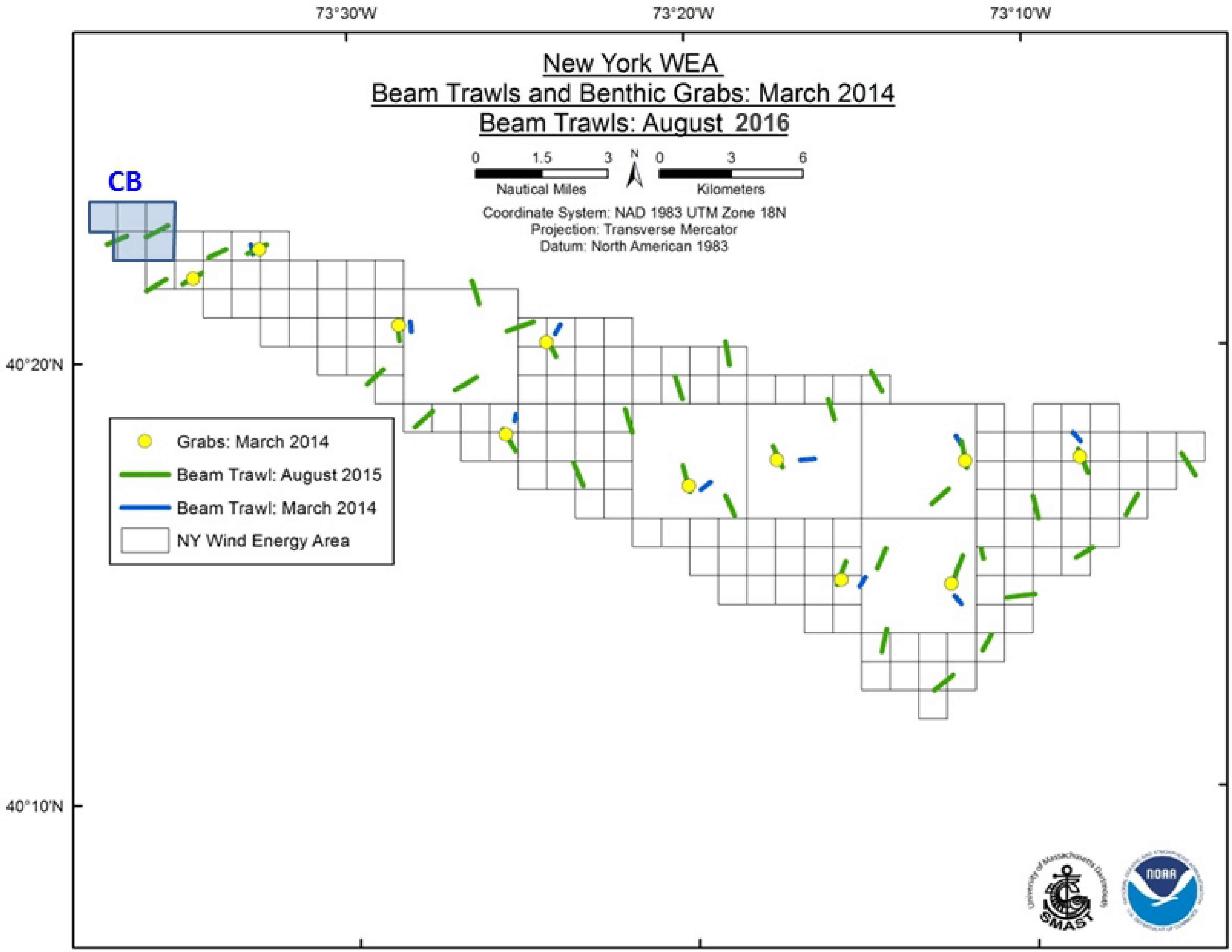


Figure 5.5-20 Locations of Beam Trawls and Benthic Grabs in the Lease Area (from Guida et al. 2017)

Note: CB indicates Cholera Bank, which was excluded from the Lease Area and is no longer part of the BOEM OCS-A 0512 Lease Area

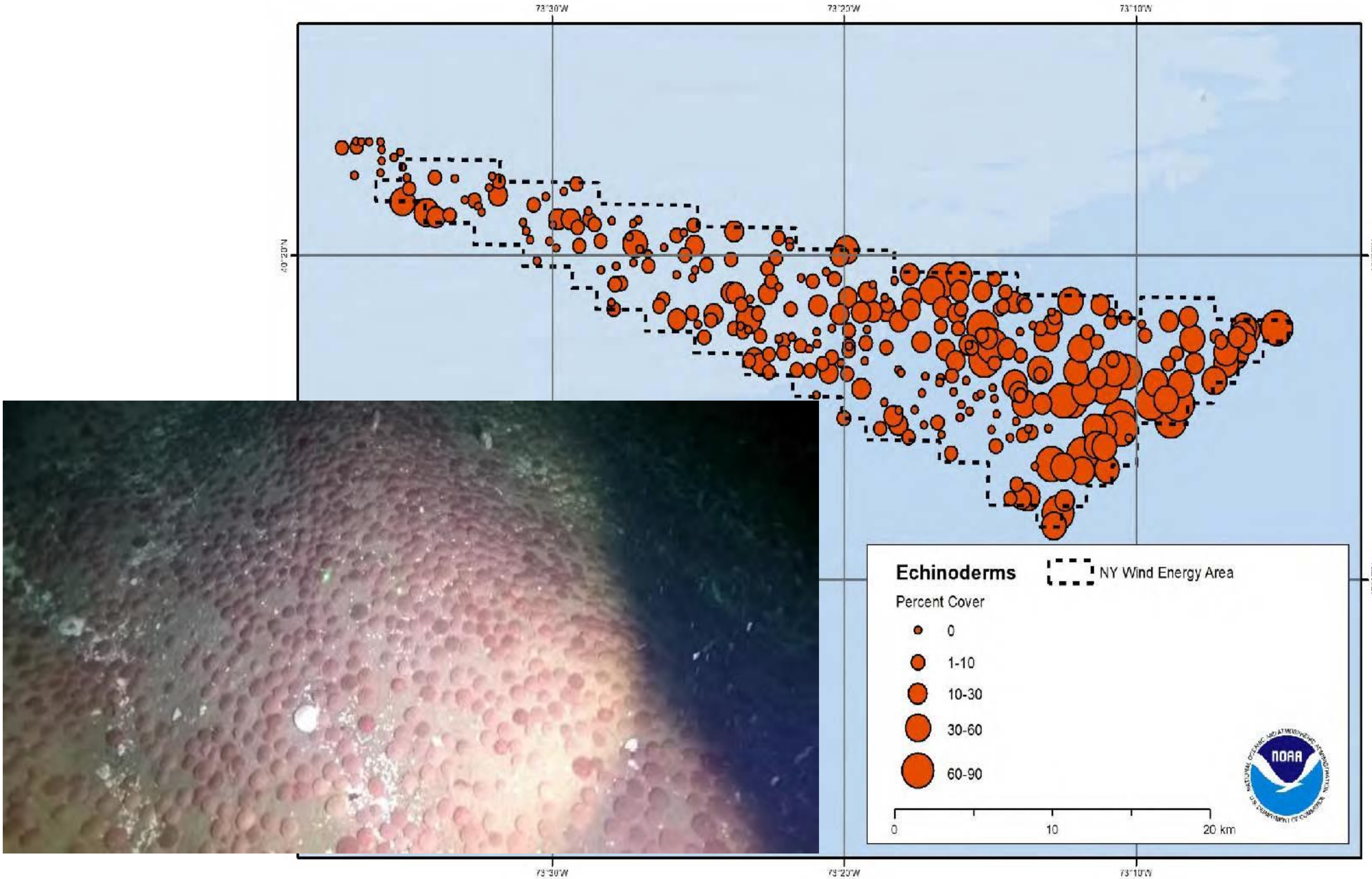


Figure 5.5-21 Relative Percent Cover of Sand Dollar and Image of High-Density Location (Battista et al. 2019)

Forage Fish and Invertebrates in Submarine Export Cable Siting Corridors

Empire conducted benthic surveys within the submarine export cable siting corridors in 2019, as described in **Table 5.5-1** above.

EW 1 Submarine Export Cable Siting Corridor

Nearshore video surveys in the EW 1 corridor reported visible invertebrates larger than 4 cm; anthozoans (approximately 47 percent) and malacostracans (approximately 46 percent) were clear dominants (**Appendix T, Attachment T-4, Figure 3-7**). In the 74 grab samples collected in the EW 1 cable corridor, mollusks, amphipods, and arthropods dominated the grab samples, with nut clams the the most abundant taxon. An average of 113 organisms from 13 families were identified per grab sample. Taxonomic richness ranged from less than 0.1 to 5.6 (mean = 2.88), diversity ranged from 0.1 to 2.94 (mean = 1.81), and evenness ranged from 0.29 to 1.0 (mean = 0.75). In preliminary analyses, neither species richness nor diversity were correlated with grain size (all $R^2 < 0.1$); evenness was slightly correlated only with fine sand ($R^2 = 0.32$). The only meaningful correlation between grain size and infaunal taxa was for mollusks with fine sand ($R^2 = 0.46$).

Additional field surveys were available to characterize benthic invertebrates in the EW 1 submarine export cable siting corridor through the Aquatic Biological Survey conducted by the USACE in support of the New York and New Jersey Harbor Deepening Project. The USACE collected benthic grab samples from the Upper and Lower Bays over a period of several years. Sediment types and the assemblage of benthic infauna reported in USACE documents related to the Harbor Deepening project are considered reasonable surrogates for characterizing the benthic community in the EW 1 submarine export cable siting corridor. USACE characterization of benthic communities are briefly described below:

- The USACE collected benthic grab samples in areas now proposed for the EW 1 submarine export cable route: Ambrose Channel (the mouth of the New York/New Jersey Harbor) and Bay Ridge (the inshore portion of the EW 1 submarine export cable route). Samples were sieved through a 500-µm mesh. The benthic community was considered representative of natural baseline conditions because the channel had not been dredged for 22 years at the time of sample collection in 2005. It was subsequently dredged in 2008 (USACE NYD 2011).
- In summer 2005, more than half of the 33 taxa collected in grab samples from Ambrose Channel were annelids; arthropods and mollusks made up most of the rest. The benthic community in Ambrose Channel was characterized as moderately abundant, high diversity, and high evenness relative to the rest of the New York/New Jersey Harbor. Juvenile blue mussel (*Mytilus edulis)* dominated samples from Ambrose Channel in 2005 but were absent in 2009. It was suggested that the juvenile blue mussels collected in 2005 were being carried by currents to established intertidal mussel beds where they could settle and mature (USACE NYD 2011).
- The samples from Bay Ridge also contained annelids, arthropods, and mollusks, but at much lower abundances than in Ambrose Channel. The Bay Ridge samples had the highest diversity and evenness of all harbor samples. Of the 20 taxa collected, the dwarf surfclam (*Mulinia lateralis*) was present at the highest density (35 organisms per square meter).
- The borrow areas off the northern New Jersey coast and southern Long Island were found to support similar assemblages of benthic invertebrates. The location near the EW 2 submarine export cable route was dominated by polychaetes and amphipods (based on number of individuals) and by sand dollars (based on weight; USACE NYD 2013).

The Billion Oyster Project has been working since 2014 to restore the Eastern oyster (*Crassostrea virginica*) to the New York/New Jersey Harbor. One of the seven restored reefs is at Bush Terminal Park near the EW 1 export cable landfall. The oyster was once abundant in the harbor, but since the early 1900s populations have declined by more than 99 percent in response to wastewater discharges, oyster disease, overharvesting, and dredging for shipping channels. The Nature Conservancy provides support with monitoring restored oyster reefs at seven sites in the New York/New Jersey Harbor, including the Bush Terminal Park Community Reef adjacent to the EW 1 landfall in the Upper Bay. Nearly one million 2 mm oysters were installed in 2016 to create the Bush Terminal Park Community Reef; additional culch was placed on the reef in 2018 (McCann 2018).

Oysters at the Bush Terminal Reef grew more quickly than at other sites and began cementing together to form a reef. Some individuals appeared to have spawned in summer 2017; however, no recruits were observed the following spring. To date, the incidence of oyster diseases has been low at this reef. Water quality was generally good, with adequate dissolved oxygen. Measures of biodiversity showed no difference between the restored reef and a reference location in 2017. Long-term monitoring studies of biodiversity, reproduction, growth, and other parameters are ongoing (McCann 2018).

Empire's video imagery in the EW 1 submarine cable corridor included 381 vertebrates from 19 unique taxa in 9 orders; the most abundant were skates (approximately 29 percent), cod (approximately 18 percent), and unidentified teleosts (approximately 35 percent) (**Appendix T, Attachment T-4, Figure 3-6**). The NEFSC seasonal trawls and the NOAA and BOEM characterization surveys discussed above were limited to federal waters. While some species occur widely throughout the Project Area, others are more closely associated with nearshore and estuarine waters. This section presents site-specific data on species collected within state waters of New York that are expected to occur in the submarine export cable siting corridors. The principal source of distribution and abundance data on fisheries species in this area is the Aquatic Biological Survey conducted by the USACE in support of the New York and New Jersey Harbor Deepening Project. Data include eight years of bottom trawl surveys (2002 to 2010), and nine years of near-bottom ichthyoplankton tows (2002 to 2011). Unless otherwise noted, all data in this section were taken from these reports (USACE NYD 2015a,b).

Samples from within the Upper and Lower Bay were used to characterize species likely to occur within the EW 1 submarine export cable siting corridor (USACE NYD 2015a,b).

Samples collected in the Upper and Lower Bay were used to characterize species likely to occur within the EW 1 submarine export cable siting corridor. The USACE survey goals focused on differentiating samples from within channels and outside of channels. Although the EW 1 submarine export cable will be installed outside the channel, species within and outside of channels were included in the discussion because construction impacts could occur throughout the EW 1 submarine export cable siting corridor. Fishes with demersal life stages in the Lower Bay and Upper Bay include winter flounder, American eel (*Anguilla rostrata*), Atlantic tomcod (*Microgadus tomcod*), and white perch (*Morone americana*). In recent years, summer migrants such as summer flounder, black sea bass, and scup have become increasingly common. Black sea bass settle as juveniles in nearshore waters, including the Raritan/Hudson estuary (USACE NYD 2015a).

Migratory schooling species dominated nine years of demersal fish surveys in the Lower Bay and Upper Bay (2002–2010) conducted by the USACE. Typical species included white perch, bay anchovy (*Anchoa mitchilli*), spotted hake, Atlantic herring, winter flounder, Atlantic silversides, Atlantic menhaden, alewife, blueback herring (*Alosa aestivalis*), and striped bass. Relative abundance of species varied by year, largely driven by winter temperatures. In years with mild to moderate winters, abundance of alewife and spotted hake increased in both bays, and American sand lance and Atlantic silverside increased in the Lower Bay. In years with colder winters, fish species were more evenly distributed throughout the system. Collections were greatest in spring in both Upper and Lower Bays, where the bay anchovy was the principal catch. Although 81 fish taxa were collected during the 9-year survey, about two-thirds of all individuals were of five species: bay anchovy, white perch, spotted hake, alewife, and striped bass. Except for white perch and bay anchovy, juvenile life stages dominated the catches (USACE NYD 2015a). All species listed in **Table 5.5-6** were reported from the Upper or Lower Bay and are assumed to occur in the EW 1 submarine export cable siting corridor.

Table 5.5-6 Demersal Species in New York/New Jersey Harbor and Rockaway Borrow Area

Common Name	Scientific Name	Rockaway Borrow Area
Alewife a/	*Alosa pseudoharengus*	
American eel	*Anguilla rostrata*	
American sand lance	*Ammodytes americanus*	
American shad a/	*Alosa sapidissima*	
Atlantic butterfish b/	*Peprilus triacanthus*	✓
Atlantic cod	*Gadus morhua*	
Atlantic croaker a/	*Micropogonias undulatus*	✓
Atlantic herring b/	*Clupea harengus*	✓
Atlantic menhaden a/	*Brevoortia tyrannus*	✓
Atlantic moonfish	*Selene setapinnis*	✓
Atlantic silverside	*Menidia menidia*	
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	
Atlantic tomcod	*Microgadus tomcod*	
Bay anchovy	*Anchoa mitchilli*	✓
Black drum	*Pogonias cromis*	
Black sea bass b/	*Centropristis striata*	✓
Blueback herring a/	*Alosa aestivalis*	✓
Bluefish	*Pomatomus saltatrix*	✓
Clearnose skate b/	*Raja eglanteria*	✓
Conger eel	*Conger oceanicus*	
Crevalle jack	*Caranx hippos*	
Cunner	*Tautogolabrus adspersus*	✓
Feather blenny	*Hypsoblennius hentzi*	
Fourbeard rockling	*Enchelyopus cimbrius*	
Fourspine stickleback	*Apeltes quadracus*	
Fourspot flounder	*Hippoglossina oblonga*	✓
Gizzard shad	*Dorosoma cepedianum*	
Grubby	*Myoxocephalus aenaeus*	
Hickory shad	*Alosa mediocris*	
Hogchoker	*Trinectes maculatus*	
Lined seahorse	*Hippocampus erectus*	
Little skate b/	*Raja erinacea*	✓

Table 5.5-6 Demersal Species in New York/New Jersey Harbor and Rockaway Borrow Area (continued)

Common Name	Scientific Name	Rockaway Borrow Area
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	
Mummichog	*Fundulus heteroclitus*	
Naked goby	*Gobiosoma bosci*	
Northern kingfish	*Menticirrhus saxatilis*	✓
Northern pipefish	*Syngnathus fuscus*	
Northern puffer	*Sphoeroides maculatus*	✓
Northern sea robin	*Prionotus carolinus*	✓
Northern stargazer	*Astroscopus guttatus*	
Oyster toadfish	*Opsanus tau*	
Pollock	*Pollachius virens*	
Rainbow smelt	*Osmerus mordax mordax*	
Red hake b/	*Urophycis chuss*	✓
Rock gunnel	*Pholis gunnellus*	
Scup b/	*Stenotomus chrysops*	✓
Seaboard goby	*Gobiosoma ginsburgi*	
Sheepshead	*Archosargus probatocephalus*	
Shortnose sturgeon	*Acipenser brevirostrum*	
Silver hake b/	*Merluccius bilinearis*	✓
Silver perch	*Diapterus rhombeus*	
Smallmouth flounder	*Etropus microstomus*	✓
Smooth dogfish	*Mustelus canis*	✓
Spiny dogfish	*Squalus acanthias*	
Spot	*Leiostomus xanthurus*	✓
Spotted hake	*Urophycis regia*	✓
Striped anchovy	*Anchoa hepsetus*	✓
Striped bass a/	*Morone saxatilis*	
Striped burrfish	*Chilomycterus schoepfii*	✓
Striped cusk-eel	*Ophidion marginatum*	
Striped killifish	*Fundulus majalis*	
Striped mullet	*Mugil cephalus*	
Striped sea robin	*Prionotus evolans*	✓
Summer flounder b/	*Paralichthys dentatus*	✓
Tautog	*Tautoga onitis*	✓
Three-spined stickleback	*Gasterosteus aculeatus*	
Weakfish	*Cynoscion regalis*	✓

Table 5.5-6 Demersal Species in New York/New Jersey Harbor and Rockaway Borrow Area (continued)

Common Name	Scientific Name	Rockaway Borrow Area
White mullet	*Mugil curema*	
White perch	*Morone americana*	
Windowpane b/	*Scophthalmus aquosus*	✓
Winter flounder b/	*Pleuronectes americanus*	✓
Winter skate b/	*Raja ocellata*	✓
Yellowtail flounder	*Pleuronectes ferrugineus*	

Source: USACE NYD (2015a, Table C5)

Notes:
a/ State managed species of concern
b/ Federally managed (EFH) species

EW 2 Submarine Export Cable Siting Corridor

Empire's benthic surveys in the EW 2 corridor reported invertebrate assemblages consistent with softbottom habitats in the NY Bight. Overall, the macrofaunal community revealed a relatively equitably distributed community, with instances of patchiness and a lack of consistent dominance, albeit with a notable higher abundance of the polychaete *Polygordius jouinae*. Multivariate analysis of the faunal data revealed that stations were more dissimilar than similar and that differences largely corresponded with absences and higher abundances of the top ten ranking taxa. Similar to finding in the EW 1 corridor, percentage of fine sand had a limited but significant effect on the separation of species assemblages (**Appendix T, Attachment T-5**).

All grab samples were classified as CMECS Soft Sediment Fauna at the biotic subclass level. About 30 percent of the grab samples were categorized as CMECS Biotic Group Mobile Crustaceans on Soft Sediments. The Biotic Groups Diverse Soft Sediment Epifauna and Small Surface-Burrowing Fauna were also relatively common, each accounting for 24 percent (n=9) of stations. Siphons identified as the ocean quahog were recorded in 60 images, notably at Station EW2-14; empty quahog shells were present in 50 images (Appendix T, Attachment T-5). In the nearshore EW 2 videos, gastropods made up approximately 79 percent of the visible organisms larger than 4 cm (**Appendix T, Attachment T-6, Figure 3-6**).

Numerous winter skate and five spiny dogfish were observed in video images in the EW 2 submarine export cable corridor (**Appendix T, Attachment T-5**). Few fish were observed in the nearshore EW 2 videos: a few skates, black sea bass, and unidentified bony fish (**Appendix T, Attachment T-6, Table 3-2**).

Samples from the Rockaway Borrow Area, which occurs in New York waters between the EW 1 and EW 2 submarine export cable siting corridors (USACE NYD 2015a,b; USACE NYD 2008) were used to develop the species list representative of the nearshore portion of the EW 2 submarine export cable siting corridor (**Figure 5.5-22**).

Demersal fish species reported from New York/New Jersey Harbor that were also collected in the Rockaway Borrow Area (USACE NYD 2008) are listed in **Table 5.5-6**. The Rockaway Borrow Area represents a similar sandy nearshore habitat to the EW 2 submarine export cable siting corridor. No recent NEFSC seasonal trawl reports were available for this area.

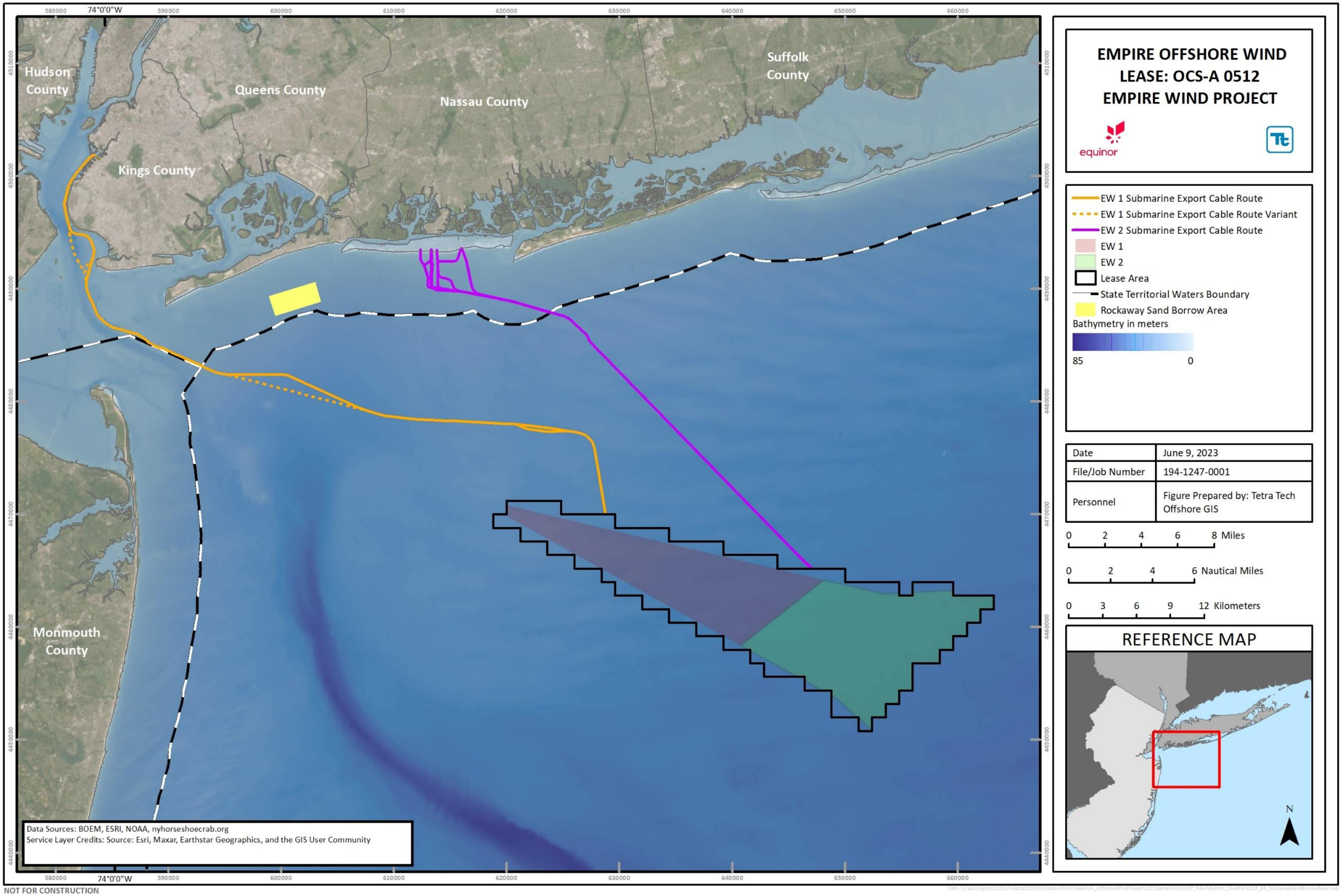


Figure 5.5-22 Rockaway Borrow Area

Pelagic Species in State Waters

Blueback herring and alewife dominated USACE mid-water trawl samples throughout the New York/New Jersey Harbor (2011 to 2013). These river herring migrate through the Upper Bay to spawn in the Hudson River in spring, when discharges are typically greatest. Abundances peaked in April, declined in May, and dropped to near zero in June (USACE NYD 2015b). The most abundant managed pelagic fishes in the Lower and Upper Bays were Atlantic herring and Atlantic butterfish; bluefish and silver hake were present but less common. Pelagic fish in the Lower Bay and Upper Bay identified as species of concern by NOAA include alewife, blueback herring, American shad, and striped bass (USACE NYD 2015b). The Atlantic menhaden, Atlantic herring, bay anchovy, and striped anchovy (*Anchoa hepsetus*) are considered important in the bays because of their role as key forage species (MAFMC 2017).

The pelagic species assemblage varied by season and area. In the Upper Bay, Atlantic herring, bay anchovy, alewife, and blueback herring were most abundant in winter and spring. In summer and fall, the bay anchovy made up almost 90 percent of the trawl samples. In the Lower Bay, the bay anchovy represented 74 percent of the samples in fall (the remainder was mostly blueback herring). Bay anchovy made up 91 percent of the spring samples and 99 percent of the summer samples (USACE NYD 2015b).

Ichthyoplankton surveys were conducted in January and June for 10 years (2002-2011) in the Upper and Lower Bays. Four of the 22 taxa in the ichthyoplankton trawls accounted for 95 percent of all eggs: bay anchovy, wrasse (including cunner [*Tautogolabrus adspersus*] and tautog), Atlantic menhaden, and windowpane flounder. Federally managed species making up a substantial portion of the ichthyoplankton included winter flounder and windowpane flounder (all 10 years) and Atlantic mackerel (6 of 10 years); the Atlantic menhaden made up about 9 percent of the eggs collected. Density of ichthyoplankton increased from January to June, as winter spawners (winter flounder and American sand lance) had relatively lower density than spring spawners. Eggs were most abundant in May and June. Fish larvae were more evenly distributed throughout the system than eggs, possibly because tidal mixing facilitated transport. Bay anchovy, gobies, and winter flounder comprised about 80 percent of the larvae in trawl samples, which contained 51 species overall.

Other common pelagic species in this area include bluefish, squid, cownose ray, several skates (e.g., clearnose, winter, little), and the highly migratory bluefin tuna, swordfish, and sharks (e.g., sand tiger [*Carcharias Taurus*], dusky [*Carcharhinus obscurus*], sandbar [*Carcharhinus plumbeus*]).

5.5.1.3 Threatened and Endangered Species

Four fish species listed under state or federal endangered species statutes potentially occur in the Lease Area or submarine export cable siting corridors (**Table 5.5-7**). Of these, only the Atlantic sturgeon is expected to occur in the Project Area.

Table 5.5-7 Protected Fish Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Federal Status a/	New York Status a/	Likelihood of Occurrence b/
Atlantic sturgeon	*Acipenser oxyrinchus*	E	CI	High
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	Low
Giant manta ray	*Manta birostris*	T	-	Low
Oceanic whitetip shark	*Carcharhinius longimanus*	T	-	Low

Sources: NOAA Fisheries 2018a, NYSDEC 2019b

Notes:

a/ Species Status: CI = Critically Imperiled; E = Endangered; T =Threatened

b/ The likelihood of occurrence was informed by field observations, consultation with federal and state agencies, and available literature. Low – The species is uncommon or generally absent from Project Area, but marginally suitable habitat is present; Moderate – The species is uncommon but known to occur in Project Area and suitable habitat is present.

Atlantic Sturgeon – Federal and New York State Protected Species

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is listed as endangered under the ESA and critically imperiled in New York (NY Natural Heritage Program 2019). The Atlantic sturgeon is a large, bottom-dwelling, long-lived anadromous fish. Anadromous fish hatch from eggs laid in rivers, then migrate to oceanic waters as juveniles. It feeds on benthic invertebrates such as isopods, crustaceans, worms, and mollusks (NOAA Fisheries 2014; NMFS 1998; Stein et al. 2004). Although several distinct population segments (DPS) of the Atlantic sturgeon are listed under the ESA, the DPS are not entirely separate and all individual sturgeon are protected.

Adult Atlantic sturgeon migrate to freshwater spawning habitats, including the Hudson River; eggs hatch in the rivers and the young migrate to marine foraging waters (NOAA Fisheries 2017b). During non-spawning years, adults may remain in marine waters year-round (Bain 1997). Spawning adults migrate upriver in spring to spawn, then back into estuarine and marine waters in summer or fall (Dadswell 2006). Immature Atlantic sturgeon disperse widely once they move into coastal waters (Secor et al. 2000) and are often observed over mud-sand bottoms (Dadswell 2006). Subadults and adults forage in coastal waters and estuaries, generally in shallow (35 to 165 ft [10 to 50 m]) inshore areas of the continental shelf (Dunton et al. 2015; 75 Federal Register No. 3 [January 6, 2010: 838-841]). The Atlantic sturgeon is strongly associated with specific coastal areas, including the Hudson River and estuary, as well as the mouths of Narragansett Bay and Chesapeake Bay, and the inlets of the North Carolina Outer Banks, and it also occurs in the Cooper River estuary of South Carolina (Ingram et al. 2019; Stein et al. 2004).

Declines of sturgeon populations are attributed to overfishing, habitat loss, and degradation of spawning grounds. The most recent stock assessment for Atlantic sturgeon reports that all DPSs are still depleted relative to historical abundances, but some recovery has been observed. The 2017 abundance estimate for the New York Bight DPS was 34,566 individuals (ASMFC 2017b). Populations in New Jersey rivers are also reported to be improving (NJDEP 2018). Specific threats on the East Coast include the damming of major rivers that prevents upstream spawning, dredged material disposal, channel maintenance, oil and gas exploration, trawling, and water quality degradation by pesticides, heavy metals, and other agricultural and industrial constituents of concern (USFWS and NOAA Fisheries 2009; Collins et al. 2000; Smith and Clugston 1997). Vessel strikes have also been noted as threats to this species (Brown and Murphy 2010; Balazik et al. 2012). In southern New Jersey's Delaware Estuary, 14 Atlantic sturgeon deaths were attributed to vessel strikes (Brown and Murphy 2010).

Passive acoustic monitoring indicates that Atlantic sturgeon occur throughout the Lease Area, with highest abundance in winter (November through January). During this time, individual sturgeon were actively moving about, spending at most 10 hours within range of a given transceiver. The researchers estimated a sturgeon could transit through the Lease Area in about 13 hours (Ingram et al. 2019). Little is known about the foraging behavior of sturgeon in offshore waters, including the Lease Area, but it is reasonable to assume they are feeding on benthic invertebrates. Although foraging habits of Atlantic sturgeon are not well described, a study of stomach contents of more than 200 sturgeon caught by commercial fishing vessels off the coast of New Jersey reported that polychaetes and isopods dominated the prey; sand and organic debris took up a substantial portion of the stomachs, and both fish and mollusks were rare. Prey composition was seasonally variable, and more sturgeon stomachs were empty in the spring than in the fall (Johnson et al. 1997).

Adult, subadult, and juvenile sturgeon left the Lease Area to aggregate in inshore coastal waters in spring, as adults prepared to enter the river to spawn. The Atlantic sturgeon was virtually absent from the Lease Area from July to September (Ingram et al. 2019).

Critical habitat for the Hudson River DPS of the Atlantic sturgeon is designated from River Mile 1 to the Troy Lock and Dam north of Albany, a length of 154 mi (248 km) (NOAA Fisheries 2017b).

Shortnose Sturgeon – Federal and New York State Endangered Species

The shortnose sturgeon (*Acipenser brevirostrum*) is listed as endangered under the ESA and in New York under 182.2(g) of 6 NYCRR Part 182 (NYSDEC 2019b). The shortnose sturgeon primarily occurs in the Hudson River and several other Atlantic coastal rivers. The Hudson River population of shortnose sturgeon is almost exclusively confined to the river, unlike other populations that use coastal marine waters to move between rivers (Pendleton et al. 2019; Kynard et al. 2016). In New York, this species ranges from River Mile 0 at the southern tip of Manhattan to 150 miles upriver (NYSDEC 2019b). This species may transit through the EW 1 landfall and submarine export cable route within state waters, and be temporarily exposed to Project-related activities, but is not expected to be affected by the Project. The shortnose sturgeon is not expected to occur in the Lease Area, nor along the EW 2 submarine export cable route (NOAA Fisheries 2013).

Giant Manta Ray – Federal Threatened Species

The giant manta ray is a large migratory species typically occurring offshore of productive coastlines (NOAA Fisheries 2018b). It ranges throughout tropical, subtropical, and temperate oceans filter-feeding on zooplankton; it is largely threatened by commercial fishing, especially industrial purse seine and artisanal gillnet fisheries (Miller and Klimovich 2017; NOAA Fisheries 2018b). This species may transit through the Project Area and be temporarily exposed to Project-related activities but is not expected to be affected by the Project.

Oceanic Whitetip Shark – Federal Threatened Species

The oceanic whitetip shark was listed as threatened throughout its range under the ESA in 2018 (NOAA Fisheries 2018c). This pelagic shark ranges throughout tropical and subtropical oceans, generally on the outer continental shelf or around oceanic islands in water depths greater than 600 ft (183 m) (NOAA Fisheries 2018c). It is most typically reported in the warm (more than 68 °F [20 °C]) surface layers of deep open waters. The oceanic whitetip shark is threatened by pelagic longline, purse seine, and gillnet fisheries, as well as shark finning (NOAA Fisheries 2018c; Young et al. 2018). This species may transit through the Project Area and be temporarily exposed to Project-related activities but is not expected to be affected by the Project.

5.5.1.4 Regional Effects of Climate Change on Distributions of Fish and Invertebrates

Changes in physiochemical oceanic conditions have been implicated in largescale shifts in species assemblages across the United States Atlantic coast, including Southern New England and the Mid-Atlantic Bight. In conjunction with fishing pressure, increasing ocean temperatures are reported to have caused managed fishery species to shift northward over the past several decades (Lucey and Nye 2010). Global climate change manifests as increases in ocean temperatures, seasonal shifts in thermal stratification of nearshore waters, and decreases in pH (acidification of seawater). These physical and chemical changes affect marine communities as species become redistributed based on their physiological preferences or tolerances (Morley et al. 2018).

Temperature

Recent increases in water temperatures in Southern New England are expected to continue (Kavanaugh et al. 2017; NOAA Fisheries 2017a; Forsyth et al. 2015), causing several groundfish species to move northward and farther offshore (Pinsky et al. 2013; Nye et al. 2009; Selden et al. 2018; Rheuban et al. 2017; Kleisner et al. 2017). Increases in estuarine water temperatures in spring are associated with poor recruitment of winter flounder in New Jersey and New York (Able et al. 2014). Changes in locations or timing of spawning in response to temperature may lead to shifts in both demersal and pelagic species assemblages (Bethony et al. 2017; Walsh et al. 2015). Several pelagic forage species have been increasing in Southern New England, including butterfish, scup, squid (Collie et al. 2008), and Atlantic mackerel (McManus et al. 2018). Likewise, the black sea bass has been expending northward and becoming more abundant in the Project Area (Slesinger et al. 2019). Conversely, spiny dogfish, little skate, and silver hake have moved southward (Walsh et al. 2015). The influx of spiny dogfish in Southern New England suggests this species may fill the feeding niche historically held by the Atlantic cod (Selden et al. 2018). NEFSC seasonal trawls did not catch a single Atlantic cod in the Lease Area between 2003 and 2016 (Guida et al. 2017) despite cod eggs being well-represented in plankton trawls throughout in the Lower and Upper Bays from 2002 to 2011 (USACE NYD 2015a).

Bottom temperatures in the Project Area have increased more than surface temperatures in the past 30+ years, disproportionately affecting demersal organisms such as lobster (Wahle et al. 2015) and Atlantic cod (Kavanaugh et al. 2017). Secondary effects of increased temperatures may be mediated by interspecific interactions, such as competition and foraging. For example, in Long Island Sound, the winter flounder now competes for food with smallmouth flounder (*Etropus microstomus*) and scup, which are more tolerant of warm water. At the same time, the winter flounder is under increasing predatory pressure from temperature-tolerant summer flounder, striped bass, and bluefish (Howell et al. 2016; Frisk et al. 2018).

The surfclam population has shifted north and offshore in the past 20 years; New Jersey populations are now farther offshore, and nearshore populations have shifted northward to Long Island and beyond (Hofmann et al. 2018). The surfclam is considered highly vulnerable to climate change through direct physiological stress (Hornstein et al. 2018) and indirect decreases in its food supply (Hofmann et al. 2018; Hare et al. 2016). About two-thirds of its diet is provided by the fall-winter bloom of phytoplankton that normally responds to ocean mixing when the surface waters cool and sink in the fall. However, when high fall temperatures delay the turnover of ocean waters, the phytoplankton bloom is either small or delayed, reducing the availability of food for the surfclam. The surfclam population off the New Jersey coast benefits from phytoplankton fed by natural upwelling in the area, but larval recruitment has been declining overall (Hofmann et al. 2018). Many surfclam larvae are transported southward to areas that are no longer able to support adult surfclam because of inadequate food and physiological stresses of warm water temperatures. The loss of these makes it difficult for the population to expand into better habitats offshore and farther north, which restricts the surfclam's ability to adapt to climate changes throughout its current range (Hofmann et al. 2018). Conversely, ocean quahog growth rates in the New York Bight have responded favorably to increased bottom temperatures (Pace et al. 2018).

Anadromous fish such as American shad, alewife, blueback herring, striped bass, Atlantic sturgeon, and American eel migrate through the Lower Bay and Upper Bay as they come and go from the Hudson River. These species are particularly vulnerable to climate change, as they are sensitive to physiological stress of water temperature and acidification as well as increased habitat degradation during river flooding (Hare et al. 2016). The food supply of planktivores and other filter feeders is also threatened by climate change. Copepods and other zooplankton mature more quickly, produce fewer offspring, and carry smaller fat reserves when water temperatures increase (Kavanaugh et al. 2017).

Acidification

As more carbon dioxide is released to the atmosphere, the pH of ocean waters will continue to decrease (Saba et al. 2016). Acidification of seawater makes it more energetically costly for an animal to produce a calcareous shell (Przeslawski et al. 2015). Bivalves such as Atlantic sea scallop, surfclam, and ocean quahog are expected to be adversely affected, as larval recruits tend to have thinner or deformed shells and weak predator-avoidance maneuvers when reared under low pH conditions (Stevens and Gobler 2018; Cooley et al. 2015).

Quantitative predictive models of increasing acidification indicate that the landings and economic value of Atlantic sea scallop are likely to decline in the next few decades (Rheuban et al. 2018). Larval longfin inshore squid were also reported to exhibit physical and behavioral abnormalities when reared under low pH conditions in the laboratory (Kaplan et al. 2013). Arthropods, such as crabs and lobster, are considerably less sensitive to the negative effects of acidification (Styf et al. 2013). Direct effects of acidification on cartilaginous and bony fishes are more subtle; early results indicate that low pH causes physiological stress and potential interference with chemosensory processes in some species (Heuer and Grosell 2014; Fabry et al. 2008).

5.5.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the Project Design Envelope (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For benthic and pelagic habitat and species, the maximum design scenario is the full build-out of EW 1 and EW 2, which incorporates a total of up to 149 foundations at any of 176 locations within the Lease Area (made up of up to 147 wind turbines and 2 offshore substations) with export cable routes to EW 1 and EW 2 (see **Table 5.5-8**). Impacts to benthic and fish resources were analyzed for two foundation types: monopiles for the wind turbine foundations and piled jackets for the offshore substation foundations (see **Section 3** for descriptions). Calculations supporting the maximum design scenario are shown in **Table 5.5-9** through **Table 5.5-12**.

Table 5.5-8 Summary of Maximum Design Scenario Parameters for Offshore Benthic and Pelagic Habitats and Resources

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum number of structures.
Interarray cables	Based on full build-out of EW 1 and EW 2, with the maximum number of structures (147 wind turbines and 2 offshore substations) to connect. EW 1: 116 nm (214 km). EW 2: 144 nm (267 nm).	Representative of the maximum length of interarray cables to be installed.
Submarine export cables	Based on full build-out of EW 1 and EW 2. EW 1: 40 nm (74 km). EW 2: 26 nm (48 nm).	Representative of the maximum length of new submarine export cables to be installed.
Wind turbine foundation Softbottom habitat loss	Based on the maximum amount of scour protection for monopile foundations: 207 ft (63 m) diameter	Representative of the maximum amount of softbottom benthic habitat lost to foundation and scour protection installation, which would result in the greatest surface area of hard substrate introduced to the Project Area.
Wind turbine foundation	Monopile	Representative of the foundation option that has an installation method that would result in the maximum introduction of underwater noise.
Wind turbine foundation Installation method Underwater noise	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Wind turbine foundation Installation method Physical disturbance	Monopile	Representative of the installation method that would result in the maximum volume of sediment disturbance during installation.

Table 5.5-8 Summary of Maximum Design Scenario Parameters for Offshore Benthic and Pelagic Habitats and Resources (continued)

Parameter	Maximum Design Scenario	Rationale
Duration Offshore construction	Based on full build-out of EW 1 and EW 2. Based on the maximum number of structures (147 wind turbines and 2 offshore substations), submarine export and interarray cables, and maximum period of cumulative duration for installation.	Representative of the maximum period required to install the offshore components, which has the potential to impact benthic and pelagic invertebrates and fish in, the Project Area.
Underwater noise Pile driving – monopiles	Pile diameter: 36 ft (11 m) Max penetration: 180 ft (55 m) Max hammer energy: 5,500 kJ Typical hammer energy: 2,300 kJ Total average pile driving duration per foundation: 3 hours 30 minutes Total duration: 609 hours EW 1: 248.5 hours EW 2: 360.5 hours	The longest duration of impact for monopiles, which equates to the maximum number of pile-driving events and the maximum amount of time required to drive all monopiles (active pile driving; EW 1 and EW 2).
Underwater noise Pile driving – piled offshore substations (EW 1 and EW 2)	Pile diameter: 8 ft (2.5 m) Max penetration: 295 ft (90 m) Number of piles per foundation: 12 Max hammer energy: 4,000 kJ Typical hammer energy: 3,200 kJ Total max pile driving duration: 3 hours 30 minutes Total number of piles for: EW 1: 12 EW 2: 12 Total duration of pile driving: EW 1: 42 hours EW 2: 42 hours	The longest duration of impact for piled jackets for offshore substations and the maximum amount of time required to drive all piled jackets for offshore substations (active pile driving; for EW 1 and EW 2).
Cofferdam	Vibratory Pile Driving	Representative of the installation method that would generate underwater noise in the nearshore environment
Project-related vessels Underwater noise	Based on full build-out of EW 1 and EW 2, which correspond to the maximum amount of structures (147 wind turbines and 2 offshore substations), submarine export and interarray cables, and maximum associated vessels.	Representative of the maximum predicted Project-related vessels for underwater vessel noise.

Table 5.5-8 Summary of Maximum Design Scenario Parameters for Offshore Benthic and Pelagic Habitats and Resources (continued)

Parameter	Maximum Design Scenario	Rationale
Operations		
Wind turbines Underwater noise	Based on full build-out of EW 1 and EW 2 (147 wind turbines). EW 1: 57 wind turbines. EW 2: 90 wind turbines.	Representative of the maximum underwater noise generated by operational wind turbines.
Project-related vessels Underwater noise	Based on a full build-out of EW 1 and EW 2 (147 wind turbines, 2 offshore substations, and submarine export and interarray cable routes) and associated vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels for underwater noise.
Loss of habitat Foundation type	Based on the maximum overall footprint (147 x 39,902 ft^2 [3,707 m^2] for monopiles with scour protection and 2 x 93,560 ft^2 [8,692 m^2] for piled jackets with scour protection). Total 6,052,714 ft^2 (562,315 m^2, 139 acres, 56.2 ha) including scour protection.	Representative of the maximum long-term loss of seabed habitat.
EMF Interarray cables	Based on a full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations), which represents the maximum length of interarray cabling. EW 1: 116 nm (214 km). EW 2: 144 nm (267 km).	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within EW 1 and EW 2.
EMF Submarine export cables	Based on a full build-out of EW 1 and EW 2 (2 offshore substations and corresponding submarine export cable routes), which represents the maximum number and length of submarine export cables. EW 1: 40 nm (74 km). EW 2: 26 nm (48 km).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable routes.

Table 5.5-9 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Acoustic Impacts of Pile Driving on Offshore Benthic and Pelagic Habitats and Resources

Type and size	Number of Wind Turbines	Pile Diameter (m)	Drive Time per Foundation (hr)	Total Drive Time (hr)	Max kJ
Monopile	147	11	3	441	5,500

Table 5.5-10 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Benthic Substrate Burial

Type and Size	Number of Wind Turbines	Foundation Diameter at Substrate (m)	Foundation Footprint (m^2)	Total Foundation-Buried Substrate (m^2)	Total Foundation-Buried Substrate (ha)
Monopile	147	11	95	13,970	1.4

Table 5.5-11 Supporting Calculations: Required Scour Protection for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation Area at Substrate (m^2)	Scour Protection around Each Foundation (m^2)	Total Scour Protection (ha)
Monopile	147	95	3,612	53.1

Table 5.5-12 Supporting Calculations: Total Habitat Conversion to Hard Bottom for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation Diameter at Substrate (m)	Foundation Footprint with Scour Protection (m^2)	Total Benthic Habitat Conversion (ha)
Monopile	147	11	3,707	54.5

5.5.2.1 Construction

Construction may include the following potential impact-producing factors to benthic and pelagic habitats and species:

- Construction of offshore components, including foundations, wind turbines, offshore substations, submarine export and interarray cables, and the associated scour and cable protection.

The following impacts may occur as a consequence of factors identified above:

- Direct disturbance, injury, and/or mortality of benthic species;
- Short-term change in water quality, including turbidity, sediment deposition, suspended sediment and chemical contamination;
- Short-term entrainment of plankton and ichthyoplankton species;
- Short-term disturbance of common softbottom sandy habitat; and
- Short-term increase in Project-related noise, including vibrations.

Disturbance, injury, or mortality of benthic species: Immobile or slow-moving demersal life stages of fish and invertebrates (including eggs and larvae) could be injured or killed during pre-construction grapnel runs, pre-sweeping and pre-trenching activities, pile driving for monopile and piled jacket foundations, seabed preparation activities, anchoring, cable burial and installation, dredging, and armoring activities. All of these activities would disturb the seabed directly and crush or bury small sessile benthic organisms. Planktonic organisms could be entrained by motorized equipment during these activities.

Pre-lay grapnel runs, pre-sweeping and pre-trenching activities, and dredging, which would be completed throughout the Project Area prior to foundation and cable installation, are focused on clearing debris (e.g., abandoned fishing gear) from the seafloor. These preparatory activities would disturb the bottom similar to the way bottom dredges and trawls do. Similarly, placement and the potential dragging of anchors on construction vessels would injure or kill organisms by direct contact. However, most construction vessels will maintain position using DPS or jack-up features, limiting the use of anchors. Anchoring would only occur in specified holding areas if vessels are required to wait, but this would be an uncommon occurance. Based on an analysis of a similar project (Block Island Wind Farm), NOAA Fisheries (2015) estimated that each anchor would temporarily disturb an area of 0.12 ac (0.05 ha). Assuming the Project would require anchors, some areas of the bottom would be disturbed; most of the affected area would be within habitats with prior and ongoing impacts from non-Project-related anchoring, trawling and dredging.

After grapnel clearing and leveling of the seafloor, the monopiles and piled jacket offshore substation foundations would be installed. The area of disturbance is summarized in **Table 5.5-12**.

Following the pre-lay grapnel run and pre-sweeping and pre-trenching activities within the submarine export cable routes, cable-laying equipment would disturb the bottom within a narrower band where the cable would be buried. Burrowing surfclam and other invertebrates that were not previously disturbed by the grapnel would be displaced by the jet plow (or other installation equipment) as the cables were installed. The jet plow would move slowly, which would allow most mobile fish and invertebrates time to move away from the equipment and likely escape injury; soft-bodied sessile invertebrates within the trenched area would be crushed or buried. Shelled mollusks would fare better; mortality of surfclam left behind in the path of a commercial clam dredge is generally assumed to be 12 percent (Kuykendall et al. 2019), although mortality could be considerably lower. Only one percent of the surfclam in an experimentally trawled area in Portugal died from trawl injury (Sabatini

2007). Injury and death of surfclam following commercial dredging are attributed to the direct impact of the dredge teeth. In contrast, the jet plow has no metal teeth and so would not cause physical breakage of surfclam shells. The jet plow would remain in a given area for only a few hours, representing a transient impact on fish and invertebrates. Surfclams, ocean quahogs, and other burrowing bivalves would use their muscular foot to reposition themselves at the desired depth in the sediment after the cable installation was complete. The submarine export cable siting corridors were selected to minimize overlap with sensitive benthic habitats, and cables will be further micro-sited within the routes to avoid boulders and other fine-scale hardbottom, to the extent feasible. Given these avoidance and conservation measures, the probability of adverse interactions of construction with sensitive benthic resources is low.

Change in water quality, including turbidity, sediment deposition, suspended sediment, and chemical contamination. Existing information indicates that the subsurface currents within the Lease Area and adjacent waters are expected to be typically less than 0.3 ft per second (0.1 m per second). To better understand the physical environment, Empire installed current meters in the Lease Area to collect site-specific measurements to support sediment transport modeling for the COP assessments (see **Section 4.2** and **Appendix J Sediment Transport Analysis**). Based on the existing information, the relatively low near-bed current speeds are not expected to generate significant quantities of suspended sediments during construction. Armoring around the foundations where appropriate would further reduce the potential for scour to generate suspended sediment plumes.

Empire will conduct studies to identify where scour protection could be applied to reduce the suspension of sediments around the foundations and cables. This is a balance between reducing scour through placement of hard material versus loss of existing habitat. For this analysis, it was assumed that the seafloor around each foundation would be armored with rock or other material to prevent bottom scour; it was also conservatively assumed that 10 percent of the submarine export and interarray cables would require armoring (surface protection), mostly in areas where sufficient burial cannot be achieved (i.e., at cable and pipeline crossings). Areas assumed to require scour protection or armoring are listed in **Table 5.5-13**.

Table 5.5-13 Maximum Scour Protection/Armoring per Project Component

Project Component	Maximum Design Scenario	Total Armored Area
Monopile Wind Turbine Foundations	147 foundations	131.2 ac (53.1 ha)
Piled Jacket Offshore Substation Foundations	2 foundations	4.3 ac (1.7 ha)
Interarray Cables	10% of 260 nm (481 km); 16 ft (5 m) wide	59.4 ac (24.1 ha)
Submarine Export Cables		
EW 1	10% of 40 nm (74 km); 36 ft (11 m) wide	20.1 ac (8.1 ha)
EW 2	10% of 26 nm (48 km); 36 ft (11 m) wide	13.0 ac (5.3 ha)

Armoring material would be lowered into place from a construction vessel, which would be stabilized by dynamic positioning, spuds, or anchors. Mobile fish and invertebrates would likely leave the area to avoid the noise and physical disturbance during armoring. Sessile organisms within the armored area that were injured or buried by the armoring material would likely be scavenged by fish, crabs, and other mobile predators following construction activity in the area (Vallejo et al. 2017). The armored areas would be colonized by organisms that attach to hard substrate (sessile anthozoans, sponges, bryozoans), mobile macroinvertebrates such as crabs, and small demersal fish (NOAA Fisheries 2015). Organisms would emigrate from adjacent habitats or recruit from the plankton and reestablish the infaunal and epifaunal communities in adjacent softbottom habitats.

Turbidity

Softbottom sediment would be suspended and turbidity would increase temporarily within and immediately adjacent to submarine export cable routes (see **Section 4.2** and **Appendix J** for additional information on the expected suspended sediments and turbidity resulting from submarine export cable installation). Long-term, chronic increases in suspended sediment can cause physiological stress to sessile organisms; however, most fish and invertebrates are capable of mediating short-term turbidity plumes by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilbur 2000). Some bivalves temporarily close their shells to avoid contact with unsuitable water, which temporarily interrupts their ability to feed and excrete wastes (Roberts and Elliott 2017; Roberts et al. 2016).

During the brief disturbance of the bottom as the cable is installed, turbidity would temporarily reduce visibility and alter the behavior of some fish and invertebrates in the immediate vicinity. Pelagic fishes, such as river herring and striped bass in the Lower and Upper Bays may encounter areas of increased turbidity, especially in relatively confined areas. However, fish and invertebrates inhabiting estuarine and coastal habitats are generally adapted to temporary turbidity events caused by storms, and may even use the visual cover provided by suspended sediment to forage opportunistically. Conversely, the suspended sediment plume raised by the jet plow may directly increase the density of food particles in the immediate area, indirectly benefitting the surfclam and other suspension feeders in the submarine export cable corridors. The high metabolic demands of large surfclam may not be met solely by planktonic food sources. The nutritional value of suspended sediment near the sea floor can be two orders of magnitude greater than in the water column 3 ft (1 m) above the sea floor (Munroe et al. 2013). Surfclam and other demersal filter feeders may benefit from the benthic algae and detritus mobilized by bottom disturbance during construction. Blue crab and horseshoe crab typically occur in dynamic nearshore waters where turbidity is naturally high; effects on these species would be transient and similar to those described for other large mobile demersal crustaceans such as lobster and *Cancer* crabs.

Species with estuarine life stages are sensitive to suspended-sediment. Spawning adults stressed by changes in dissolved oxygen or obstructed passage to spawning habitats have been found to resorb their eggs and migrate offshore having spawned fewer batches or without spawning (Evans et al. 2011). Mobile juveniles and adults may exhibit behavioral changes in response to elevated turbidity, including avoidance of the impact area induced by low levels of oxygen (NJDEP 2018). Turbidity also causes light attenuation, which can hinder foraging and localized navigation. These can lead to temporary community shifts as organisms move elsewhere.

Studies of turbidity raised by hydraulic dredges, which are considerably larger than the jet plows proposed for the Project, indicate that suspended sediments behind the dredge fall rapidly back to the bottom within a short distance from the dredge, posing no obstacle to fish migration or transit through the area (USACE NYD 2015b). Suspended sediment concentrations during jet plowing and cable installation at the Block Island Wind Farm were well below predictions of the project-specific turbidity model (Elliot et al. 2017). Sediment modeling for this Project indicates that suspended sediment would increase in the immediate area around bottom-disturbing construction, then decrease to ambient concentrations (see **Section 4.2** and **Appendix J**).

Within the Project Area, oysters at the Bush Terminal Community Reef have grown quickly, spawned, and begun to cement together to form a reef since installation in 2016. To date, the incidence of oyster diseases has been low at this reef. Water quality is generally good, with adequate dissolved oxygen. The oyster reefs are in a protected area near shore where disturbance from cable installation is expected to be minimal. Short-term suspension of sediment within the water column is not considered a stressor to oysters, as these animals feed on plankton and other small particles that are suspended with the sediment.

Sediment Deposition

Following cable installation and armoring, suspended sediments would settle in and adjacent to the submarine export cable routes. The duration and height of the suspended sediment above the bottom would be influenced by particle size and bottom currents (see **Section 4.2** and **Appendix J**). Along the submarine export cable routes, pre-sweeping activities will result in the side-casting of material along sandwaves and megaripples; at submarine cable and pipeline asset crossings, sediment may be side-cast or removed. At the landfall for EW 1, sediment would be removed from SBMT to facilitate submarine export cable burial and installation. Dredged material would be disposed of in a location detailed in a Dredge Disposal and Management Plan and pre-approved by the applicable agencies (see **Section 3**).

Some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) and solitary star coral larvae could be buried by deposited sediments during construction. However, measurable sediment deposition would be limited to the installation trench and areas directly adjacent. Currents, storms, and other oceanographic processes frequently disturb softbottom habitats in the Project Area, and native fish and invertebrates are adapted to respond to such disturbances. For example, the surfclam is considered tolerant of smothering and burial by sediment because it is a fast burrower that can move both vertically in the sediment and laterally across the surface of the sediment; its recovery following sedimentation events is very high. Under experimental trawl conditions, the surfclam reburied in the sediment within a few minutes of the trawl disturbance (Sabatini 2007). Mobile scavengers such as hermit crabs, whelks, sea stars, and some fish would likely move into the area to eat the dead and injured invertebrates (Sciberras et al. 2018; Vallejo et al. 2017; Kaiser and Hiddink 2007; Ramsay et al. 1997; NYSERDA 2017). Some species may even benefit from disturbances as new substrate becomes available for colonization (NOAA Fisheries 2018d).

Indirect impacts on fish and invertebrate resources from sediment suspension and deposition would be short-term and minimal. This one-time disturbance would not prevent natural recovery of benthic communities. Estimates of recovery time following construction vary by region, species, and type of disturbance. Case studies from cable installations on the continental shelf at depths comparable to the Project Area indicate that recovery begins immediately after construction and is complete within two years after jet plowing; the duration depends on the availability of mobile sediment (Brooks et al. 2006). Softbottom habitat recovers more quickly after cable installation by plowing than by jetting (Kraus and Carter 2018). Evidence of recovery following sand mining in the United States Atlantic and Gulf of Mexico indicates that softbottom benthic habitat in the Project Area would fully recover within 3 months to 2.5 years (Kraus and Carter 2018; BOEM 2015; Normandeau 2014; Brooks et al. 2006). NOAA Fisheries estimated recovery of the softbottom benthic community at Block Island Wind Farm within three years (NOAA Fisheries 2015).

Suspended Sediment and Chemical Contamination

Sources of non-routine chemical releases during construction include suspension of contaminated sediments within the submarine export cable routes, fuel spills from vessels, and releases of bentonite drilling muds associated with HDD at the export cable landfall sites.

Sediment in the Lease Area is not known or expected to be contaminated, as no industry or other source of chemical releases exist at that distance from shore (Merck et al. 2009, cited in Taormina et al. 2018). Furthermore, the Project avoids known dump sites such as the Historic Area Remediation Site known as the "Mud Dump" (USACE NYD 2019). Subsurface sediment disturbed by cable installation in the EW 1 submarine export cable siting corridor, particularly in the Lower and Upper Bays, is likely to contain elevated concentrations of constituents of concern, as discussed in **Section 4.2**. However, constituents of concernin sediment in this area would not necessarily affect local benthic organisms. A joint USGS/NOAA Fisheries study used standard coastal monitoring protocols to evaluate the effect of suspended sediments on mussels from sites in northern New Jersey, Hudson/Raritan Bay, and southern Long Island following Hurricane Sandy (Smalling et al. 2016). Despite well-documented elevated concentrations of PCBs in sediments in the Hudson River/Raritan Bay area, concentrations of PCBs in mussels were unchanged following the storm. Likewise, concentrations of legacy organochlorine pesticides (chlordane and dichlorodiphenyltrichloroethane [DDT]) in mussels from Jones Beach, Long Island, and dieldrin in Hudson River/Raritan Bay mussels were lower than before the hurricane (Smalling et al. 2016). These results indicate that resuspension of sediments during installation of the submarine export cables would be unlikely to cause an increase in constituent of concernuptake by local organisms. Direct and indirect adverse impacts on fish and invertebrates exposed to suspended sediment would be short-term and localized.

In addition to chemical constituents of concern, fecal coliform colonies have affected water and sediment in coastal portions of the submarine export cable siting corridors. Shellfish in nearshore and inshore portions of the submarine export cable siting corridors are considered unsuitable for harvest based on water quality monitoring for nutrients, fecal coliform, and harmful algae (NYSDEC 2019c; **Figure 5.5-23**).

Typical offshore construction support vessels burn diesel fuel and have the potential to accidentally release small amounts of fuel to the waterway. Diesel floats on the water's surface briefly before volatilizing; it does not sink to the bottom and would not affect benthic habitat or species. Empire would require all construction vessels to minimize the risk of fuel spills and leaks, as detailed in **Appendix F Oil Spill Response Plan**; vessels would not refuel at sea. Construction vessels would comply with USGS regulations and with discharge limits in the Vessel Incidental Discharge Act of 2018, as appropriate for the vessel size and type. Chemical releases from vessels are considered unlikely; impacts would be short-term and localized.

During HDD at the export cable landfall sites, the release of non-toxic drilling mud would be unlikely, but possible. Empire's HDD Contingency Plan, which would be submitted for review prior to the start of HDD, would specify response actions to be implemented if an accidental release occurred. Given the unlikely occurrence of a release and the precautions outlined in the Contingency Plan, impacts of drilling muds on benthic habitat would be indirect and temporary, consistent with BOEM's analysis of the HDD installation at Virginia Offshore Wind Technology Advancement Project (BOEM 2015.)

Project-related marine debris would have an indirect, short-term effect on fish and invertebrate resources. However, Empire would continue practices established during the site assessment surveys that require all offshore personnel to comply with USCG regulations on the proper disposal of marine debris.

The wind turbine and offshore substation foundations would support an extensive artificial reef habitat in the Lease Area, and likely act as fish aggregation devices. The presence of foundations would alter the surrounding habitat by temporarily disturbing sand ripples and mega-ripples, introducing artificial habitat, changing bottom scour patterns, and increasing shade.

Short-term Entrainment of Plankton and Ichthyoplankton Species

Ichthyoplankton may be entrained by the jet plow during cable installation. The jet plow would move continuously, affecting a given area for a brief time. The area of impact would be small relative to the available habitat for ichthyoplankton, consistent with entrainment analyses for other offshore wind farms in Southern New England (BOEM 2019c). Species entrained would vary by location, water depth, and season. Although entrained organisms would likely be killed, the loss would not be detectable against the background loss to existing vessels, including hydraulic scallop and clam dredges, in the Project Area.

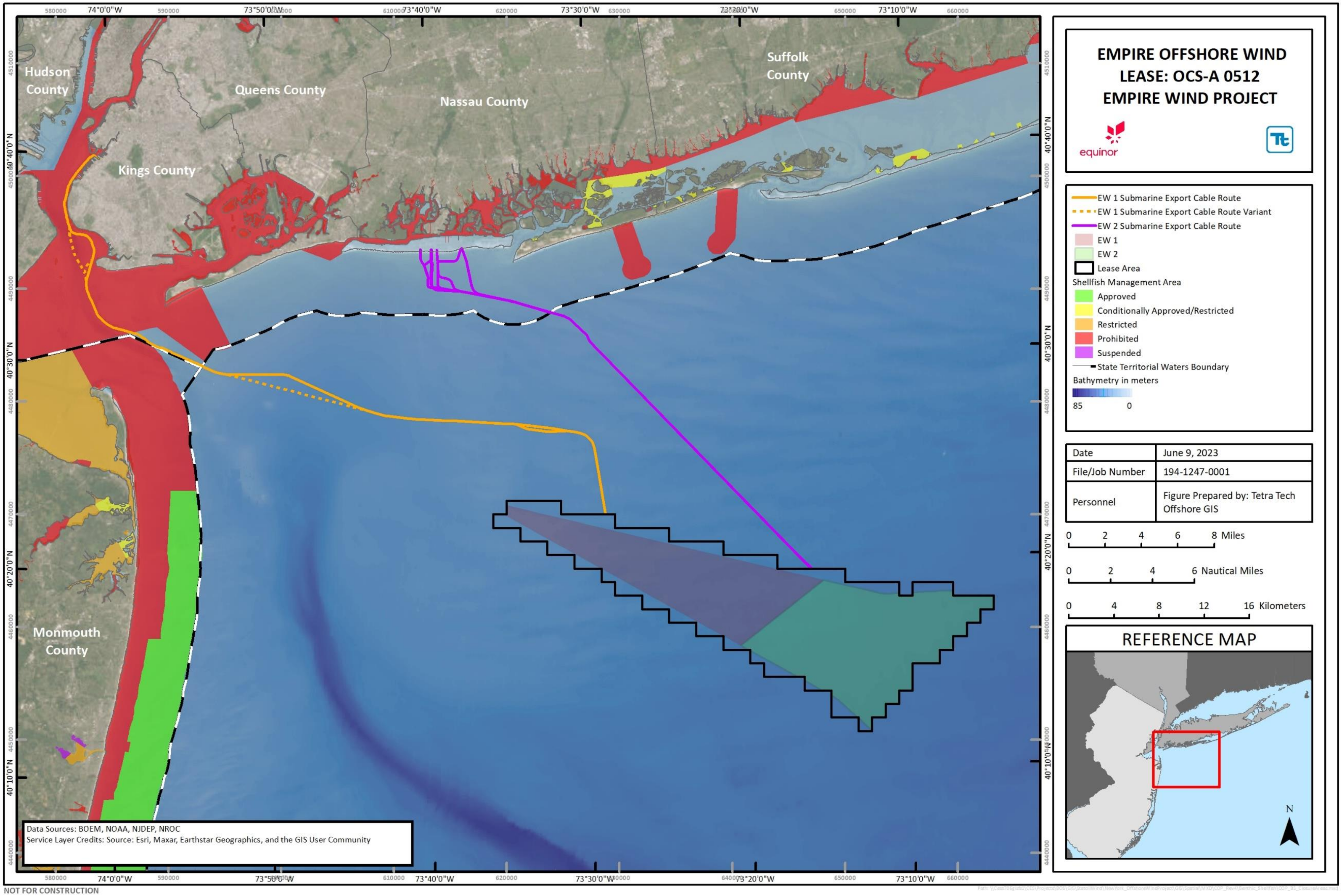


Figure 5.5-23 Certified and Uncertified Shellfish Areas in Project Area

Short-term Disturbance of Common Softbottom Sandy Habitat

As described in Section 5.5.1, much of the Lease Area is characterized as sand ripples several centimeters high, which are formed by modest currents interacting with the bottom. The pre-lay grapnel runs and installation of interarray cables would disturb the sand ripples temporarily, but tidal and wind-forced bottom currents would reform most ripple areas within days to weeks. Areas that are more strongly influenced by extreme weather events would reform in response to Nor'easters and tropical systems. The natural pattern of sand ripples would return to pre-construction conditions within a few months. The only permanent loss of habitat would be the soft-bottom in the Lease Area converted to hardbottom by foundations and scour protection (**Table 5.5-12**), and the supplemental cable armoring (**Table 5.5-13**). The remainder of the Lease Area and the submarine export cable siting corridors would remain softbottom habitat.

Larger sandwaves are maintained by current flow into and out of New York/New Jersey Harbor in the nearshore portion of the EW 1 submarine export cable siting corridor; this high-flow area of sandwaves is designated EFH for silver hake. Sandwaves increase habitat value for demersal species by providing topographic relief where fish can shelter from high current flow and hide from predators and prey (Auster et al. 2003; Lock and Packer 2004; Hallenbeck et al. 2012). Sandwaves in the submarine export cable siting corridors would reform by natural processes following cable installation.

Short-term Increase in Project-related Noise, Including Vibrations

The Project will generate noise during construction, which could directly and indirectly affect marine fish and invertebrates. Sudden loud noises can cause behavioral changes, permanent or temporary threshold shifts, injury, or death (Popper and Hastings 2009; Popper et al. 2014; Popper and Hawkins 2016; Andersson et al. 2017; Southall et al. 2019). Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a permanent threshold shift, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a temporary threshold shift, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015).

Underwater noise associated with pile driving is a function of the type and size of piling, as well as the method of driving. The greatest source of injurious noise in the Lease Area would be pile driving using an impact hammer and the corresponding vibration of the seabed as the pile is driven into the substrate. Empire modeled the use of an impact hammer with a typical energy of 2,300 kJ and a maximum energy of 5,500 kJ to install the pilings for monopile and an impact hammer with a typical energy of 3,200 kJ and a maximum energy of 4,000 kJ to install the piled jacket foundations (see **Table 5.5-9** and **Appendix M-2 Empire Wind Acoustic and Exposure Modeling**). Impact driving of small-diameter temporary piles for goal posts to assist in the HDD cable landfall process would also generate noise, though less than the monopiles (**Appendix M-1 Underwater Acoustic Assessment: Vibratory Pile Driving, Cable Landfall and Marina Activities**).

Temporary sheet-pile cofferdams may be installed at the export cable landfalls where the submarine export cables would transition from subsea burial in trenches to placement using HDD. The sheet piles would be placed in a tight configuration around an area approximately 20 ft by 50 ft (6 m by 15 m). Vibratory pile drivers used to install the cofferdams would temporarily elevate underwater sound pressure and particle velocities, which could affect fish and invertebrates in the vicinity. In general, vibratory pile driving is less noisy than impact pile driving. Impact pile driving produces a loud impulse sound that can propagate through the water and substrate, whereas vibratory pile driving produces a continuous sound with peak pressures lower than those observed in pulses generated by impact pile driving.

Cofferdams would be constructed on the EW 2 submarine export cables within open coastal waters where fish and other organisms would be free to adjust their location. At the EW 1 landfall, however, the cofferdam would be installed in a relatively confined area. The Atlantic sturgeon could be exposed to vibratory pile driving noise during installation of the cofferdam in the Hudson River. Results of the acoustic analysis of vibratory piling are in **Section 4.4.2** and **Appendix M-1**. Underwater noise would also be generated by the bulkhead repairs and removal of berthing piles along the EW 2 Onshore Substation C location (**Appendix M-1**).

The potential impact of underwater noise is influenced by the physiology of the receiver, the magnitude of the sound, and the distance of the receiver from the sound. Fish and invertebrates may be sensitive to both sound pressure and particle motion (oscillation of water molecules set in motion by sound) generated by underwater construction. While all marine fish and invertebrates can detect particle motion, fish with swim bladders connected to the ear are most sensitive to sound pressure (Popper and Hawkins 2018; Hawkins and Popper 2018; Popper et al. 2014) (**Table 5.5-14**).

Table 5.5-14 Relative Sensitivity of Fish and Invertebrates to Sound

Morphological Type	Vulnerability to Barotrauma	Vulnerability to Sound Pressure	Typical Species in Project Area
No swim bladder or other gas-filled organ linked to hearing	Low	No	Fish: flatfish, sharks, rays, some tunas, some eggs and larvae Invertebrates: squid, clams, whelk, crabs, lobster
Swim bladder not related to hearing	Medium	No	Sturgeons, striped bass, yellowfin and bluefin tuna, some eggs and larvae
Swim bladder or gas-filled organ related to hearing	High	Yes	Atlantic cod, haddock, herring.

Interim threshold criteria established by a Working Group on Effects of Sound on Fish and Turtles initiated by NOAA were finalized under the ANSI (Popper et al. 2014). Although data were not adequate to derive acoustic criteria for fish or invertebrates, the Working Group did develop general guidelines for predicting acoustic sensitivity from basic morphological traits of fish and invertebrates. Consensus was reached on numeric thresholds for mortality, recoverable injury, and temporary threshold shifts, as well as qualitative risk of masking effects and behavioral responses for fish and invertebrates at three relative distances from the sound source (near, intermediate, and far). Injury thresholds for fish with swim bladders not linked to hearing were applied to eggs and larvae based on morphological similarities because information on these early life stages was not available (Popper et al. 2014). Consensus guidance is summarized in **Table 5.5-15**.

Table 5.5-15 Consensus Guidance on Acoustic Thresholds for Fish and Invertebrates

Morphological Type	Potential or Actual Mortality	Recoverable Injury	Temporary Threshold Shift	Masking	Behavioral Responses
No swim bladder	>219 dB SEL_{cum} or >213 dB peak	>216 dB SEL_{cum} or >213 dB peak	>>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Swim bladder (no hearing)	210 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low

Table 5.5-15 Consensus Guidance on Acoustic Thresholds for Fish and Invertebrates (continued)

Morphological Type	Potential or Actual Mortality	Recoverable Injury	Temporary Threshold Shift	Masking	Behavioral Responses
Swim bladder (hearing)	207 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Eggs and larvae	>210 dB SEL_{cum} or >207 dB peak	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Source: Popper et al. (2014)

Notes:

Peak and rms sound pressure levels are shown as decibels referenced at 1 micropascal (dB re 1 μPa); sound exposure level (SEL) as decibels referenced at 1 micropascal squared-second (dB re 1 $\mu Pa^2 \cdot s$). No data are available to support thresholds for particle motion, so values are given in terms of sound pressure for all fish and invertebrates.

N = Near (tens of meters from the source), I = Intermediate (hundreds of meters), F = Far (thousands of meters).

As more data on the effects of noise on fish and invertebrates become available, the interim noise thresholds may be updated (Popper and Hawkins 2019). More recent empirical studies suggest that the thresholds may be as much as 20 dB too low for most species (see review by Casper et al. 2016). Guidance from Swiss researchers points to uncertainties in the injury thresholds in Popper et al. (2014) resulting from the confined test chambers where test fish were exposed to noise for 24 minutes with no choice of leaving (Andersson et al. 2017). For example, a cod or herring can swim more than 3,281 ft (1,000 m) in 24 minutes, thus reducing its exposure to injurious noise through avoidance behavior. Even in open water, uncertainties related to interspecific variability suggest that the interim guidelines may be overprotective. Fishes in the field exhibit various reactions to pile driving noise; in south Florida, the sheepshead (*Archosargus probatocephalus*) remained for 10 days in a pile driving area while the grey snapper (*Lutjanus griseus*) left the area after only three days (Iafrate et al. 2016). NOAA Fisheries concluded in a Biological Opinion that acoustic stressors were unlikely to adversely affect Atlantic sturgeon or their prey.

An individual fish would be injured by pile driving noise only if it remained near the pile during installation (NOAA Fisheries 2015). Because the ESA requires protection of individual fish, it is reasonable to conclude that the lack of adverse effect on the Atlantic sturgeon applies equally to species managed for commercial harvest under the MSA. Fish and adult squid in the open waters of the Lease Area could readily avoid harmful noise levels by temporarily leaving the area as soon as ramp-up pile driving began, if not before. Schools of pelagic fish moved horizontally and vertically when an air gun was shot, but no overall effect of the noise on their diurnal movements was observed (Carroll et al. 2017).

The 2014 interim criteria for predicting acoustic impacts to fish and invertebrates are not reflective of the effect on these taxa of particle motion (Hawkins and Popper 2016) or sediment vibration (Roberts et al. 2016). Fish and invertebrates have been shown to detect and respond to particle motion in small hard-surfaced experimental chambers in the laboratory. However, the environmental field conditions that determine the probability of detection and response of particle motion by organisms in the field cannot be replicated in the laboratory (Popper and Hawkins 2019; Hawkins and Popper 2016). The study of noise effects on marine invertebrates has lagged behind fish and other vertebrates (de Soto 2016). A marine mussel and hermit crab were reported to detect and respond to sound-generated vibrations of the sediment itself, suggesting acoustic pathways not typically measured or modeled (Popper and Hawkins 2018 and references within). These logistical limitations have stalled the development of consensus guidelines on predictive impacts of particle motion and vibrations on fish and invertebrates (Andersson et al. 2017).

The effects of noise on squid behavior varies by species, life stage, and individual. Most species of squid can detect particle motion with statocysts (Mooney et al. 2010) and a lateral line (Solé et al. 2018), similar to some fish. An Australian squid (*Sepioteuthis australis)* exposed to air gun sounds similar to the proposed pile driving squirted ink and then quickly jetted away from the sound. Other individuals of the same species reacted by freezing (Fewtrell and McCauley 2012). In a separate laboratory experiment on *Loligo vulgaris* and *Illex coindetii*, the squid dropped to the bottom of the tank and did not move for several days (Solé et al. 2013). The reaction of squid in the Project Area to pile driving noise cannot necessarily be predicted from observations of fish or other species of squid in the laboratory; the behavior of individual squid in experimental chambers may or may not represent the reaction to pile driving noise by schools of free-swimming squid in the Project Area.

Sessile demersal species such as squid egg mops, demersal fish eggs and larvae, surfclam, scallop, and ocean quahog would be exposed to sound pressure, particle motion, and substrate vibrations throughout the period of pile driving. Surfclam, ocean quahog, and scallops would likely respond to the vibration and sound of the impact hammer by closing their valves or "flinching", which prevents feeding (Charifi et al. 2017; Day et al. 2017). The loss of foraging opportunity resulting from closed valves would be a short-term, reversible, adverse impact on these species; once the disturbance ended, the bivalves would resume feeding. A brachyuran crab, two species of lobster (Edmonds et al. 2016), and a hermit crab (Roberts et al. 2016) also detected and responded to particle motion in the laboratory. These crustaceans may be temporarily disturbed during pile driving.

As discussed in **Section 8.8**, substantial commercial harvest of squid occurs in the Lease Area in some years. Despite the limited acreage of EFH for squid eggs in the Lease Area (14,902 ac [6,031 ha] or 18.8 percent; **Appendix U**), the Lease Area is reported to support extensive squid spawning (Guida et al. 2017). Effects of acoustic stress on squid reproductive behavior or demersal eggs is unknown. One squid laid eggs on the camera during the air gun test, but the authors could not determine whether the spawning was a reaction to the acoustic stress or simply a response to an available substrate for placing eggs (Fewtrell and McCauley 2012). As discussed above, laboratory data suggest that some cephalopods may be susceptible to injury by loud noises, particularly during early life stages (Solé et al. 2018, 2013). Some adult and hatchling squid could be exposed to and injured by acoustic stressors during pile driving.

Ichthyoplankton have limited ability to flee unfavorable conditions, although more developmentally mature individuals of some species may be capable of directional swimming (Pineda et al. 2007). The sensory cells of newly hatched squid were shown to be susceptible to injury by anthropogenic sound in controlled laboratory studies. When squid hatchlings were exposed to 50-400 Hz sinusoidal wave sweeps for 2 hours at a measured sound pressure level of 157±5 dB re 1 μPa with peak levels up to 175 dB re 1 μPa, statocysts and lateral line cells were damaged (Solé et al. 2018). In some larval fish, sensory hair cells were able to regenerate within a few weeks, but the permanence of the damage to squid sensory cells is not known (Solé et al. 2018). Little is known about the effects of loud noises of ichthyoplankton, but monkfish and cod egg survival and abundance were not affected by seismic sounds (Carroll et al. 2017).

Results of Empire's underwater acoustic modeling are presented in **Appendix M-1** and **Appendix M-2**. The assessment concluded that the footprint of harmful noise relative to the extent of habitat and the short duration of pile driving would not cause population-level effects on fish, bivalves, squid, or other invertebrates. These findings are consistent with modeling and field measurements for offshore wind foundations in the Mid-Atlantic Bight and Southern New England that reported only short-term adverse effects on fish, invertebrates, and EFH exposed to pile driving noise (BOEM 2018, 2015). An individual fish or squid would experience harmful cumulative exposure only if it followed the pile driving equipment throughout the Lease Area for weeks or months; an unlikely scenario. Individual Atlantic sturgeon could be exposed to pile driving noise briefly, but are not expected to remain in the ensonified area for more than a few hours. Even under relatively quiet baseline (non-construction) conditions, individual sturgeon were demonstrated to move throughout the Lease Area rather than remain in a fixed location. It is reasonable to assume that Atlantic sturgeon would respond to the increased activity associated with pile driving by moving away from the zone of influence. Empire is committed to using a ramp-up procedure as part of avoidance, minimization, and mitigation measures for marine mammals and sea turtles, which will also allow fish and other mobile organisms to leave the immediate area to avoid injurious cumulative exposure (see **Section 5.6 Marine Mammals** and **Section 5.7 Sea Turtles** for additional information). Given the extent of suitable habitat outside the construction area, it is reasonable to expect adult fish and squid to relocate temporarily during pile driving (BOEM 2015). Given the naturally high mortality of fish and invertebrate eggs and larvae in the field, injury caused by acoustic pulses during pile driving would not cause significant population-level effects on any species.

The number of individual fish or invertebrates potentially affected by pile driving noise would be negligible relative to overall abundance of these managed species. Impacts to fish and invertebrates (including ichthyoplankton), would be direct and short-term. Overall, noise associated with pile driving would be temporary and localized.

Vessel Traffic

Vessels used for construction would introduce noise into the Project Area. Construction vessel noise does not differ substantively from noise generated by other commercial vessels moving slowly while trawling or idling in an area. Noise generated during cable laying (using jet plow or similar equipment) would be similar to other diesel-powered vessels. The noise of maintenance dredging was determined not to differ from vessel background sounds and to pose no barrier to migratory behavior of fishes in New York/New Jersey Harbor (USACE NYD 2015b). The acoustic impact of vessels on fish and invertebrates would be temporary and localized.

Project-related activity that poses potential vessel strike risk to Atlantic and shortnose sturgeon includes the transport of turbines towers, cables, and scour protection materials from three ports, two located on the Hudson River of New York and one located on the Cooper River of South Carolina. Turbine towers will be transported from Port of Albany to SBMT and rock for scour protection will be transported from Port of Coeymans to the Lease Area. Both ports are located near the city of Albany, New York on the Hudson River. For each transit from Port of Albany, three towers would be loaded from shore at Port of Albany onto a large (300- to 400-ft [91- to 122-m]) barge and towed downriver by two tugs for final staging at SBMT. The tugs and barge would then return upriver, repeating this transit until all towers are transported to SBMT. The anticipated transport schedule will be one barge every 14 days. In the maximum buildout scenario for EW 1 and EW 2 (147 total turbine towers), there would be an expected total of 98 transit trips executed to and from Port of Albany to SBMT. Considering that the expected configuration involves one barge and two tugs traveling together (i.e., 3 vessels), there would be a maximum 294 total vessel trips for this purpose over the course of EW 1 and EW 2 construction. For scour protection transport, one fall pipe vessel would be loaded with material at the Port of Coeymans and transit directly to the Lease Area for installation. The expected number of trips from Port of Coeymans would be minimal, estimated at 15 round-trips (30 trips to and from the port) over the course of EW 1 and EW 2 construction. Due to the proximity of Port of Coeymans to Port of Albany, the number of fall pipe vessel trips can be added to the number of tug and barge trips for an expected maximum of 324 vessel trips on the Hudson River.

It is currently expected that inter-array cables and submarine export cables will be transported from a manufacturing facility located on the Cooper River just north of Charleston, South Carolina. Cable spools will be loaded onto one or two cable lay vessels, which will transit from this facility to the Lease Area. The expected number of trips through the Cooper River would also be minimal, estimated at 10 round-trips (20 trips to and from the port) over the course of EW 1 and EW 2 construction.

The Hudson and Cooper Rivers provide designated critical habitat for the Endangered New York Bight and Carolina DPSs of Atlantic sturgeon, respectively (NOAA Fisheries 2022a). Based on guidelines from NOAA Fisheries (2017c), vessel transit down the Hudson River would not affect or degrade any of the physical or biological features identified for Atlantic sturgeon critical habitat (e.g., salinity, hard or soft substrate, water depth, openness of river channels, temperature, and dissolved oxygen, as described in NOAA Fisheries 2017c, Section 4.5.5.1 Preliminary Resource Characterization). However, vessel strikes remain a potential threat to sturgeon from all vessel traffic, related and unrelated to the Project, in both river systems. Vessel strikes on sturgeon have been documented in large, industrialized river systems of the mid-Atlantic including the Hudson, Delaware, and James Rivers (Balazik et al. 2012; Brown et al. 2010; NOAA Fisheries 2022b; NOAA Fisheries 2017d). No information was found regarding vessel strikes on sturgeon in the Cooper River.

Sturgeon mortalities caused by vessel strikes are usually inflicted on larger fish—likely to be spawning adults—and may therefore have disproportionately greater negative impacts to population recovery efforts than other sources of mortality (Balazik et al. 2012; Brown and Murphy 2010; Hilton et al. 2016). In the Five-Year Review of the New York Bight DPS of Atlantic sturgeon, NOAA Fisheries stated that vessel strikes present a "primary threat" to the DPS that inhabits and spawns in the Hudson River (NOAA Fisheries 2022b). In 2019, a NYSDEC survey reported at least 17 Atlantic sturgeon deaths due to vessel strikes in the Hudson River, of which at least 10 were adults. NOAA Fisheries and cooperating agencies agree that these counts are underrepresented due to limited available data (NOAA Fisheries 2022b). Data on sturgeon vessel strike mortality and population impacts are difficult to obtain, relying on limited research studies and public reporting (ASMFC 2017b; Balazik et al. 2012). Additionally, studies have shown that mitigation efforts, such as reduced vessel speed, are unlikely to reduce the likelihood of vessel strikes because Atlantic sturgeon do not exhibit avoidance behaviors when in the presence of vessels or underwater construction (Balazik et al. 2020; DiJohnson 2019; Reine et al. 2014). However, studies on collisions with other protected species suggest that severity of injury caused by a strike may be reduced with reduced speed when collision occurs with a hull or other blunt feature of a vessel (i.e., not including propeller blades) (NOAA Fisheries 2018e). While there has been no research to determine how vessel speed relates to risk of sturgeon strike or mortality, it is assumed that slower vessel speeds reduce the risk of mortality. However, propeller strikes may still cause severe injuries regardless of speed (NOAA Fisheries 2018e).

The risk of sturgeon vessel strikes from Project-related vessel traffic can be assessed based on the relative increase in the number of vessel trips expected to occur in the Hudson and Cooper Rivers. Vessel strike risks to sturgeon in the wider portions of these rivers—the lower Hudson approaching New York Harbor and the lower Cooper approaching the Charleston Harbor—and the open ocean are considered negligible due to the deeper and less obstructed waters and more dispersed vessel traffic (NOAA Fisheries 2018e). The Hudson River from Albany to New York Harbor regularly experiences high commercial and recreational vessel traffic, and therefore consistent sturgeon collision risk (NOAA Fisheries 2018e). According to the USACE Waterborne Commerce Statistics Center, there was a total of 146,305 commercial vessel trips taken on the Hudson River in 2018 (USACE 2020). Assuming that non-Project-related vessel traffic patterns during EW 1 and EW 2 construction phases will not be considerably higher or lower than in 2018, an additional 324 vessel trips in a year would represent an approximately 0.22 percent increase in annual trips. There is no available data describing the vessel activity in the Cooper River. Due to the presence of many commercial and industrial ports and proximity to the densely populated coastal Charleston region, it is presumed that high vessel traffic regularly occurs in the Cooper River, and that the additional 30 vessel trips related to Project construction activities will also represent a relatively low increase in vessel traffic. Of note, these estimates represent an overestimation in overall relative increase because the total number of transits for the Project will take place over more than one year.

Whether the vessels used for the Project will have differential potential impacts or threats than any other size or type of vessel transiting the Hudson or Cooper rivers at any given time is unknown (NOAA Fisheries 2018e). A NOAA Fisheries Biological Opinion for the construction and operation of the New Jersey Wind Port on the Delaware River (NOAA Fisheries 2022c) notes that larger, deeper-draft vessels take up more space in the water column and may pose more of a sturgeon collision threat simply because sturgeon have less space to avoid hulls or propellers. This report also suggests a potential higher risk of propeller strike or entrainment for larger vessels because larger propellers draw proportionately more water from the water column than those of smaller vessels (NOAA Fisheries 2022c). However, since the vessels used for EW 1 and EW 2 construction transits are similar in size to those already in use in these rivers for other purposes, the risk of vessel strike for sturgeon is expected to be similar to baseline conditions. Additionally, the small number of proposed vessel trips on the Cooper River would cover a relatively short distance of 23 miles (37 km) each, and are therefore not likely to present a meaningful risk of sturgeon vessel strikes.

Empire proposes to implement measures to avoid, minimize, and mitigate the impacts of vessel strikes with other protected species such as marine mammals and sea turtles (Section 5.6.3). The potential for severe injury or mortality caused by a strike to any species may be reduced, as mentioned above, because proposed vessels are expected to move slowly to safely navigate the rivers. For instance, transit speeds between the Port of Albany and SBMT are expected to be 3 to 4 knots. While vessel strike is considered a risk for all vessel activity on the Hudson River, there is a low probability of increased risk associated with Project-related vessel traffic from Port of Albany or Port of Coeymans to SBMT or the Lease Area. As mentioned above, the approximately 0.22 percent increase in annual traffic is likely an overestimation, as trips for the Project construction would be spread over the course of more than one year. The USACE Waterborne Commerce Statistics Center's Hudson River statistics also only account for commercial traffic and do not include recreational traffic, representing even more of an underestimation of overall traffic and an overestimation of the relative increase attributable to the Project. Assuming all vessels (small recreational, large commercial, barges, etc.) pose the same likelihood of vessel strike, the approximately 0.22 percent increase in overall vessel traffic on the Hudson River and the 30 trips on the Cooper River represent a negligible increase in the likelihood of a vessel strike on sturgeon.

Similar conclusions were reached in the analysis of increased vessel traffic in the NOAA Fisheries (2018e) Biological Opinion for the construction of the Tappan Zee Bridge Replacement. That analysis covered much of the same portion of the Hudson River with similar types of tug and barge trips. An approximately 1 percent increase in traffic from the Tappan Zee Bridge project in 2016 resulted in "no indication" of vessel strikes on sturgeon (NOAA Fisheries 2018e). Further, a projected traffic increase of 0.08 percent in 2017 and 0.17 percent in 2018 was estimated to result in 0.0072 and 0.0153 vessel strikes, respectively (NOAA Fisheries 2018e). NOAA Fisheries concluded that an increase in sturgeon strikes caused by that project was unlikely and, thus, effects of the traffic increase on sturgeon were discountable. Because the estimated traffic increase from the Empire Wind Project of less than 0.22 percent is comparable to the increase analyzed by NOAA Fisheries for the Tappan Zee Bridge project, the risk of vessel strike on sturgeon caused by Project-related vessel traffic may also be considered discountable and negligible.

5.5.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to benthic and pelagic habitats and species may include:

- The presence of new permanent structures and infrastructure (i.e., foundations, wind turbines, and offshore substations); and
- Presence of new buried submarine export and interarray cables.

The following impacts may occur as a consequence of the factors identified above:

- Long-term disturbance, displacement, and/or modification of habitat and the introduction of artificial habitat;
- Introduction of nonindigenous species;
- Increase in shading and Project-related artificial lights;
- Underwater noise/vibration;
- Changes in water quality (turbidity, incidental spills, and marine debris); and
- Long-term increase in Project-related EMF.

Long-term disturbance, displacement, and/or modification of habitat and the introduction of artificial habitat. Underwater portions of foundations would be colonized by encrusting and attaching organisms, creating an array of biogenic reefs in the Lease Area around foundations (Degraer et al. 2018; Hooper et al. 2017a,b; Griffin et al. 2016; Fayram and de Risi 2007). Algae, sponges, tubeworms, bryozoans, hydroids, anemones, blue mussels, barnacles, amphipods, and tunicates would begin recruiting from the plankton shortly after the structures were installed (Causon and Gill 2018; BOEM 2015, 2014; Langhamer 2012; Langhamer et al. 2009; Steimle et al. 2002; Steimle and Zetlin 2000). Attached organisms would create secondary habitat, increase biodiversity, and attract mobile fish and invertebrates that feed on them (Causon and Gill 2018).

Studies of colonization of concrete foundations in the North Sea reported no difference in the types of epifauna accumulated on these structures and other marine infrastructure (Kerckhof et al. 2010). Each studied foundation provided about 7,000 ft^3 (650 m^2) of new hard surface for colonization. Foundations on a flat sandy shelf similar to the Lease Area, where the only available hard structure was shipwrecks, were colonized by more than 60 species within a few months of installation. After four years, 84 species of epifauna were reported (Coates et al. 2014). Early colonizing bivalve species often disappeared as succession progressed; after one year, the foundations were dominated by crustaceans (especially juvenile crabs), mollusks, and annelids. The calcareous tubes constructed by polychaetes and amphipods on the foundations provided additional rugosity and microhabitats for smaller organisms, leading to a rich and complex reef community. Seasonal variability was noted, as species richness increased during summer (Kerckhof et al. 2010).

The assemblage of species that colonizes each foundation in the Lease Area would be influenced not only by the surface area to be colonized but also by the availability of larval recruits immediately following installation because planktonic larval assemblages vary throughout the year. Therefore, the pattern of colonization and succession would vary throughout the Lease Area, especially during the early years (Krone et al. 2013, 2017). The dominant northward current in the Mid-Atlantic Bight is the Gulf Stream, which carries ichthyoplankton and pelagic fish into Southern New England from the south (NOAA Fisheries 2017a). Planktonic larvae and cool water from the Gulf of Maine are delivered to the Project Area by a cold countercurrent. The quasi-decadal shift in the latitude of the Gulf Stream is reported to cause a subsequent northward shift in some species, such as the silver hake, in response to increases in bottom temperature (Davis et al. 2017). The wind turbines are not expected to interfere with these oceanic currents or to disrupt the typical dispersion of eggs and larvae in the region.

Within the vast waters of the Project Area, the thin vertical foundations provide a relatively small surface area for settlement. Recruitment is influenced by numerous environmental signals in addition to the presence of physical structure, including stage of larval development, temperature, prey availability, and chemical odor of conspecifics (McManus et al. 2018; Pineda et al. 2007). Foundations predicted to serve as attachment sites for squid and herring eggs in the North Sea have so far not been demonstrated as such (Vandendriessche et al. 2016). Planktonic life stages of fish would not be directly affected by the introduction of foundations or scour protection.

Colonization of concrete foundations in the North Sea varied on the vertical axis, with more species reported nearer the seafloor (possibly because tube-building species use suspended sediment to construct tubes) (Kerckhof et al. 2010). Overall abundance of mobile demersal megafauna was highest at the bottom of the foundation, perhaps because the bottom anchorage offered shade, shelter, and access to surrounding soft-bottom areas for foraging (Krone et al. 2013). Assemblages of mobile demersal megafauna (large crustaceans and fish) associated with the lower levels of steel jacket foundations and shipwrecks in the German Bight (North Sea) were dominated by *Cancer* crabs (Krone et al. 2013). The upper portions of steel jacket and monopile foundations were colonized by larval edible crab (*Cancer pagurus*), possibly increasing overall production of this species in the offshore subtidal wind farm area (Krone et al. 2017). Related crabs in the Project Area (e.g., Jonah crab, *Cancer borealis*) may use the monopile and jacket foundations in similar ways.

The area surrounding each foundation would accumulate remains of the attached organisms, such as empty mollusk shells and a rain of enriched fecal particles, known as littoral fall or foundation effect (Causon and Gill 2018; Coates et al. 2014; Goddard and Love 2008). Accumulations of empty shells provide essential habitat for juvenile lobster, crabs, and benthic fishes. In particular, discarded bivalve shells are known to provide valuable habitat for juvenile ocean pout, little skate, American lobster, red hake, black sea bass, and other species, and to support more species per unit area than habitat with no shells (Coen and Grizzle 2007). Squid egg masses were observed attached to empty ocean quahog shells in the Lease Area (Guida et al. 2017). The organic detritus around the wind turbines would then be colonized by benthic organisms attracted by the nutrients or physical shelter near the foundations. Based on studies of well-established oil and gas platforms, enrichment of the benthic community would be detectable only within 3 to 16 ft (1 to 5 m) of the foundation (Bergstrom et al. 2014; Wilhelmsson et al. 2006).

A study of small-scale effects of wind farm construction documented variability in grain size, total organic carbon, and benthic species assemblages along 656-ft (200-m) horizontal transects out from the concrete foundations. Organic carbon enrichment was highest in samples near the foundations and decreased with distance along the 656-ft (200-m) transects. Mean grain size was smaller immediately adjacent to the foundations, possibly due to construction activities and the slight slowing of bottom currents as they moved around the foundations. Sediment grain size generally increases with distance from foundations (Methratta 2021); the finer grained, low-flow pocket immediately down-current from the foundations may provide a sheltered area where both larval recruits and organic matter may accumulate and enrich the seafloor (Coates et al. 2014). The speed and direction of bottom currents were reported to be unaffected by piled jacket foundations, likely because the water moves through rather than around the foundation (Reubens et al. 2016; Coates et al. 2014).

The biodiversity and productivity of the foundations could influence the distribution and abundance of predatory fish and invertebrate species (Rein et al. 2013; Reubens et al. 2013). Benthic fish collected within and outside a wind farm in the North Sea had stomachs full of hardbottom prey, suggesting that fish associated with softbottom adjacent to the wind farm responded to the prey associated with the foundations (Degraer et al. 2016). The sandy substrates typical of the Lease Area provide little habitat for fish and invertebrates that prefer structure, including black sea bass, ocean pout, red hake, monkfish, and squid (eggs) (NEFMC 2017 and references within).

Because hardbottom and three-dimensional structures in the Project Area are currently limited to shipwrecks and artificial reefs, some structure-oriented species are expected to respond favorably to the habitat created by wind turbine foundations, scour protection, and armoring materials (Guida et al. 2017). Black sea bass, tautog, scup, lobster, summer flounder, cod, and several species of edible crab are reported at artificial reefs in nearby coastal New York waters. Adult black sea bass do not move far from where they settle as adults; they are currently most abundant in the western third of the Lease Area (Guida et al. 2017). The addition of complex structural habitat would expand the area of settlement habitat to deeper waters and potentially support greater abundance of this species in the area (Guida et al. 2017 and references within). Likewise, adult and subadult tautog prefer structured habitats, particularly in winter, and are expected to take advantage of the newly placed foundations in the Lease Area after construction (ASMFC 2019c). The Jonah crab is also reported to be attracted to rocky habitats with crevices as well as softbottom habitats (ASMFC 2019b; NOAA Fisheries 2018d).

An offshore wind farm in the United Kingdom reported initial aggregations of European lobster within a newly constructed wind farm; studies on long-term effects on lobster densities are ongoing (Roach et al. 2018). The same reaction of American lobster to the Project cannot be assumed, however, because the Southern New England lobster stock has collapsed, and recruitment is exceedingly low (ASMFC 2018a,b; Le Bris et al. 2018). After several years of steadily declining catches and record low recruitment, only about two percent of all Atlantic Coast landings in 2017 came from the Southern New England stock (ASMFC 2018c). Recruitment and growth of young lobsters is most successful in cobble habitats (Collie and King 2016). Although recent research has demonstrated that larval lobster may recruit to firm mud bottoms, unconsolidated sand of the type that dominates the Lease Area provides poor shelter for lobster (Dinning and Rochette 2019). Primary causes of the poor condition of the Southern New England and Mid-Atlantic lobster stock include increasing water temperature and fishing pressure, making recovery of lobster in the Project Area unlikely (ASMFC 2018a). Despite the overall decline of the lobster stock in the Project Area, recreational and limited commercial harvest is supported in the Mud Hole area of the Hudson Shelf Valley,[10] outside the Project Area. Lobster pots were so dense in the Mud Hole during 2018 geophysical surveys that Empire's vessels delayed surveying that area due to the risk of snagging tow survey equipment on them. Empire subsequently completed the survey during a period of harvest closure in May 2019. Commercial harvest of lobster and Jonah crab are discussed in more detail in **Section 8.8**.

Evidence for the effect of well-established offshore wind farms on distributions of fish and macroinvertebrates in Europe is equivocal. Increases in Atlantic cod and pouting to wind turbine foundations in the Belgian part of the North Sea were reported to reflect better quality forage relative to nearby sources, leading to greater reproductive output (Reubens et al. 2014). Demersal fish abundances were higher near wind turbine foundations than in surrounding softbottom habitats (Wilhelmsson et al. 2006; Bergstrom et al. 2013, 2014). At a wind farm in the Netherlands, an increase in sand eels within the wind farm area was attributed to the attraction of this semi-pelagic species to the hardbottom scour protection around the foundations (Rein et al. 2013). Benthic epifauna growing on wind turbines in the North Sea were reported to provide increased feeding opportunities for other fish, which redistributed fish in patchy assemblages distributed throughout the wind farm impact area (Stenberg et al. 2015). Likewise, pagurid crab abundance increased on wind turbine

[10] https://www.njtvonline.org/news/video/forget-maine-jersey-fisherman-catch-quality-lobsters/

foundations and the surrounding rock armoring, which provided crab nursery habitat (Krone et al. 2017). An artificial reef intentionally placed near Sydney Harbor created an "ecological halo" 15 times larger than the reef footprint within which abundance of demersal fishes increased (Reeds et al. 2018). Oil platforms on the California coast, which have similar underwater structure to the jacket foundations proposed for the offshore substations, supported demersal and pelagic juvenile fish that in turn attracted predatory rockfishes (Claisse et al. 2014, 2015). NOAA Fisheries concluded that any individual Atlantic sturgeon that migrated through an operational wind farm in this region would likely benefit from the increased prey associated with the rock armoring around the wind turbine foundations and submarine export and interarray cables (NOAA Fisheries 2015).

A recent meta-analysis of the effect of wind farms on fish abundance concluded that effects are positive, meaning that more fish occur within wind farms than at nearby reference locations (Methratta and Dardick 2019). However, not all studies report strong correlations of fish abundance with offshore wind farms. In the North Sea, an increase in structure-associated fish near a wind farm was reported, but the increase was not clearly attributable to site-specific productivity or immigration from surrounding areas (Rein et al. 2013). A review of operating wind farms in the Belgian part of the North Sea reported no difference in abundances of fish eggs, fish larvae, or squid larvae within and outside of the wind farm (Degraer et al. 2016; Vandendriessche et al. 2016). Neither distribution, abundance, nor reproductive success of the benthic, resident eelpout (*Zoarces viviparus*) were affected by a wind farm in the Baltic Sea (Langhamer et al. 2018).

Whether artificial reefs increase or simply redistribute overall productivity is an open question (Shipp and Bartone 2009; Love et al. 2006; Girard et al. 2004). The expansion of structure-associated species into the Lease Area is not guaranteed. Demersal fish and the American lobster did not respond as expected to the increase in hard structure at the Block Island Wind Farm; no effect on the distribution, abundance, or condition of fish was demonstrated (Wilber et al. 2018; Carey 2017).

Offshore structures attract most highly migratory fishes (NOAA Fisheries 2017a); mahi-mahi and some tuna (e.g., yellowfin [*Thunnus albacares*], bigeye [*Thunnus obesus*]) and sharks (e.g., dusky, whitetip, shortfin mako, common thresher [*Alopias volpinus*]) may be drawn by the abundant prey (Wilhelmsson and Langhamer 2014; Itano and Holland 2000) or use the structures as navigational landmarks (Taormina et al. 2018). Schooling forage fish (Brown et al. 2010), sea turtles (Blasi et al. 2016), and marine mammals (Rein et al. 2013) also congregate around offshore structures (Raoux et al. 2017). Effects on fish and invertebrate populations may be adverse, beneficial, or mixed, depending on the species and location (van der Stap et al. 2016; NOAA Fisheries 2015).

Battista et al. (2019) noted that benthic species assemblages are not well-correlated with substrate type in the Lease Area, largely because of the relative uniformity of substrate type in the area. Although the Project would introduce habitat variability and complexity to the area, the extent of artificial reef and the acreage subject to reef effect represents a small fraction of the total softbottom on the Southern New England continental shelf.

Potential impacts of the monopile and piled jacket foundation types would differ slightly for various demersal species. The monopile foundations would provide largely smooth vertical walls for attachment. Conversely, the piled jacket foundation would provide greater surface area for encrusting and attaching organisms and more sheltering area, enhancing the reef effect and increasing potential habitat complexity. The piled jacket would also provide hard surfaces of diverse orientations relative to the largely vertical orientation of the monopiles. Because some species prefer to settle on surfaces with a particular orientation, the piled jacket foundation is expected to support a greater diversity of organisms (Causon and Gill 2018). However, the species assemblage that would colonize each foundation type is expected to vary and cannot be known in advance. Given the highly localized extent of the converted habitat, population-level effects on fish or invertebrate resources would not be measurable.

In summary, the habitat value of operating monopiles and piled jackets would be similar but not identical. The complex structure of a piled jacket foundation would support a more complex reef community than a smooth monopile (Wilhelmsson and Langhamer 2014). As a consequence of the structural complexity, piled jacket foundations would support a greater diversity of organisms. The monopiles would deflect bottom currents differently than piled jacket foundations, which allow water to flow through the structure. Placement of scour protection would mediate effects on bottom currents.

On balance, the Project's impact on benthic and pelagic habitat would be either neutral or beneficial to most fish and invertebrates (Hooper et al. 2017b). While the presence of foundations may influence local distributions of demersal fish and invertebrates on a small spatial scale, no population-level effects are expected. Structure-associated species such as black sea bass, Jonah crab, and others may benefit from the expanded habitat. The new infrastructure would neither harm nor benefit demersal species that prefer open sandy bottoms, such as surfclam, ocean quahog, and some flatfish, because sandy bottom is not a limiting feature in the Project Area.

Introduction of nonindigenous species. Offshore wind farms have been reported to host nonindigenous invasive species, especially in nearshore intertidal areas (Adams et al. 2014; Mineur et al. 2012; Kerckhof et al. 2010). Wind farms in intertidal habitats in the Belgian part of the North Sea may provide steppingstones for invasive species. In contrast, subtidal wind turbine foundations were found to have little effect on the spread of nonindigenous invasive species (Degraer et al. 2016). The nearest wind turbine foundation for the Project would be at least 12 nm (22 km) from shore. Because hard substrate is already available within the Project Area in the form of shipwrecks, artificial reefs, and derelict fishing gear, the introduction of wind turbine foundations is not expected to have a measurable impact on invasive species.

Shading and Project-related artificial lights. The Project would introduce shade and artificial lighting to the Project Area. The impacts of shading on primary productivity would be discountable because the above-water portion of the wind turbines is narrow and vertical, the two offshore substations are relatively small in context of the overall Lease Area and located individually within the Lease Area, and the phytoplankton in the surface waters around the structures would remain in the shade only briefly as they are transported by waves and currents.

Artificial lights would be installed on the wind turbines and offshore substations as required for navigational safety. The lights are designed to penetrate only the top few centimeters of the water column, leaving the vast majority of the water column unilluminated. Most demersal fish and invertebrates in the Lease Area would be unlikely to detect the additional light at the water surface.

Some zooplankton and ichthyoplankton may aggregate around spots of light in the water (Hernandez et al. 2003; Hernandez and Shaw 2003), and pelagic predators (e.g., mackerels and herrings) may opportunistically feed there. Although the risk of predation on individual larvae may increase in the immediate vicinity of a lighted structure, the risk is fleeting because planktonic organisms are not expected to remain in one location for long periods of time. The response to artificial lights varies among fishes. Mackerels forage well in very low light; in contrast, Atlantic herring and other clupeids feed best in very bright light (Keenan et al. 2007). Many of the fish observed in the water column near offshore infrastructure during daylight migrate vertically at night, thus avoiding the nighttime effects of artificial light (Barker and Cowan 2018).

Artificial lights on the wind turbines and offshore substation would not disrupt daily or seasonal migrations of fish or invertebrates in the Project Area. Nighttime light pollution does not substantially decrease primary productivity (Gaston et al. 2013) and the lighting on offshore wind turbines was determined not to affect fish to a meaningful extent (Orr et al. 2013). Unlike the intense lights that support 24-hour work on fully staffed oil platforms, the lights on wind turbines and offshore substations are designed strictly for navigational safety. The limited area of low-wattage lighting on the wind turbines and offshore substations would affect a minimal fraction of the available sea surface and be unlikely to affect fish or invertebrate populations.

Introduction of noise and vibration. The Project will generate noise during operations, which could directly and indirectly affect marine fish and invertebrates. Sudden loud noises can cause behavioral changes, permanent or temporary threshold shifts, although rarely injury or death (Popper and Hastings 2009; Popper et al. 2014; Popper and Hawkins 2016; Andersson et al. 2017; Southall et al. 2019; Popper and Hawkins 2018). Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a PTS, which leads to long-term loss of hearing sensitivity. Less intense noise may cause a TTS, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015).

Vessels used for operations and maintenance would introduce routine noise into the Project Area. Project-related vessel noise does not differ substantively from noise generated by other commercial vessels moving slowly while trawling or idling in an area. The acoustic impact of vessels on fish and invertebrates would be temporary and localized.

During operations, the wind turbine gears, generators, and blades would generate above-water noise that could be transmitted as sound pressure or vibrations through the foundation to the water. Field data from operating wind farms indicate that both turbine noise and natural background underwater noise generated by wave action and entrained bubbles are influenced by wind speed. Under stronger wind conditions, the increase in background ocean noise masks the increase in turbine noise, creating a steady state (Nedwell et al. 2004).

Change in water quality, including oil spills. During operations, routine maintenance activities have the potential to result in temporary increases in turbidity and sedimentation in the Project Area. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2** and **Appendix J**. As shown, the increase in turbidity and or release of constituents of concern from re-suspended sediments is not expected to exceed background levels during natural events and will be short-term and temporary in nature.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills. Empire has developed an OSRP (**Appendix F**), which details all measures proposed to avoid inadvertent releases and spills and a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.12 Public Health and Safety**. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts on the benthic environment and species from impacts to water quality and spills:

- All Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an OSRP (**Appendix F**).

Project-related EMF. The submarine export cables would generate EMF in the Project Area, as described in **Appendix EE Offshore Electric and Magnetic Field Assessment**. Some fish and invertebrates are known to detect and respond to EMF from buried cables, but no clear trend of avoidance, attraction, or adverse effects has been established. A recent review of potential effects of the weak EMF generated by alternating current undersea power cables associated with offshore wind energy projects would not negatively affect any fishery species in Southern New England because the frequencies are not within the range of detection for these species (Snyder et al. 2019). Nevertheless, Empire has committed to sufficiently burying electrical cables wherever feasible, which will minimize detectable EMF.

Numerous studies of EMF emitted by subsea alternating current cables reported no interference with movement or migration of fish or invertebrates (Hutchison et al. 2018; Love et al. 2017; Rein et al. 2013); no adverse or beneficial effect on any species was attributable to EMF (Snyder et al. 2019; Copping et al. 2016). A review of effects of EMF on marine species in established European offshore wind farms suggested that heat generated by electrified cables should be further investigated (Rein et al. 2013). Follow-up analysis of thermal effects of subsea cables on benthic species concluded that effects were negligible because cable footprints are narrow, and the small amount of thermal output is easily absorbed by the sediment overlying buried cables (Taormina et al. 2018; Emeana et al. 2016). Thermal gradients do not form above the buried cables because the overlying water is in constant motion. At Block Island Wind Farm, located off the Rhode Island coast, buried subsea cables were determined to have no effect on Atlantic sturgeon or on any prey eaten by whales or sea turtles (NOAA Fisheries 2015), which includes most fish and macroinvertebrates.

Given the data from operational wind projects, field experiments in Europe and the United States (Snyder et al. 2019; Kilfoyle et al. 2018; Taormina et al. 2018; Wyman et al. 2018; Love et al. 2017; Dunlop et al. 2016; Gill et al. 2014), modeling results of the potential effects of EMF on fish and invertebrates in the Project Area (**Appendix EE**), and Empire's commitment to cable burial, impacts of energized cables on fish and invertebrates would be negligible. No adverse effect of existing subsea cables offshore or in state waters of New York has been demonstrated for any marine resource (NYSERDA 2017; Copping et al. 2016). EMF generated by the buried submarine export and interarray cables would be detectable by some benthic fish and invertebrates, but would not adversely impact individuals or populations (Snyder et al. 2019).

5.5.2.3 Summary of Potential Impacts to Benthic and Pelagic Habitats and Fish and Invertebrates

The assemblages of demersal and pelagic fishes and invertebrate species in the Project Area may be minimally altered by the introduction and long-term presence of the wind turbine and offshore substation foundations, although the alteration would not necessarily represent an adverse impact. Marine species assemblages are presently undergoing large regional shifts in response to changing ocean temperatures and fishing pressures, and predictions about future stable ecological states are highly uncertain.

Prior to establishing the boundaries of the New York WEA, BOEM spent considerable effort conferring with stakeholders about the suitability of the area for lease. During that process, the most important fishing areas and most sensitive habitat areas (five aliquots in Cholera Bank) were excluded from the Lease Area to avoid substantial effects on fish and invertebrate resources (BOEM 2016). In addition, Empire designed the Project to avoid or minimize impacts to benthic and pelagic habitats and resources, for example by routing the submarine export cables to avoid Cholera Bank, seagrasses, and other sensitive benthic habitats.

The Project Area has been heavily fished by commercial clam and scallop dredges for decades and has the characteristics of a seafloor repeatedly disturbed by bottom fishing gear. The typical New Bedford scallop dredge homogenizes softbottom habitats as it stirs up and redistributes particles in the top layer of sediment. Overall, the dredges directly injure or kill nearly as many scallops as they harvest; crabs, gastropods, and soft-bodies invertebrates are also crushed or maimed, which leads to an increase in mobile scavenging species such as hermit crabs. Repeated dredging reduces biodiversity and degrades the area for future scallop recruitment (Stewart and Howarth 2016). Scallop dredging also results in injuries and mortality of non-target fish (bycatch), especially skates (Knotek et al. 2018). In a recent study, up to 63 percent of little skate discarded by scallop dredges died following release; winter skate fared only slightly better; 45 percent mortality (Knotek et al. 2018).

Overall, commercial fisheries discarded about six times as many skates as their total landings, amounting to almost 73 million pounds (33 million kilograms) of skate discards in 2010 (NMFS 2013, as cited in Knotek et al. 2018). The one-time bottom disturbance associated with construction of the Project would be comparable to the scallop dredging and bottom trawling that has occurred repeatedly in the Project Area, but would not represent a substantial incremental impact within the current disturbance regime.

Despite the bottom disturbance caused by other existing anthropogenic activities (e.g., anchoring, fishing trawls, and other gear), effects on populations or stocks of managed species are not generally considered substantial because the effects are limited to localized areas and a small number of individual organisms at any one time. For example, the MAFMC found no evidence that squid egg mops attached to benthic substrates were harmed by fishing activities (MAFMC 2011). NOAA Fisheries determined that intensive trawling (up to 81 vessels per month) in a single area had no adverse effect on squid (BOEM 2018). Within this context, the single disturbance of cable installation within narrow corridors would cause little harm to squid egg mops or other benthic resources. The long-lasting physical effects of bottom disturbance on benthic habitats and species assemblages is generally attributed to repeated disturbances that reinjure surviving individuals and interfere with the settlement of colonizers (Hiddink et al. 2017; Kaiser et al. 2006). The one-time disturbance associated with the installation of foundations and submarine export and interarray cables would not harm populations of fish or invertebrates or prevent natural recovery of benthic habitat.

Benthic communities on the OCS in waters less than 262 ft (80 m) generally recover within a few weeks to two years after cable installation, depending on the available supply of sediment (Brooks et al. 2006). Recovery time varies somewhat with the method of installation, with more rapid recovery after plowing than jetting (Kraus and Carter 2018). Modeling of jet plow impacts for the Cape Wind project indicated that effects would be temporary, as benthic organisms would recolonize the jet-plowed trench within 38 days (BOEM 2018).

The analysis of impacts supports the overall determination that the Project would not result in substantial adverse impacts on demersal or pelagic life stages of fish or invertebrates. Impacts on demersal and pelagic life stages of fish and invertebrates would be short-term and not affect stocks or populations. The introduction of hard structures may benefit some species/life stages that require or prefer rugosity, including squid eggs, black sea bass, lobster, and edible crabs. Extensive acreage of the sand and gravelly sand softbottom habitat favored by surfclam, scallop, and ocean quahog would remain available for recruitment and development. Both adverse and beneficial effects would be largely reversible following decommissioning.

5.5.2.4 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.5.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and potential impacts will be re-evaluated at that time.

Under 30 CFR § 585.910, BOEM requires that infrastructure be fully removed or severed 15 ft (4.6 m) below the sediment surface; predictive ecosystem modeling indicates that the novel site-specific benthic-pelagic coupling relationships established when the foundations and associated scour protection were installed would be decoupled, returning regional connectivity parameters to pre-construction conditions (van der Molen et al. 2018). Other impacts to resources during decommissioning, including introduction of noise and sediment resuspension, are expected to be similar or less than those experienced during construction, as described in Section 5.5.2.1. Cable removal is not anticipated to require jetting or trenching, and no pile driving will be required for decommissioning. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3.**

5.5.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described in Section 5.5.2, Empire is proposing to implement the following avoidance, minimization, and mitigation measures.

5.5.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.5.2.1:

- Avoiding, to the extent possible, siting structures (wind turbines, offshore substations, and submarine export and interarray cables) in areas of sensitive habitat, where feasible;
- Mitigation and avoidance measures to protect water quality, such as spill prevention;
- Sensitive lighting schemes to minimize exposure of light;
- Establishing seasonal work windows that avoid sensitive life stages, as feasible;
- Using ramp-up pile driving protocols;
- Using appropriate measures for vessel operation and implementing an OSRP (**Appendix F**), which includes measures to prevent, detect, and contain accidental release of oil and other hazardous materials. Project personnel would be trained in accordance with relevant laws, regulations, and Project policies, as described in the OSRP;
- Installing silt curtains in sensitive areas, as warranted by results of the sediment modeling; and
- Most construction vessels will maintain position using dynamic positioning, limiting the use of anchors and jack-up features, where feasible. Any anchors or jack-up features would be placed within the previously cleared and/or disturbed area around the foundations.

In addition, during construction, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.5.2.1:

- The use of HDD at export cable landfall at EW 2 to minimize physical disturbance of coastal habitats;
- Empire would implement appropriate measures during HDD activities at export cable landfalls to minimize potential release of HDD fluid. To minimize an inadvertent fluid return, an HDD Contingency Plan would be developed and implemented;
- Using appropriate measures and timing during cable installation activities to minimize sediment resuspension and dispersal in areas of known historically contaminated sediments; and
- Consideration of the timing of construction activities; working with the fishing industry and fisheries agencies on sensitive spawning and fishing periods to actively avoid or reduce interaction with receptors, where feasible.

5.5.3.2 Operations and Maintenance

During operations, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate the impacts described in Section 5.5.2.2:

- Sensitive lighting schemes on wind turbines and offshore substations to minimize exposure of light;

- A commitment to sufficiently bury electrical cables where feasible, minimizing seabed habitat loss and reducing the effects of EMF; where deep burial is not technically feasible, rock armoring will shield the cable from the overlying water;
- The development and enforcement of an OSRP (**Appendix F**);
- Installation of scour protection, as needed; and
- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.

As indicated in the list of measures above, Empire proposes to monitor select benthic, finfish, and/or invertebrate resources to clarify baseline conditions and reduce uncertainty in assessing changes in distribution or abundance of resources within the context of climate change and other large-scale regional variables. During the COP review process, Empire will work with regulatory agencies and stakeholders in development of appropriate program(s).

5.5.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in Section 5.5.3.1 and Section 5.5.3.2. A full decommissioning plan will be submitted for approval to BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.5.4 References

Table 5.5-16 Data Sources

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
NOAA NCEI	Sand and Gravel Borrow Area	http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Federal-Sand-n-Gravel-Lease-Borrow-Areas_gdb.aspx	https://mmis.doi.gov/boemmmis/metadata/PlanningAndAdministration/LeaseAreas.xml
NOAA NCEI	Aliquots with Sand Resources	https://www.boem.gov/Sand-Aliquots-Shapfile/	https://mmis.doi.gov/boemmmis/metadata/PlanningAndAdministration/ATLSandAliquots.xml
Gardline Habitat Characterization Report (2019)	CMECS Sample Location	N/A	N/A
NJDEP	Shellfish Management Area	https://opendata.arcgis.com/datasets/e8153c69f8e64d77a770d0eb6f51e9fd_2.zip?outSR=%7B%22latestWkid%22%3A3857%2C%22wkid%22%3A102100%7D	https://www.arcgis.com/sharing/rest/content/items/e8153c69f8e64d77a770d0eb6f51e9fd/info/metadata/metadata.xml?format=default&output=html
NOAA	Recreational Diving Reef	ftp://ftp.coast.noaa.gov/pub/MSP/ArtificialReefs.zip	https://inport.nmfs.noaa.gov/inport/item/54191
NOAA	Dredged Material Disposal Site	ftp://ftp.coast.noaa.gov/pub/MSP/OceanDisposalSites.zip	https://inport.nmfs.noaa.gov/inport/item/54193
NOAA Fisheries	Atlantic Sturgeon Critical Habitat	https://www.fisheries.noaa.gov/webdam/download/91216948	https://www.fisheries.noaa.gov/webdam/download/92900513
NOAA Fisheries	Surfclam/ Quahog Totals	https://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/rsr/clam/clam-rsr-2018.pdf	N/A
NOAA NCCOS 2019 NY Bight Report	Benthic Habitat	https://coastalscience.noaa.gov/project/seafloor-substrate-mapping-model-new-york/	https://coastalscience.noaa.gov/data_reports/comprehensive-seafloor-substrate-mapping-and-model-validation-in-the-new-york-bight/
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A

Table 5.5-16 Summary of Data Sources (continued)

Source	Includes	Available at	Metadata Link
Northeast Ocean Data	Shellfish Management Area	http://www.northeastoceandata.org/files/metadata/Themes/Aquaculture.zip	http://www.northeastoceandata.org/files/metadata/Themes/Aquaculture/ShellfishManagementAreas.pdf
NY OPDGIG	Recreational Diving Wreck	https://opdgig.dos.ny.gov/	http://opdgig.dos.ny.gov/geoportal/catalog/search/resource/detailsnoheader.page?uuid={4990846B-A419-486B-AA9F-A7D770382832}
NYSDEC	Statewide Seagrass Map	https://www.arcgis.com/home/webmap/viewer.html?webmap=12ba9d56b75d497a84a36f94180bb5ef&extent=-74.6987,39.852,-71.315,41.7603	N/A
USACE	USACE Benthic Samples	https://www.nan.usace.army.mil/Portals/37/docs/harbor/Biological%20and%20Physical%20Monitoring/Benthic/2006%20Harborwide%20Benthos%20Report.pdf	N/A

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5.6 Marine Mammals

This section describes the marine mammal (whales, dolphins, porpoise, and seals) species known to be present, traverse, and/or incidentally occur in the waters within and surrounding the Project Area. The Project Area includes the Lease Area as well as the waters adjacent to the submarine export cable routes. Potential impacts to marine mammals resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Empire as a result of engagement and following recommended best management practices are also described, which are intended to avoid, minimize, and/or mitigate potential impacts to marine mammals.

Other resources and recent assessments detailed within this document that provide information on marine mammals include the following:

- Underwater Noise (Section 4.4.2);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (Section 5.5);
- Sea Turtles (Section 5.7);
- Underwater Acoustic Assessment (Appendix M-1 and Appendix M-2);
- Ornithological and Marine Fauna Aerial Survey (Appendix P);
- Benthic Resource Characterization Reports (Appendix T); and
- Essential Fish Habitat (EFH) Assessment (Appendix U).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the EW 1 and EW 2 submarine export cable routes (see **Figure 5.6-1**).

In accordance with BOEM's site characterization requirements in 30 CFR § 585.626(3) and BOEM's *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F* (Marine Mammal and Sea Turtle Guidelines; BOEM 2019), this section relies on several sources of data and information in its assessment of marine mammals that may be present in the Project Area. These include regionally specific and Empire–led focused studies, including the following (with additional details following):

- Avian site-specific aerial surveys by Empire that included marine mammal data (**Appendix P Ornithological and Marine Fauna Aerial Survey)**;
- Protected Species Observer (PSO) marine wildlife collected data (A.I.S. 2019 and AOSS 2019);
- Digital aerial baseline surveys by NYSERDA of marine wildlife in support of offshore wind energy (APEM and Normandeau Associates 2018);
- NYSDEC aerial survey marine mammal collected data (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020);

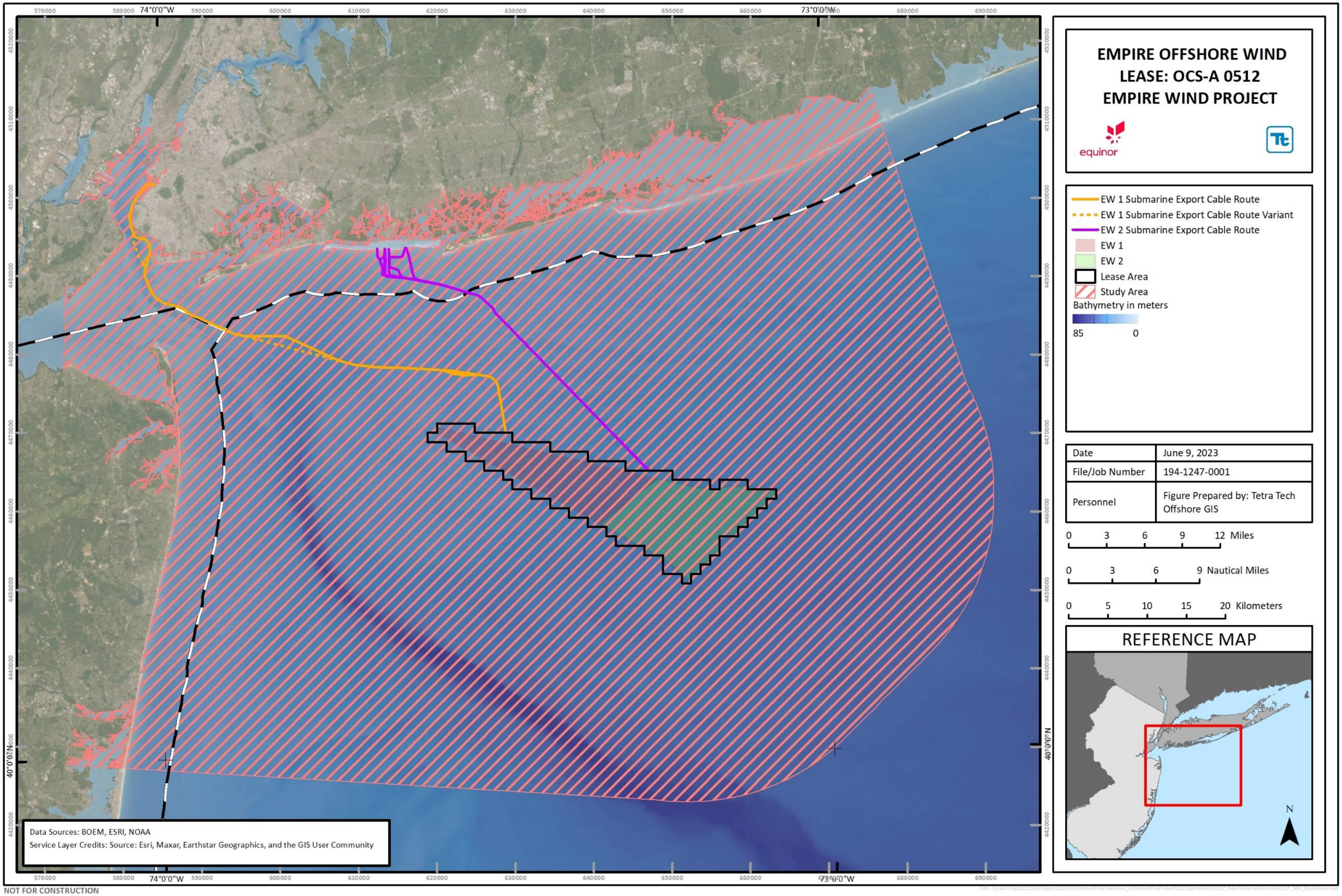

Figure 5.6-1 Marine Mammal Study Area

- Geospatial sighting information retrieved from the Ocean Biogeographic Information System (OBIS) datasets (Roberts et al. 2016a, 2016b, 2017, 2018, and 2020; Halpin et al. 2009); and
- Publicly available literature on local sighting or acoustic data findings, including but not limited to the following:
  - NOAA surveys: Atlantic Marine Assessment Program for Protected Species surveys (AMAPPS I and II surveys);
  - NOAA species Stock Assessment Reports (SARs; Hayes 2018, 2019, 2020);
  - Compendium Reports or Technical Reports (e.g., Ecology and Environment Engineering 2017; DiGiovanni and DePerte 2013); and
  - Published peer reviewed studies including from Woods Hole Oceanographic Institute (WHOI), Wildlife Conservation Society (WCS), Cornell Bioacoustics Research Program, and others (e.g., WCS Ocean Giants 2020; Estabrook et al. 2019; Davis et al. 2017; Stone et al. 2017; Whitt et al. 2013 and 2015; Muirhead et al. 2018).

Empire supported the collection of Project-specific digital camera aerial survey sighting data and vessel-based visual sighting data that encompassed the Lease Area plus a 6.2-mi (10-km) buffer around it (see **Appendix P** for additional information). The aerial surveys were conducted monthly over the course of a year, from November 2017 to October 2018, and recorded sightings of avian, marine mammal, sea turtle, and other species, including sharks, rays, and large fish assemblages. The digital camera aerial data collected by Empire is intended to supplement the data collected by other entities, including the aerial survey data collected by NYSERDA (APEM and Normandeau Associates 2018), which collected digital camera data within a larger area in New York Bight (encompassing the Lease Area). Data are also included from a visual observer line transect aerial survey project performed by Tetra Tech over the Lease Area and surrounding vicinity (these surveys fly directly over the Lease Area as part of a much larger study area located in the New York Bight) under contract to NYSDEC (Tetra Tech and SES 2018, Tetra Tech and LGL 2019 and 2020).

PSO visual sighting data (and some Passive Acoustic Monitoring [PAM] acoustic detection data) specific to the Project Area were also collected during Project-related vessel-based survey activities conducted in 2018 and 2019. Alpine Oceanic and Seismic Survey Inc.'s PSO sighting reports and A.I.S.'s PSO reports (AOSS 2019; A.I.S. 2019) include sightings from the Lease Area and surrounding waters. The sighting data are summarized in **Table 5.6-1** (aerial survey digital imagery data) and **Table 5.6-2** (PSO visual sighting data). Sighting data from these aerial surveys were organized by general categorical regions, defined as follows:

- Lease Area (sighting occurred within the Lease Area);
- Lease Area 6.2 mi-(10-km) buffer (sighting occurred within a 6.2-mi [10-km] buffer area of the Lease Area, not including the Lease Area itself)[11];
- Submarine export cable siting corridor (sighting occurred along the submarine export cable route, within a corridor 1,640 ft [500 m] wide in state waters or 3,280 ft [1,000 m] wide in federal waters);
- Nearshore (sighting fell outside of the Project Area and within state waters [within the 3-nm {5.6-km} limit from the New York coastline]); and
- Offshore (sighting fell outside of the Project Area in federal waters [outside the 3-nm {5.6-km} limit from the coast).

[11] Note that the digital camera aerial data collected by Empire (**Appendix P**) is limited to 2.5 mi (4 km) around the Lease Area, while the digital camera aerial data collected by NYSERDA (APEM and Normandeau Associates 2018) extends out to 6.2 mi (10 km).

Table 5.6-1 Aerial Survey Sighting Data Summary

Species	Lease Area	Lease Area 10-km buffer	Submarine Export Cable Siting Corridor	Nearshore	Offshore
Atlantic spotted dolphin	0	0	0	0	57
Atlantic white-sided dolphin	0	0	0	0	25
Beaked whale (unid.)	0	0	0	0	18
Blue whale	0	0	0	0	2
Bottlenose dolphin	7	36	0	55	829
Common dolphin	74	188	0	0	5,021
Minke whale	0	3	0	0	27
Common/White-sided dolphin	0	0	0	0	47
Dolphin species (unid.)	7	26	0	8	3,389
Dwarf sperm whale	0	0	0	0	2
Fin whale	0	1	0	0	38
Gray seal	0	1	0	1	4
Harbor porpoise	3	14	0	8	313
Harbor seal	0	0	0	0	3
Harp seal	0	0	0	0	1
Humpback whale	0	2	0	0	17
North Atlantic right whale	0	0	0	0	6
Pilot whale (unid.)	0	0	0	0	266
Pygmy sperm whale	0	0	0	0	2
Risso’s dolphin	0	0	0	0	1,097
Rough-toothed dolphin	0	0	0	0	16
Seal species (unid.)	0	1	0	7	48
Sei whale	0	0	0	0	7
Short-finned pilot whale	0	0	0	0	24
Sperm whale	0	0	0	0	10
Striped dolphin	0	0	0	0	332
Marine Mammal (unid.)	0	2	1	0	204
Whale (unid.)	0	0	0	0	28

Sources: APEM and Normandeau Associates 2018; **Appendix P**

Note that the digital camera aerial data collected by Empire (**Appendix P**) is limited to 2.5 mi (4 km) around the Lease Area, while the digital camera aerial data collected by NYSERDA (APEM and Normandeau Associates 2018) extends out to 6.2 mi (10 km).

Table 5.6-2 PSO Report Sighting Data Summary

Species	Lease Area	Lease Area 10-km buffer	Submarine Export Cable Siting Corridor	Nearshore	Offshore
Atlantic spotted dolphin	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0
Beaked whale (unid.)	0	0	0	0	0
Blue whale	0	0	0	0	0
Bottlenose dolphin	0	16	0	17	120
Common dolphin	1,063	317	32	0	345
Dolphin species (unid.)	270	21	26	32	27
Dwarf sperm whale	0	0	0	0	0
Fin whale	123	28	3	1	17
Gray seal	10	0	1	1	0
Harbor porpoise	0	0	0	0	0
Harbor seal	1	0	0	0	0
Harp seal	0	0	0	0	0
Humpback whale	61	10	14	9	28
Marine animal (unid.)	1	0	0	0	0
Minke whale	33	5	0	0	13
North Atlantic right whale	0	0	0	0	0
Pilot whale (unid.)	0	0	0	0	0
Pinniped (unid.)	0	0	2	0	0
Pygmy sperm whale	0	0	0	0	0
Risso's dolphin	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0
Seal species (unid.)	0	0	0	0	0
Sei whale	0	0	0	0	0
Short-finned pilot whale	0	0	0	0	0
Sperm whale	0	0	0	0	0
Striped dolphin	0	0	0	0	0
Marine mammal (unid.)	0	0	0	0	0
Whale (unid.)	50	3	3	3	10

Sources: AOSS 2019; A.I.S. 2019

Additional data sources come from acoustic buoys located in the Project Area. WHOI first deployed an acoustic buoy in the New York Bight (WHOI 2018) known as the "Blue York" buoy, deployed near the eastern boundary of the Lease Area. As part of a collaborative grant agreement with WCS and WHOI, Empire funded the deployment of two other real-time whale detection and monitoring buoys. These two buoys are planned to be active for at least two years, complimenting and adding to the existing data. They are deployed in the southeast quadrant of the Lease Area (known as the SE buoy) and in the northwest quadrant of the Lease Area (the NW buoy). Recently presented data from the newer SE and NW buoys analyzed two data streams: 2017-2018 (archived recordings) and 2018-2020 (real-time detection data) (WCS Ocean Giants 2020). The SE and NW buoys will help to further describe the spatial and temporal distribution of four large whale species within the Lease Area: North Atlantic right whale (*Eubalaena glacialis;* right whale), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and humpback whale (*Megaptera novaeangliae*). The real time data collection allows for preliminary spatial species comparisons from the SE and NW buoys and provides species' acoustic presences and their vocal behavior.

The Bioacoustics Research Program at Cornell University's Lab of Ornithology has also deployed acoustic buoys (Estabrook et al. 2019) under the auspices of the NYSDEC. Several buoys were deployed along two major transect lines spanning the New York Bight (i.e., they parallel the two major shipping lanes entering and leaving New York Harbor: Nantucket to Ambrose and Ambrose to Hudson Canyon Lanes). The focus of the Cornell buoys is to collect calls from six large whale species (right, fin, sei, blue, sperm, and humpback) in the New York Bight, and there are 15 autonomous (independent) recorders located in and around the shipping lanes from the shelf break to the New York Harbor. Acoustic data collection began in October 2017 and is planned to continue year-round, through September 2020. Initial findings are presented in Estabrook et al. 2019. This technical report (unpublished) covers the first year of acoustic survey results from October 2017-July 2018. The subsequent years' findings have not yet been published.

These collective acoustic studies, combined with the visual studies, are assisting with gaining a better understanding of the spatial and temporal distribution of marine mammals within the Lease Area. The buoys will provide an understanding of the wider regional context of whale distribution, and the underwater noise measurements will provide existing baseline underwater noise data within the Lease Area. Empire is open to future collaborations on relevant regional studies and is actively engaged with entities such as Regional Wildlife Science Entity and other collaborative, coordinated efforts to gain additional information, as feasible.

In addition, this section relies on publicly available information (including existing literature and reporting on sightings, such as from newspaper or other historical accounts), NOAA Fisheries Stock Assessment Reports (Hayes et al. 2018, 2019, 2020), scientific publications or technical reports, and geospatial sighting information retrieved from the OBIS datasets (**Figure 5.6-2**) (Roberts et al. 2016a, 2016b, 2017, 2018, and 2020; Halpin et al. 2009). The compendium of data sources utilized included both general Mid-Atlantic sources (to account for marine mammal mobility and distribution and abundance trends) as well as reports highly specific to New York marine mammal data collection efforts.

Other data sources include the NOAA Fisheries aerial and vessel-based surveys (AMAPPS I and II), and its associated PAM studies for marine mammals and/or sea turtles along the East Coast of the U.S. For several decades, NOAA Fisheries has been conducting systematic aerial or vessel-based surveys and passive acoustic monitoring studies known as the AMAPPS surveys (NOAA Fisheries 2017a and 2019a). Older published reports such as the Cetacean and Turtles Assessment Program (CETAP 1982) are also included.

Numerous papers cited include general regional overviews (e.g., Davis et al. 2017; Stone et al. 2017) and sources specific to the more precise Project Area waters of New York were evaluated, such as DiGiovanni and DePerte 2013, Whitt et al. 2013 and 2015, Ecology and Environment Engineering 2017, and Muirhead et al. 2018.

Findings from multiple surveys in the Study Area indicate marine mammals may occur in the Project Area during all seasons; this includes data from the multiple-entity aerial surveys, which found that some species of large whales occur in the Lease Area during all seasons. Multiple studies or published findings show other marine mammals, such as dolphins or pinnipeds, have been documented to occur in and around the Lease Area and submarine export cable routes, generally with seasonal rather that year-round presence. More information on these species-specific details are described in the Section 5.6.1. In addition, average densities for common marine mammals that may occur in the Study Area are provided in **Table 5.6-3**. Seasonal densities are included where these data are available.

Table 5.6-3 Average Seasonal Density Summary for Marine Mammal Species Considered Common in the Study Area

Species	Winter	Spring	Summer	Fall
Atlantic spotted dolphin	0.005	0.010	0.144	0.130
Atlantic white-sided dolphin	0.532	1.016	0.656	0.585
Beaked whales a/	0.000			
Cuvier's beaked whale	0.004	0.004	0.004	0.004
Bottlenose dolphin	0.783	1.064	6.596	2.548
Common dolphin	4.944	0.622	0.982	3.298
Harbor porpoise	9.073	5.186	0.059	1.067
Pilot whales	0.107			
Risso's dolphin	0.005	0.001	0.010	0.005
Minke whale	0.026	0.077	0.021	0.014
North Atlantic right whale	0.292	0.268	0.022	0.012
Humpback whale	0.056	0.037	0.022	0.073
Fin whale	0.078	0.145	0.165	0.126
Sei whale	0.001	0.011	0.001	0.001
Sperm whale	0.001	0.003	0.022	0.011
Seals b/	7.422	0.119	0.157	0.157

Source: Roberts et al. 2021a

Notes: Density summary per season are provided in numbers of individuals per 38.6 mi^2 (100 km^2.
a/ Beaked whales: Density value is an annual value and reflects a merged category for all beaked whale species in the Study Area, including the most commonly sighted (e.g., Cuvier's, True's, Blainville's, or Sowerby's). Beaked whales are difficult to identify at sea due to morphology and cryptic behaviors (not staying at the surface for long periods) this this category includes all whales in the family Ziphiida, most likely genus Mesoplodon or Ziphius.
b/ Seals: This category reflects pooled data from sightings of both harbor seals and gray seals. A minimum number of detections are necessary in order to derive the detection function uses in the density formula that informs these values. Since sighting data of seals in the Study Area per species was limited data were pooled. This is standard line transect practice for similar species with limited sightings.

An overarching finding of the collective data available from recent studies indicates that humpback whales and fin whales are the most abundant large whale species in the Study Area. Site-specific aerial surveys conducted by Empire found fin whales sightings accounted for 28 percent of the observations (**Appendix P**). Tetra Tech (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020) found the highest large whale sighting rates (utilizing a different parameter that statistically incorporates sighting effort) were for both humpback and fin whales. Though rates varied seasonally, both these species occurred year-round. The Empire-supported WCS/WHOI SE buoy found general whale's acoustic presence peaked during winter (December – February) and was high during spring (March – May) and fall (September – November) but declined and was at a minimum in summer (June – August). The Blue York buoy has documented many large whale species, including humpback whales, right whales, fin whales, and less commonly sei whales. The Cornell buoys have detected all six focal study species (i.e., right, fin, sei, blue humpback, and minke whales). Right whales, fin whales, and humpback whales were detected every month of the year.

5.6.1 Affected Environment

The affected environment is defined as the coastal and offshore areas where marine mammals are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

All marine mammal species are protected under the Marine Mammal Protection Act (MMPA) of 1972 (50 CFR § 216) as amended in 1994. Within the framework of the MMPA, marine mammal populations are further defined into a "stock", which is defined as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature" (16 U.S.C. § 1362). The MMPA prohibits the "take" of marine mammals, which is defined under the MMPA as the harassment, hunting, or capturing of marine mammals, or the attempt thereof. "Harassment" is further defined as any act of pursuit, annoyance, or torment, and is classified as Level A (potentially injurious to a marine mammal or marine mammal stock in the wild) and Level B (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns).

In addition, some marine mammal species found in U.S. waters are listed and protected under the ESA (16 U.S.C. § 1531). The ESA protects endangered and threatened species and their habitats by prohibiting the take of listed animals. Under the ESA, to "take" a listed endangered or threatened species is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The regulations also define harm as an act that kills or injures wildlife.

5.6.1.1 Occurrence in the Study Area

Marine mammals inhabit all of the world's oceans and are found in coastal, estuarine, and pelagic habitats. There are 38 marine mammals (cetaceans and pinnipeds) found in the Northwest Atlantic OCS region waters with documented ranges that include the Study Area. All 38 marine mammals listed in **Table 5.6-4** and **Table 5.6-5** are protected by the MMPA and five are additionally federally listed as Endangered under the ESA. Of those 38 species, there are 20 considered common (known to be present either year-round or seasonally in the Study Area); two of these are ESA-listed as Endangered: the North Atlantic right whale and the fin whale. There is no Critical Habitat for any marine mammal species in the Study Area.

Marine mammal species known to occur, but not considered common, within Northwest Atlantic OCS region waters are listed in **Table 5.6-4**. Marine mammal species known to occur and considered common within Northwest Atlantic OCS region waters are listed in **Table 5.6-5**. Since marine mammals are highly mobile, sightings recorded in waters of New York and New Jersey are considered synonymous with potential to occur in the Study Area (especially as the Study Area waters cover waters in both these states).

Table 5.6-4 Marine Mammals that are Uncommon in the Marine Waters of the Atlantic OCS, Including the Study Area

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Study Area (NY and NJ) Distribution	Likelihood of Occurrence in the Study Area	Seasonal Occurrence
False killer whale	*Pseudorca crassidens*	N/A	MMPA	1,791	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Clymene dolphin	*Stenella clymene*	N/A	MMPA	4,237	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Rough-toothed dolphin	*Steno bredanensis*	N/A	MMPA	136	W. North Atlantic	Deep ocean waters	Extralimital	Uncommon
Dwarf sperm whale	*Kogia sima*	N/A	MMPA	7,750	W. North Atlantic	Over outer continental shelf	Rare	Uncommon
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Beluga whale	*Delphinapterus lecuas*	N/A	MMPA	900	St. Lawrence Estuary	Infrequent	Rare	Uncommon
Killer whale	*Orcinus orca*	N/A	MMPA	Unknown	W. North Atlantic	Over continental shelf and rise; Open sea and offshore waters	Uncommon	Uncommon
Northern bottlenose whale	*Hyperoodon ampullatus*	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Pygmy killer whale	*Feresa attenuata*	N/A	MMPA	Unknown	W. North Atlantic	Deep ocean waters	Rare	Uncommon
Pygmy sperm whale	*Kogia breviceps*	N/A	MMPA	7,750	W. North Atlantic	Over continental slope	Rare	Uncommon
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	MMPA	28,924	W. North Atlantic	Over continental shelf to slope	Uncommon	Uncommon
Spinner dolphin	*Stenella longirostris*	N/A	MMPA	4,102	W. North Atlantic	Deep ocean waters	Rare	Uncommon

Table 5.6-4 Marine Mammals that are Uncommon in the Marine Waters of the Atlantic OCS, Including the Study Area (continued)

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Study Area (NY and NJ) Distribution	Likelihood of Occurrence in the Study Area	Seasonal Occurrence
White-beaked dolphin	*Lagenorhynchus albirostris*	N/	MMPA	536,016	W. North Atlantic	On and over continental shelf	Rare	Uncommon
Blue whale	*Balaenoptera musculus*	E	E	402	W. North Atlantic	Not well known; primarily deep waters	Unlikely	Seasonal; Winter, Fall
Striped dolphin	*Stenelle coeruleoalba*	N/A	MMPA	67,036	W. North Atlantic	Deep ocean water at edge of continental	Unlikley	Uncommon
Harp seal	*Cystophora cristata*	N/A	MMPA	7,445,000	W. North Atlantic	Continental shelf with pack ice	Rare	Uncommon
Hooded seal	*Phoca groenlandica*	N/A	MMPA	116,900	W. North Atlantic	Deep ocean water at edge of continental shelf with pack ice	Rare	Uncommon
West Indian manatee	*Trichechus manatus*	N/A	T	3,802	Florida	Freshwater, estuarine, and extremely nearshore coastal areas	Extralimital	Uncommon

Notes:
a/ E = Endangered; T = Threatened
b/ This is a total estimate for all *Mesoplodon* spp.

Sources: DoN 2005; DiGiovanni and DePerte 2013; NYSDOS 2013; Schlesinger and Bonacci 2014; Muirhead et al. 2018; NYSDEC 2015; Whitt et al. 2013 and 2015; BOEM 2018; Lowry 2016; Hayes et al. 2018; 2019, 2020; APEM and Normandeau Associates 2018; WHOI 2018; Tetra Tech and SES 2018, Tetra Tech and LGL 2019 and 2020; AOSS 2019; Estabrook et al. 2019; site-specific data, see **Appendix P**.

Table 5.6-5 Marine Mammals that are Common in the Marine Waters of the Atlantic OCS, Including the Study Area

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Study Area (NY and NJ) Distribution	Likelihood of Occurrence in the Study Area	Seasonal Occurrence
Atlantic spotted dolphin	*Stenella frontalis*	N/A	MMPA	39,921	W. North Atlantic	Primarily deeper waters	Common	Seasonal
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	MMPA	93,233	W. North Atlantic	On continental shelf and slope	Common	Seasonal
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Bottlenose dolphin	*Tursiops truncatus*	N/A	MMPA	62,851	W. North Atlantic	Coastal and offshore	Common	Year-round
Common dolphin	*Delphinus delphis*	N/A	MMPA	172,825	W. North Atlantic	Coastal and offshore	Common	Year-round
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	MMPA	5,744	W. North Atlantic	Deep ocean waters	Common	Seasonal
Harbor porpoise	*Phocoena*	SC	MMPA	95,543	Gulf of Maine / Bay of Fundy	Great South Bay	Common	Seasonal
Long-finned pilot whale	*Globicephala melas*	N/A	MMPA	39,493	W. North Atlantic	Over continental shelf to slope	Common	Year-round
Pantropical spotted dolphin	*Stenella attenuata*	N/A	MMPA	6,593	W. North Atlantic	Primarily deeper waters	Common	Year-round
Risso's dolphin	*Grampus griseus*	N/A	MMPA	35,493	W. North Atlantic	Along continental slope	Common	Year-round
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Striped dolphin	*Stenella coeruleoalba*	N/A	MMPA	67,036	W. North Atlantic	Over continental slope	Common	Seasonal
True's beaked whale	*Mesoplodon mirus*	N/A	MMPA	10,107 b/	W. North Atlantic	Deep ocean waters	Common	Seasonal
Minke whale	*Balaenoptera acutorostrata*	N/A	MMPA	24,202	Canadian E. Coast	On and over continental shelf	Common	Seasonal
North Atlantic right whale	*Eubalaena glacialis*	E	E	428	Western Atlantic	Primarily coastal	Common	Seasonal; Winter, Spring, Fall

Table 5.6-5 Marine Mammals that are Common in the Marine Waters of the Atlantic OCS, Including the Study Area (continued)

Name	Species Name	NY Status a/	Federal Status a/	Estimated Population	Stock	Known Study Area (NY and NJ) Distribution	Likelihood of Occurrence in the Study Area	Seasonal Occurrence
Humpback whale	*Megaptera novaeangliae*	E	MMPA	1,396	North Atlantic	Becoming more coastal; may be in inlets.	Common	Year-round
Fin whale	*Balaenoptera physalus*	E	E	7,418	W. North Atlantic	Throughout	Common	Year-round
Gray seal	*Halichoerus grypus*	N/A	MMPA	27,131	W. North Atlantic	Coastal and continental shelf waters	Common	Seasonal
Harbor seal	*Phoca vitulina*	N/A	MMPA	75,834	W. North Atlantic	Coastal, bays, estuaries, inlets	Common	Seasonal

Notes:
a/ SC = Species of Concern; E = Endangered; T = Threatened
b/ This is a total estimate for all *Mesoplodon* spp.

Sources: DoN 2005; DiGiovanni and DePerte 2013; NYSDOS 2013; Schlesinger and Bonacci 2014; Muirhead et al. 2018; NYSDEC 2015; Whitt et al. 2013 and 2015; BOEM 2018; Lowry 2016; Hayes et al. 2018, 2019, 2020; APEM and Normandeau Associates 2018; WHOI 2018; Tetra Tech and SES 2018, Tetra Tech and LGL 2019 and 2020; AOSS 2019; Estabrook et al. 2019; site-specific data, see **Appendix P**.

ESA-listed large whales that may occur in the region are the sei, blue (*Balaenoptera musculus*), and sperm whale (*Physeter macrocephalus*); however, these whales are highly unlikely to occur in the Study Area. The sei whale has been acoustically detected in all seasons except summer, though its geo-location within New York waters is unknown (WHOI 2018; WCS Ocean Giants 2020), and is only uncommonly observed. The blue whale has been seen in the Study Area in fall and winter including just off Sandy Hook, New Jersey, but not in the Lease Area. They have also been acoustically detected in fall, winter and spring, but not localized to the Lease Area. Sperm whales would not be expected to occur in the shallower water depths of the Study Area, though they are commonly found in all seasons in the deeper offshore waters of the OCS on the shelf break (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). While rare occurrences of these three ESA-listed whales have been reported in the Study Area, these species are considered to be rare and are not expected. Therefore, the sei, blue, and sperm whale will not be discussed further in this analysis.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and existing threats to the non-endangered or threatened and endangered marine mammals that are considered common in the waters of the New York Bight and which also have been determined to be likely to occur in the Study Area. When applicable, the subsections reference when Empire-collected Study Area-specific data observed or detected such species.

Most of the large whales generally found in the Study Area are baleen whales (a whale that has plates of whalebone in the mouth for straining plankton from the water). The sperm whale is the only large odontocete whale (whales with teeth) known to occur. The data referenced throughout this section comes from various studies listed in subsection Data Relied Upon and Studies Completed; other citations included where relevant.

As an overview, of the large whales commonly present in the Study Area, almost all studies noted that humpback whales and fin whales are present year-round and have been sighted or acoustically detected in all months. Humpback whale and fin whale abundance in the Study Area is considered increasing as compared to previous years. In year-round acoustic studies conducted using permanent buoys in the New York Bight, the sei, fin, right, and humpback whales were the most commonly detected large whales (WHOI 2018). The right whale, fin whale, humpback whale, and bottlenose dolphin were detected during all seasons in previous acoustic studies from New Jersey (NJDEP 2010). Interannual shifts were noted by the WCS/WHOI buoys (WCS Ocean Giants 2020), with peaks in fin whale and humpback whale (and sei whale) detections shifting by a month in 2019 as compared to previous years, though not in the same directions (i.e., fin whale peaks shifted forward a month and both humpback and sei whale shifted backwards). Spatial differences were noted by the real time analyses between the NW and SE buoy locations from January through April with all four species being detected, albeit sei whales at less than one percent of the days. Fin whales and humpback whales were detected in greater numbers at both the SE and NW buoys. Right whales were detected by the Blue York buoy, roughly 22 mi (35.4 km) south of Fire Island, in the winter with occasional detections in July (WHOI 2018) and by the SE WCS/WHOI buoy from November through April predominantly. The right whale occurs seasonally in Study Area waters and has been sighted in all seasons except summer; it is acoustically detected year-round, albeit rarely in summer.

Historically, the Gowanus Canal (near the EW 1 landfall) has been known for a multitude of whale and dolphin sightings. Dating back to 1928, whale hunts would occur in the canal, and records even show evidence of a sperm whale in the canal (New York Times 1928). Over the course of the last century, there have been other recorded whale and dolphin sightings, including the sighting of "Sludgie," the juvenile minke whale that stranded and eventually died in 2007 in the Gowanus Canal (Albrecht 2017). Additional historical references indicate that whales were plentiful in the area in the 1600-1800s, and a large decline was experienced due to increased water pollution from the early 1900s to the 1980s. As efforts to clean up the Hudson River and the waters surrounding Manhattan have been undertaken, there has been an increase in the number of whale sightings over the last 10 years. Two hundred and seventy-two whales have been documented in New York City waters in 2018 alone (The Guardian 2019), with a "boom" in large whales noted (National Geographic 2019). When characterizing mobile marine wildlife species, it is important to recognize that occurrences can vary from year to year and from season to season. The presence and/or absence of marine mammals within the Study Area waters can be affected by a variety of parameters, including water temperature, movements or availability of prey, and human presence or disturbance. The waters associated with the Study Area are used by marine mammals for foraging, transiting, or migrating, and some individuals may remain year-round. Some cetacean species prefer offshore, continental shelf waters during feeding seasons due to the abundance of their prey species. However, at alternate times of the year, these same species occur in shallower depths closer to shore. It should also be noted that in addition to the variable movement of marine mammals due to the factors listed, environmental changes stemming from climate change factors are affecting many marine mammals' typical foraging and migrating boundaries. Any such data, if available, is referenced within this Section under the species-specific descriptions. It is important to note that as more information becomes available on these changing trends, long-understood distributions and occurrences for various marine mammal species in these waters could change. The following species discussions are therefore based on both recent survey data and historic behavioral trends.

Marine mammal hearing, when noted, is based on the NOAA Fisheries (2018a) categories for low-, mid-, and high-frequency cetacean hearing groups. As part of an effort to assess impacts from anthropogenic sound sources, marine mammal species have been arranged into functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans (harbor porpoise), mid-frequency cetaceans (dolphins, toothed whales, beaked whales), low-frequency cetaceans (Mysticetes; i.e., baleen whales), otariid pinnipeds (sea lions and fur seals), and phocid pinnipeds (true seals). These technical guidelines from NOAA Fisheries were recently updated in 2018; the groupings are listed in **Table 5.6-6** and described in further detail in **Section 4.4.2 Underwater Acoustic Environment**. Note that otariid pinnipeds do not occur in the Study Area.

Table 5.6-6 Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range a/
Low Frequency (LF) Cetaceans (baleen whales)	7 Hz to 35 Hz
Mid-Frequency (MF) Cetaceans (dolphins, toothed whales, beaked whales) b/	150 Hz to 160 Hz
High-Frequency (HF) Cetaceans (harbor) porpoise) c/	275 Hz to 160 kHz
Otariid Pinnipeds (sea lions and fur seals) d/	50Hz to 86 kHz
Phocid Pinnipeds (true seals) e/	60 Hz to 39 kHz

Source: NOAA Fisheries 2018a

Notes:
a/ These hearing ranges are generalized for species included in the entire group as a composite.
b/ Renamed High-frequency cetaceans by Southall et al. (2019)
c/ Renamed very high-frequency cetaceans by Southall et al. (2019)
d/ Renamed Phocids carnivores in water by Southall et al. (2019)
e/ Termed Other marine carnivores in water by Southall et al. (2019)

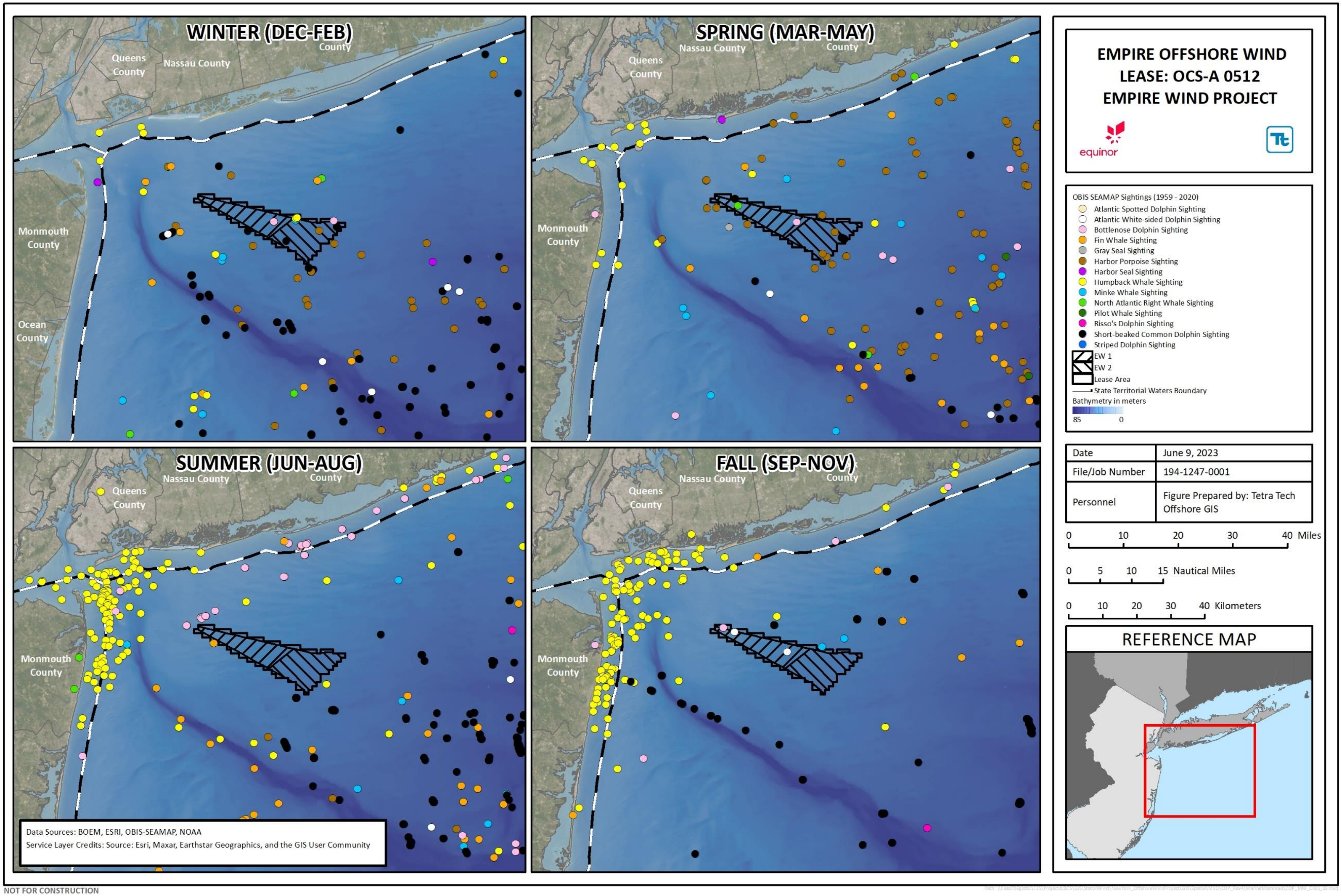

Figure 5.6-2 OBIS Seasonal Marine Mammal Sightings in the Study Area

Human-induced impacts such as underwater noise, vessel collisions, entanglements, and other human disturbances are a threat to multiple marine mammal species. Other disturbances include habitat loss, pollution, and commercial fishing (Kenney 2002). Underwater noise generated from a variety of human activities is a known stressor for marine wildlife. Noise sources include noise from vessels associated with wind farm development or operation; from construction equipment such as multi-beam echosounders or other bottom survey equipment (typically utilized during pre-construction surveys); and pile driving activities (see **Section 4.4.2** and **Appendix M-2** for additional information). Noise in the marine environment may cause injury and displacement and is known to affect marine mammal behavior. Stress from noise may reduce reproductive fitness by increasing energy expenditures, reducing foraging success, or by masking vocalizations, which can also have other indirect effects. Noise mitigations are planned as part of the Project-related avoidance, minimization, and mitigation measures, as described in Section 5.6.2 and 5.6.3. Increases in ship numbers and changes in vessel traffic associated with pre-construction surveys, wind farm construction, and post-construction operation and maintenance also increase the risk of vessel collisions with marine wildlife. These and other potential impacts to marine mammal species will be discussed further in Section 5.6.2.

5.6.1.2 Species Overview

ESA-Listed Endangered Species with Common Occurrence in the Study Area

The North Atlantic right whale, fin whale, sei whale, and sperm whale are protected under the MMPA and the ESA and are considered likely to be found in the Study Area, as documented in **Table 5.6-5**. Because these species may occur and are federally endangered, a Biological Assessment will be prepared in accordance with Section 7 of the ESA (16 U.S.C. § 1536 [c]), to address these specific species. These two ESA-listed species are known to commonly occur in both nearshore and offshore waters.

North Atlantic Right Whale

The North Atlantic right whale is a strongly migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. This species was listed as a federally endangered species in 1970 and is one of the most endangered large whale species in the world. It is considered critically endangered under the ESA and is state listed as endangered in New York.). The historic range of right whales reached its southern terminus between Florida and northwestern Africa and its northern terminus between Labrador and Norway (Kenney 2002). The present range of the right whale population extends from the wintering and calving grounds in the southeastern United States between Florida and Cape Fear, North Carolina (Hayes et al. 2020) to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St. Lawrence (Kenney 2002; Hayes et al. 2020). A few documented events of right whale calving have occurred in shallow coastal areas and bays (Kenney 2002). Observations in December 2008 noted congregations of more than 40 individual right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA Fisheries 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely due to higher food densities. North Atlantic right whales are typically found in feeding grounds within New England waters and waters of the New York Bight between February and May, with peak abundance in late March (Hayes et al. 2020). Right whales feed mostly on copepods belonging to the *Calanus* and *Pseudocalanus* genus (McKinstry et al. 2013) and are considered “grazers” as they swim slowly with their mouths open when feeding. They are the slowest swimming whales, only reaching speeds up to 10 mi (16 km) per hour. They can dive at least 1,000 ft (300 m) and typically stay submerged for 10 to 15 minutes, feeding on their prey below the surface (Jefferson et al. 2015). Right whales’ hearing is in the low-frequency range (see **Table 5.6-6**; Southall et al. 2007; NOAA Fisheries 2018a).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of these activities (Kenney 2002). North Atlantic right whales were hunted in southern New England until the early twentieth century. Shore-based whaling in New York involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern United States to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2010). Abundance estimates for right whale population vary. The 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Report indicated there were only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NOAA Fisheries 1991a). This is a tremendous difference from pre-exploitation numbers, which are thought to be around 1,000 individuals. When the right whale was protected in the 1930s, it is believed that the population was roughly 100 individuals (Waring et al. 2004). In 2015, the Western North Atlantic population size was estimated to be at least 476 individuals (Waring et al. 2016). That population size estimate decreased to 428 individuals in 2019 (Hayes et al. 2020).

Recent data (2017 to 2019) from multiple studies reveals new information regarding occurrences of right whales in the Study Area (APEM and Normandeau Associates 2018; Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). Aerial survey findings show peak right whale sighting rates in New York waters in early spring, with no sightings in summer 2018 and summer and fall 2019 (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). NYSERDA studies documented right whales in winter and spring (APEM and Normandeau Associates 2018) in the offshore area. The NYSERDA (APEM and Normandeau Associates 2018) aerial survey acquired photographs of right whales from digital aerial surveys conducted in winter and spring of 2016-2017; Whitt et al. (2013 and 2015), conducted a study in New Jersey waters adjacent to the New York Study area. Since marine mammals are highly mobile, sightings recorded in the Whitt studies are included since that study area is adjacent to the Study Area. Whitt et al. (2013, 2015) sighted right whales in winter, spring, and fall. Neither AOSS (2019) or A.I.S. (2019) visual and acoustic ship-board surveys reported sightings or detections of right whales during their survey period in the Lease Area. There have been several other acoustic monitoring studies off New York and New Jersey with right whale findings. Whitt et al. (2013) had detections in all months of the year with peak detection days in March through June. Permanent buoys deployed in the New York Bight by WHOI and WCS detected right whales between December and January and again in March and had occasional detections in July (WHOI 2018). The WCS/WHOI SE buoy is located 15.7 nm (29 km) beyond the right whale U.S. Seasonal Management Area (SMA) border, and primarily detected right whales when the SMA was in effect (November – April). Right whales were also detected sporadically other times of year (WCS Ocean Giants 2020). Another acoustic monitoring study in New York conducted from October 2017 through July 2018 reported detections of right whale calls in all seasons and all months (with the exception of no detections in August; however, several buoys were offline in August) (Estabrook et al. 2019). Estabrook et al. (2019) had peak detections between November and January. In 2008–2009, Muirhead et al. (2018) also reported right whale calls in every month, with higher detection rates in nearshore New York waters between late February and mid-May. In a large analysis of multiple acoustic datasets over a 10-year period covering the Atlantic from Florida to Greenland, Davis et al. (2017) found year-round acoustic presence of right whales in the Atlantic with the lowest rates of call detections in the summer and highest rates in the late winter and spring. This study reports trends that indicate the right whale may be shifting its range from previously prevalent occurrences in northern grounds (e.g., Bay of Fundy and the Gulf of Maine) to more frequent occurrences in the Mid-Atlantic regions throughout the year. Inter-annual variation, or perhaps seasonal differences in vocalization rates and surfacing times, may explain some differences in results from acoustic and aerial monitoring efforts, but further research and analysis would be necessary to determine this. Right whales are known to occur in the Study Area; the seasonal distribution of right whales in the Study Area can be found on **Figure 5.6-3**.

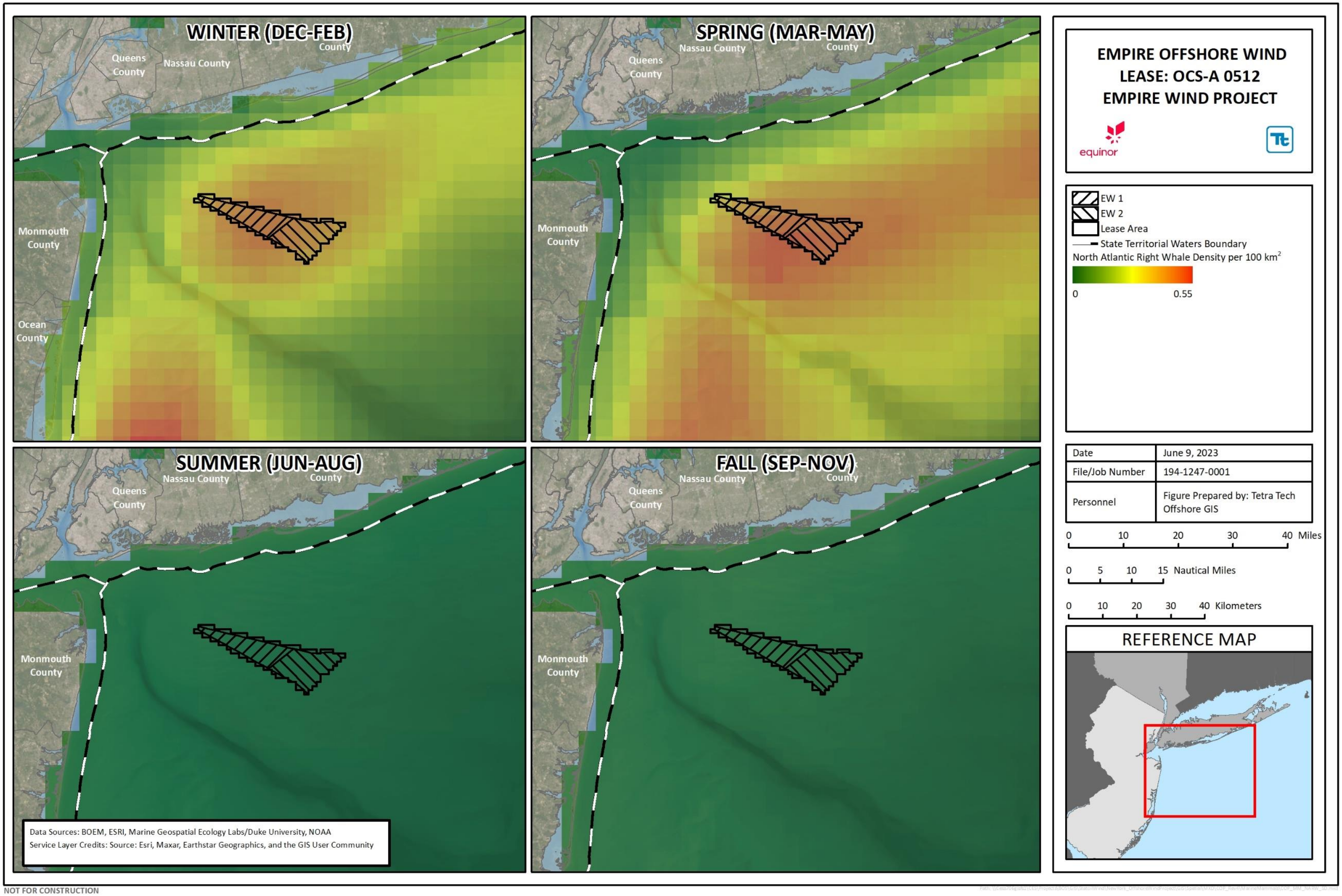

Figure 5.6-3 Seasonal Distribution of the North Atlantic Right Whale in the Study Area

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing may also negatively impact their populations (Kenney 2002). Entanglements can represent a significant trauma, and result in vast energy expenditure for large whales either from dragging gear or from trying to get released, leading to injury or death if disentanglement efforts are not successful within a critical time period (van der Hoop et al. 2017; van der Hoop et al. 2016). Such energy expenditures can have significant sub-lethal indirect and ongoing impacts to right whales, particularly reproductive females where time for reproduction could be delayed for months or years (van der Hoop et al. 2016). Recovery from entanglements and subsequent energy losses resulting in physiological stress could limit reproductive success and contribute to fluctuations in population growth (van der Hoop et al. 2016). Unfortunately, evidence suggests that recent efforts to reduce entanglement through fishing gear modification have not resulted in a decline in frequencies of entanglement or serious injury due to entanglement (Pace et al. 2014).

Between 2002 and 2006, a study of marine mammal strandings and human-induced interactions reported that right whales in the western Atlantic were subject to the highest proportion of entanglements (25 of 145 confirmed events) and ship strikes (16 of 43 confirmed occurrences) of any marine mammal studied (Glass et al, 2010). Bycatch of right whale has also been reported in pelagic drift gillnet operations by the Northeast Fisheries Observer Program; however, no mortalities have been reported (Glass et al. 2010). From 2014 through 2018, the minimum rate of annual human-caused mortality and serious injury to this species averaged 8.15 per year (Hayes et al. 2021). Records from 2014 through 2018 indicate there have been 43 confirmed injury events, including 18 mortalities (Hayes et al. 2021). From 2014 through 2018, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 6.85 per year, while ship strikes averaged 1.3 whales per year (Hayes et al. 2021). Environmental fluctuations and anthropogenic disturbance may be contributing to a decline in overall health of individual right whales that has been occurring for the last three decades (Rolland et al. 2016). The low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species than for other whales (Hayes et al. 2021). In recent years there have been increased mortality rates coupled with decreasing calving rates. In 2017, five calves were observed; however, none were sighted in 2018, and from 2017 to 2018 there were 19 confirmed mortalities (NOAA Fisheries 2018b). Changes in prey availability affect right whale calving as do entanglements. Their health, in all demographic groups and in the overall population, has steadily declined over the last thirty years of observations (Rolland et al. 2016). Ship strikes are the second most frequently documented case of mortality in right whales (NOAA Fisheries 2018b) where most ship strikes are fatal to this species (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship as they are dark in color and typically do not surface with a high profile. To address potential for ship strike, NOAA Fisheries designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. SMA for right whales in December 2008 (see **Figure 5.6-4**). NOAA Fisheries requires that all vessels 65 ft (19.8 m) or longer must travel at 10 knots (18.5 km per hour [km/h]) or less within the right whale SMA from November 1 through April 30, when right whales are most likely to pass through these waters (NOAA Fisheries 2010a; NYSDOS 2013). The most recent stock assessment report (Hayes et al. 20120) noted that studies by van der Hoop et al. (2015) have concluded large whale vessel strike mortalities decreased inside active SMAs but have increased outside of these protected areas.

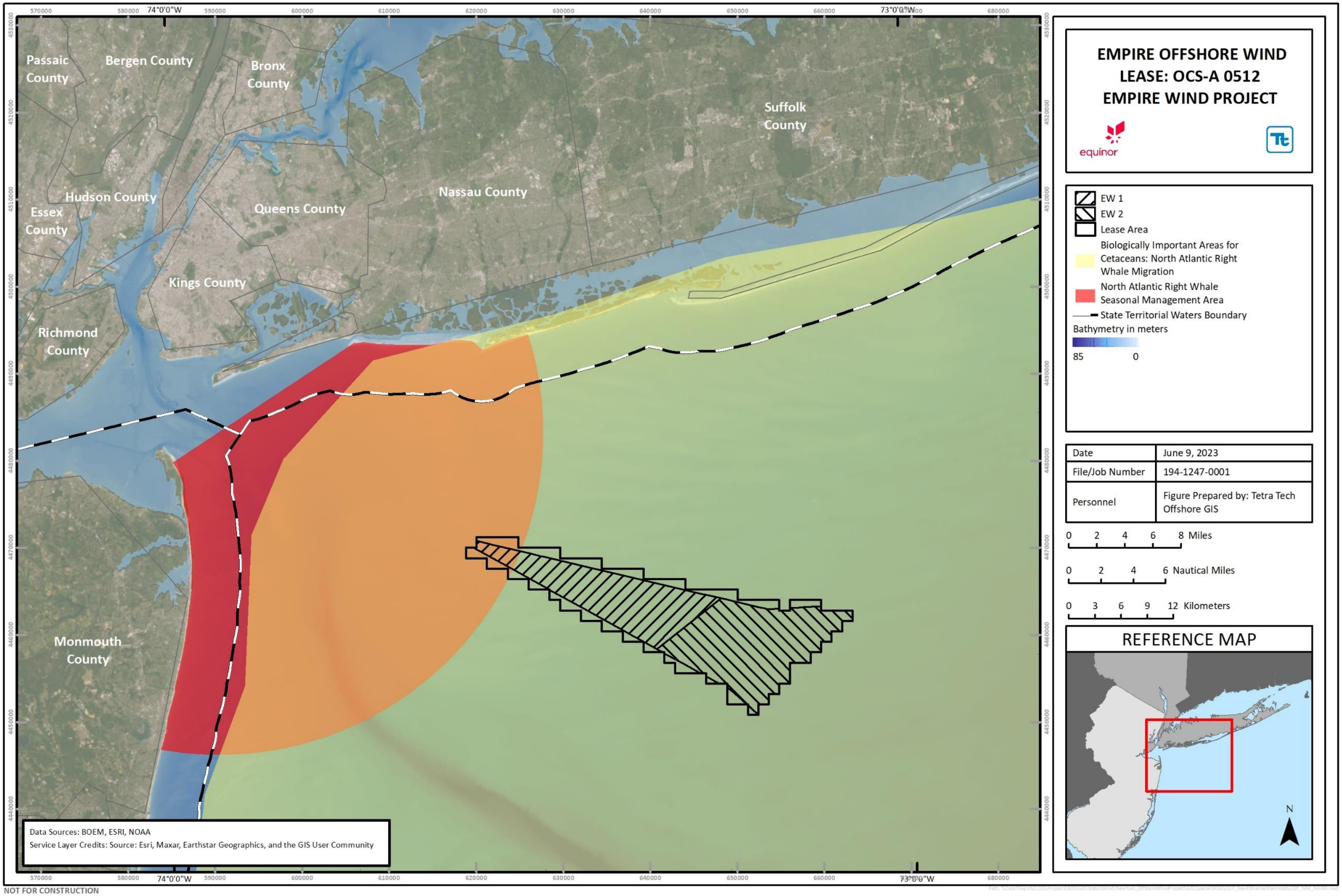

Figure 5.6-4 North Atlantic Right Whale Seasonal Management Area and Biologically Important Area

Right whales are one of the five most frequently entangled large whales (NOAA Fisheries 2017b) with the odds of an entanglement event are now increasing by 6.3 percent per year (NOAA Fisheries 2018a). In addition, Dynamic Management Areas (DMAs) are areas of temporary protection established by NOAA Fisheries for particular marine mammal species, in an effort to respond to movements of high-risk whale species (such as right whale). These DMAs are determined by sighting reports made through vessel traffic in the larger Northern Atlantic and are communicated through marine communication systems and published on their website. The Right Whale Sighting Advisory System, a statutory requirement to reduce the risk of right whale collisions, is in place for any DMA. Lease stipulation 4.2.3 also requires that that all vessel operators must comply with a 10 knot or less speed restriction in DMAs, and at all times between November 1 and April 30 in Seasonal Management Areas.

An Unusual Mortality Event (UME) for right whale strandings commenced in 2017 and continues through present. The UME was declared by NOAA Fisheries based on a high number of dead whales discovered in Canadian and U.S. waters (NOAA Fisheries 2019b).

The North Atlantic right whale is expected to have seasonal occurrence in Study Area waters, especially between February and May (with peak occurrence in March). They could occur in the Study Area in any season, though considered highly unlikely to occur in summer.

Fin Whale

The fin whale was listed as federally endangered in 1970 and is state listed as endangered in New York. The species' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Gambell 1985). They are the most commonly sighted large whales in continental shelf waters from the Mid-Atlantic Coast of the United States to Nova Scotia (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982; Hain et al. 1992). Fin whales, much like humpback whales, seem to exhibit habitat fidelity; however, their habitat use has shifted in the southern Gulf of Maine (Kenney and Vigness-Raposa 2010; Hayes et al. 2020). This is most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2010). While fin whales typically feed from Maine to Virginia in the summer, mating and calving (and general wintering) areas are still largely unknown (Hayes et al. 2020). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2010). Their gestation period is approximately 11 months, with females giving birth every two to three years, typically between late fall and winter. Fin whales hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales in the fall from the Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whale abundance off the coast of the northeastern United States has historically been highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). The best abundance estimate available for the western North Atlantic fin whale stock is 7,418 (Hayes et al. 2020).

Both historical and more recent studies have found relative abundance and density of fin whales was highest during spring, lower during summer and fall, and lowest during winter (e.g., Whitt et al. 2015; Kraus et al. 2016; Hayes et al. 2020). Whitt et al. (2015) recorded fin whales in New Jersey waters adjacent to the Study Area in all seasons. Additionally, NYSERDA (APEM and Normandeau Associates 2018) aerial data reported digital captures of fin whales in the Study Area during all seasons from 2016 to 2017. Other recent data from ongoing aerial surveys in Study Area waters show fin whale sightings in all seasons year-round, with highest sighting rates in New York waters in July, as feeding aggregations are common in summer months (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). PSO data from Empire–collected visual and acoustic shipboard surveys specific to the Study Area had numerous sightings of fin whales from May to September, with a lower number of sightings in the fall and winter months (September to December) (AOSS 2019; A.I.S. 2019) including in the submarine export cable siting corridors, Lease Area, Lease Area 2.5-mi (4-km) buffer, nearshore, and offshore areas. The vast majority of fin whale PSO sightings were in the Lease Area. Conversely, acoustic recordings in the New York Bight from October 2017 through July 2018 showed the lowest daily detection of fin whales in spring, with recordings 28 percent of days versus 43 to 46 percent of days in the other three seasons (Estabrook et al. 2019). Differences in results between the two observational methods (visual vs. acoustic) may be the result of seasonal differences in calling behavior and/or surfacing behavior. In a fall through spring study in 2008–2009, fin whales were detected on all recording days from New York–based buoys and at the highest rate during the winter, with 58 percent of days (note that this study had no recording effort during summer, a caveat when considering seasonal calling data [Muirhead et al. 2018]). The first WHOI New York Bight buoy also had the highest rate of detections of fin whale, compared to any of the other whale species detected. There were confirmed detections that were highest from July through January, tapered off January through March, and were few and far between during the months of April, May, and July (WHOI 2018). The WCS/WHOI SE buoy had the greatest detection of fin whales in fall, followed by winter and spring with a minimum in the summer (WCS Ocean Giants 2020). **Figure 5.6-5** details the seasonal distribution of the fin whale within the Study Area.

Present threats to fin whales are similar to other whale species, namely anthropogenic noise, fishery entanglements, and vessel strikes. Fin whales seem less likely to become entangled than other whale species. Glass et al. (2010) reported that between 2004 and 2008, fin whales belonging to the Gulf of Maine population were involved in only eight confirmed entanglements with fishery equipment. Furthermore, Nelson et al. (2007) reported that fin whales exhibited a low proportion of entanglements during their 2001 to 2005 study along the western Atlantic, with only eight reported events. Vessel strikes, however, may be a more serious threat to fin whales, with eight and 10 confirmed vessel strikes reported by Glass et al. (2010) and Nelson et al. (2007), respectively. This level of incidence was similar to that exhibited by the other whales studied. Conversely, a study compiling whale/vessel strike reports from historical accounts, recent whale strandings, and anecdotal records by Laist et al. (2001) reported that of the 11 great whale species studied, fin whales were involved in collisions most frequently (31 in the United States and 16 in France). From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 3.35 per year (Waring et al. 2015). From 2013 to 2017, this number has decreased to 2.35 per year (Hayes et al. 2020). An increase in ambient noise has also impacted fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003).

Fin whales are present annually throughout the waters between the coastline and the continental shelf off of New York and are expected to occur in Study Area waters. Their likelihood of occurrence increases during the spring and summer months, with the lowest densities present in the fall and winter (NYSDOS 2013; Roberts et al. 2020). Fin whales are likely to occur throughout the Study Area throughout the year.

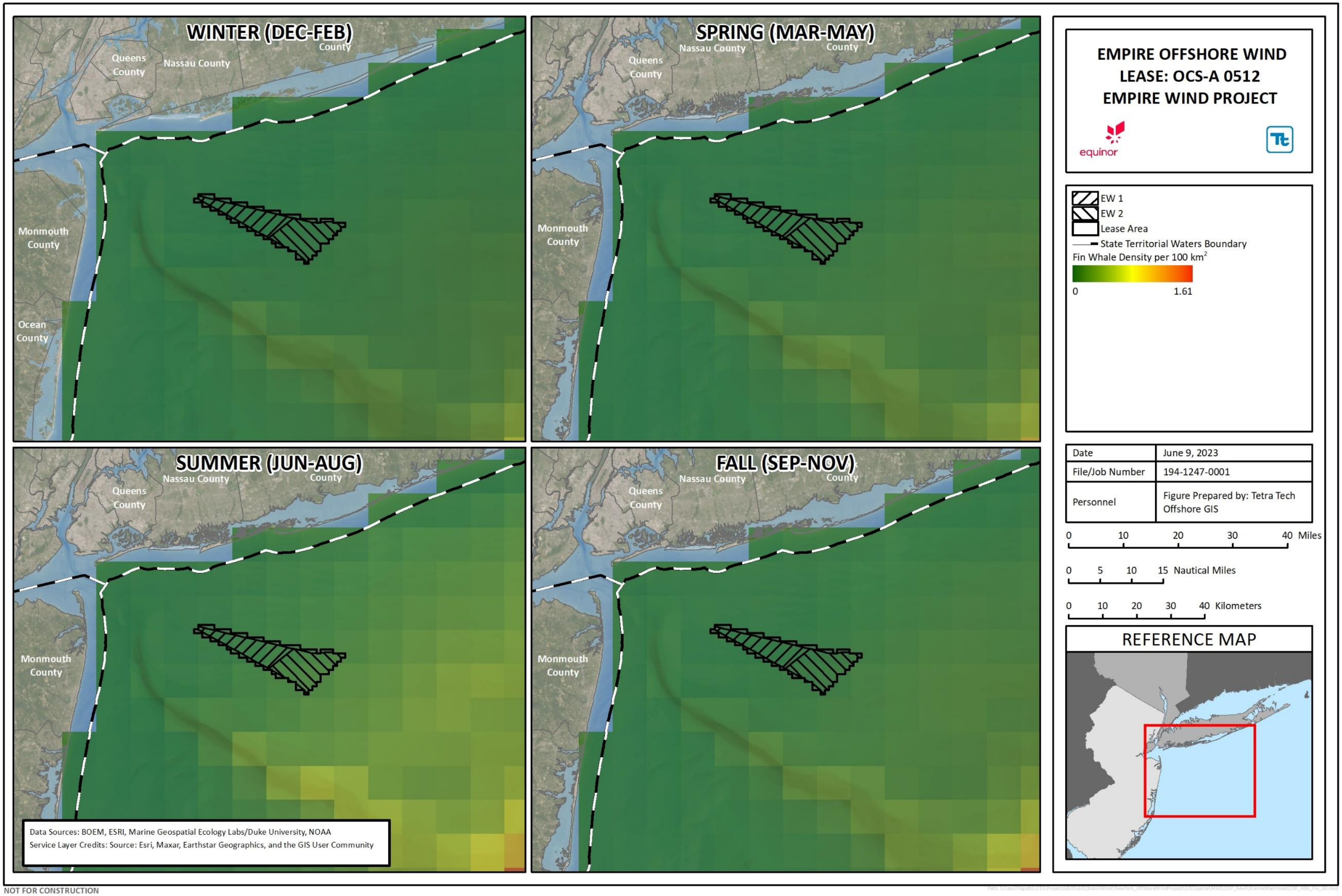

Figure 5.6-5 Seasonal Distribution of the Fin Whale in the Study Area

Sei Whale

The sei whale (*Balaenoptera borealis borealis*) is listed as endangered under the ESA and is designated as strategic under the MMPA (Hayes et al. 2021). A final recovery plan for the sei whale was published in 2011 (NOAA Fisheries 2011). A five-year review of the species was completed in 2012 (NOAA Fisheries 2012) with no change in status and another five-year review was completed in 2021 (NOAA Fisheries 2021a) with no change in status.

Sei whales are a blue-black-gray color with skin often marked by pits or wounds likely caused by ectoparasitic (i.e., parasites that live on the surface of the host body) copepods; after healing, the wounds become ovoid white scars. The sei whale can be distinguished from other baleen species by its dorsal fin, which is falcate, curves backward, and is set about two-thirds of the way back from the tip of the snout. Unlike fin whales, they tend not to roll high out of the water as they dive. The sei whale blowholes and dorsal fins are often exposed above the water surface simultaneously. Although sei whales may prey upon small schooling fish and squid, available information suggests that calanoid copepods and euphausiids are the primary prey of this species (Flinn et al. 2002). Sei whale hearing is in the low-frequency hearing range (Southall et al. 2007; NOAA Fisheries 2018a).

The sei whale is a widespread species in the world's temperate, subpolar, subtropical, and tropical marine waters. NOAA Fisheries considers sei whales occurring from the U.S. East Coast to Cape Breton, Nova Scotia, and east to 42°W, as belonging to the "Nova Scotia stock" of sei whales (Hayes et al. 2021). Sei whales occur in deep water characteristic of the continental shelf edge throughout their range (Hain et al. 1992; Hayes et al. 2021). Sei whales have been acoustically detected in the New York Bight in all seasons (Davis et al. 2020).

There is limited information on the stock identity of sei whales in the North Atlantic (Hayes et al. 2021). The best abundance estimate based on the most recent SAR for the Nova Scotia stock of sei whales is 6,292 (Hayes et al. 2021). Insufficient data are available to determine trends of the Nova Scotian sei whale population. From 2014 through 2018, the minimum annual rate of human-caused mortality and serious injury was 1.20 (Hayes et al. 2021). No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NOAA Fisheries Sea Sampling bycatch database (Hayes et al. 2021). Sei whales are likely to occur throughout the Study Area throughout the year.

Sperm Whale

The sperm whale (*Physeter macrocephalus*) is listed as endangered under the ESA and the North Atlantic stock is designated as a strategic stock under the MMPA (Waring et al. 2015). A recovery plan for sperm whales was finalized in 2010 (NOAA Fisheries 2010b), and a five-year review of the species was completed in 2015 and yielded no change in status (NOAA Fisheries 2015). NOAA Fisheries announced the initiation of a five-year review in May 2021 (NOAA Fisheries 2021b).

The sperm whale has a disproportionately large head, one quarter to one third of its total body length, with a narrow, underslung jaw (Jefferson et al. 2015). Sperm whales are generally dark gray in color with white lips and stomachs patches (Jefferson et al. 2015). The dorsal fin is low in profile, thick, not pointed or curved, and followed by "knuckle" markings along the spine. Photographs of markings on the dorsal fins and flukes of sperm whales are distinctive and used in studies of life history and behavior (Jefferson et al. 2015). Sperm whales feed primarily on large- and medium-sized squid and other cephalopods (such as octopus), medium- and large-sized demersal elasmobranchs (such as rays and sharks) and many teleost (bony) fish species (Christensen et al. 1992). While foraging, the whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft (i.e., rest in a loose grouping) together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm when foraging (Jefferson et al.

2015). Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Whitehead 2009). Male sperm whales are essentially solitary, though they rejoin or find nursery groups during prime breeding season. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2015; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, the peak breeding season occurs between October and December (Hayes et al. 2021). Sperm whale hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale (Hayes et al. 2020). This species is found in polar to tropical waters in all oceans from approximately 70° N to 70° S (Whitehead 2003). It ranges widely throughout the world's oceans but shows a strong preference for deep ocean habitats from equatorial zones to the edges of the polar pack ice (Whitehead 2003). In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre (Hayes et al. 2020). Its distribution is typically associated with waters over the continental shelf break, the continental slope, and farther offshore, with higher concentrations near drop-offs and areas with strong currents and steep topography regardless of season (Whitehead et al. 1992; Jefferson et al. 2015; Hayes et al. 2020). The sperm whale, an odontocete whale, is migratory. However, their migrations are not as well known or as predictable as other baleen whale species. In the North Atlantic, there appears to be a general shift northward during the summer, but there is no clear migratory pattern in temperate areas (Whitehead 2003).

The current abundance estimate for this species in the North Atlantic stock based on the most recent SAR is 4,349 individuals (Hayes et al. 2021). From 2008 to 2012, annual average human-caused mortality was 0.8 due to reports of one sperm whale mortality in 2009 and one in 2010 in the Canadian Labrador halibut longline fishery, one entanglement mortality in Canadian pot/trap gear, and one vessel strike mortality (Waring et al. 2015). There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. Exclusive Economic Zone during from 2013 to 2017 (Hayes et al. 2020). Sperm whales have not been documented as bycatch in the observed U.S. Atlantic commercial fisheries. Historically, 424 sperm whales were harvested in the Newfoundland-Labrador area between 1904 and 1972, and 109 male sperm whales were taken near Nova Scotia in 1964 to 1972 in a Canadian whaling fishery before whaling moratoriums were implemented (Waring et al. 2015). From 2013 to 2017, 12 sperm whale strandings were documented along the U.S. Atlantic coast (Hayes et al. 2020). Ship strikes are another source of human-caused mortality, and four reported ship strikes occurred along the east coast of the U.S. and Canada from 1994 to 2006 (Hayes et al. 2020). No recent collisions have been reported from 2006 to 2019 (Hayes et al. 2020). For the North Atlantic, the minimum population size has been estimated at 3,451 individuals (Hayes et al. 2020). Sperm whales are likely to occur throughout the Study Area throughout the year.

MMPA Protected Species (Non-ESA-Listed) with Common Occurrence in Study Area

The following MMPA-listed, non-ESA-listed species are known to occur and are commonly observed in the Study Area, thus more detail on their natural history is available. These species are known to commonly occur in both nearshore and offshore waters.

Humpback Whale

The humpback whale was listed as endangered in 1970 due to population decrease resulting from overharvesting; however, this species was delisted as threatened or endangered as of September 8, 2016 (81 Federal Register 62259). In September 2016, NOAA Fisheries revised the ESA listing for the humpback whale to identify 14 Distinct Population Segments based on breeding populations. Under this new final rule, humpback whales along the East Coast of the United States are part of the West Indies Distinct Population

Segment, which is not listed as threatened or endangered (81 Federal Register 62259). While humpback whales are not federally listed in the Study Area, this species is state listed by New York as endangered.

Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Hain et al. 1982; Kenney and Vigness-Raposa 2010). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. This species exhibits consistent fidelity to feeding areas within the northern hemisphere and feeds over the continental shelf in the North Atlantic between New Jersey and Greenland (Stevick et al. 2006). Humpbacks consume roughly 95 percent small schooling fish and 5 percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NOAA Fisheries 1991b).

Humpback whales from all of the North Atlantic migrate to the Caribbean in winter, where calves are born between January and March (Blaylock et al. 1995). In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs (Hayes et al. 2020). Their hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The humpback whale population within the North Atlantic, and more specifically the stock associated with waters surrounding New York, is known as the Gulf of Maine stock, and has been estimated to include approximately 1,396 individuals (Hayes et a. 2020). This stock is part of a larger North Atlantic population estimated to be approximately 11,500 individuals (Waring et al. 2016).

Humpbacks occur in the Study Area in all four seasons, with peak abundance typically found in spring and summer months. They are considered to be increasing in abundance in New York waters (Brown et al. 2018, 2019). While migrating, humpback whales utilize the Mid-Atlantic region (which includes waters of the New York Bight) as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Whitehead and Moore 1982). Since 1989, observations of juvenile humpbacks in the Mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. In 2017, one humpback whale made international news when it breached in front of a camera less than a few miles from Battery Park in New York (The Guardian 2019). Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. Humpback whales are one of the most common species seen in New York Harbor with a slow resurgence of sightings over the last 20 to 30 years, increasing much more rapidly in the last 10 years. The increase in sightings is attributed to two major factors: the cleanup and reduction of water-based pollution in the Harbor, as well as increase in prey fish species for these whales. Foraging, including in large aggregations, is often seen in summer months. Relative abundance by season based on sighting rates peaks in spring (2018) or summer (2019) and is also similarly high in winter. Recent aerial survey data indicate humpback whales are the most commonly seen large whale species in New York waters and confirmed that they occur in all four seasons (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020). Aerial surveys reported humpback whales in the Study Area in the Lease Area 2.5-mi (4-km) buffer and offshore (APEM and Normandeau Associates 2018 and site-specific surveys conducted by Empire, see **Appendix P**). Empire-collected PSO sighting data reported humpback whales in the Lease Area (where the majority of sightings were), as well as within the 2.5-mi (4-km) buffer of the Lease Area, along the submarine export cable siting corridor, and in offshore waters (AOSS 2019; A.I.S. 2019). Whitt et al. (2015) observed humpback whales in New Jersey waters adjacent to the Study Area in all seasons, with the highest number of sightings in winter. Humpbacks were acoustically detected in every month by Estabrook et al. (2019), and from January–June by WHOI (2018). The WCS/WHOI SE buoy had the greatest detection of humpback whales in winter followed by spring with a minimum in the summer and fall (WCS Ocean Giants 2020). **Figure 5.6-6** details the seasonal distribution of the humpback whale within the Study Area.

Humpback whales were hunted as early as the seventeenth century, with most whaling operations having occurred in the nineteenth century (Kenney and Vigness-Raposa 2010). Before whaling activities began, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as little as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International Whaling Commission. Contemporary anthropogenic threats to humpback whales include anthropogenic noise, fishery entanglements, and vessel strikes. Glass et al. (2010) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine population were involved in 77 confirmed entanglements with fishery equipment and nine confirmed ship strikes. Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of whale studied by Glass et al. (2010). A whale mortality and serious injury study conducted by Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. During this study period, humpback whales were involved in 70 reported entanglements and 12 vessel strikes and were the most common species reported dead. This number has increased to 12.15 animals per year between 2013 and 2017(Hayes et al. 2020). In addition to ship strike impacts, humpback whales were confirmed in a recent National Report on Large Whale Entanglements to be among the five most frequently entangled large whale species (NOAA Fisheries 2017b). They are the most frequently reported entangled large whales, representing 68 percent of all confirmed entanglements since 2007 (NOAA Fisheries 2017b). In 2017 alone, there were 49 confirmed entanglements, 23 of which were off of the Northeast Atlantic Coast. Once entangled, they can swim for long distances dragging the attached gear, which can result in fatigue, compromised feeding ability, or severe injury or death. Additionally, impacts associated with entanglements may result indirectly in reduced reproductive success or death. Unusual Mortality Events are documented when there are a larger number of strandings than typical in one or more locations of the same species. There has been a documented UME for humpback whales for the years of 2016 to 2019, with a much larger number of strandings reported compared to prior years. For a variety of reasons, including ship strike, illness, entanglement, and other unknown causes, 17 whales have stranded off the coast of New York during these three years. Off of New Jersey, seven whales stranded during this time (NOAA Fisheries 2019c).

Humpback whales are known to occur and are present annually throughout the waters between the coastline and the continental shelf off of New York. They are expected to occur in Study Area waters with the highest likelihoods in spring and summer.

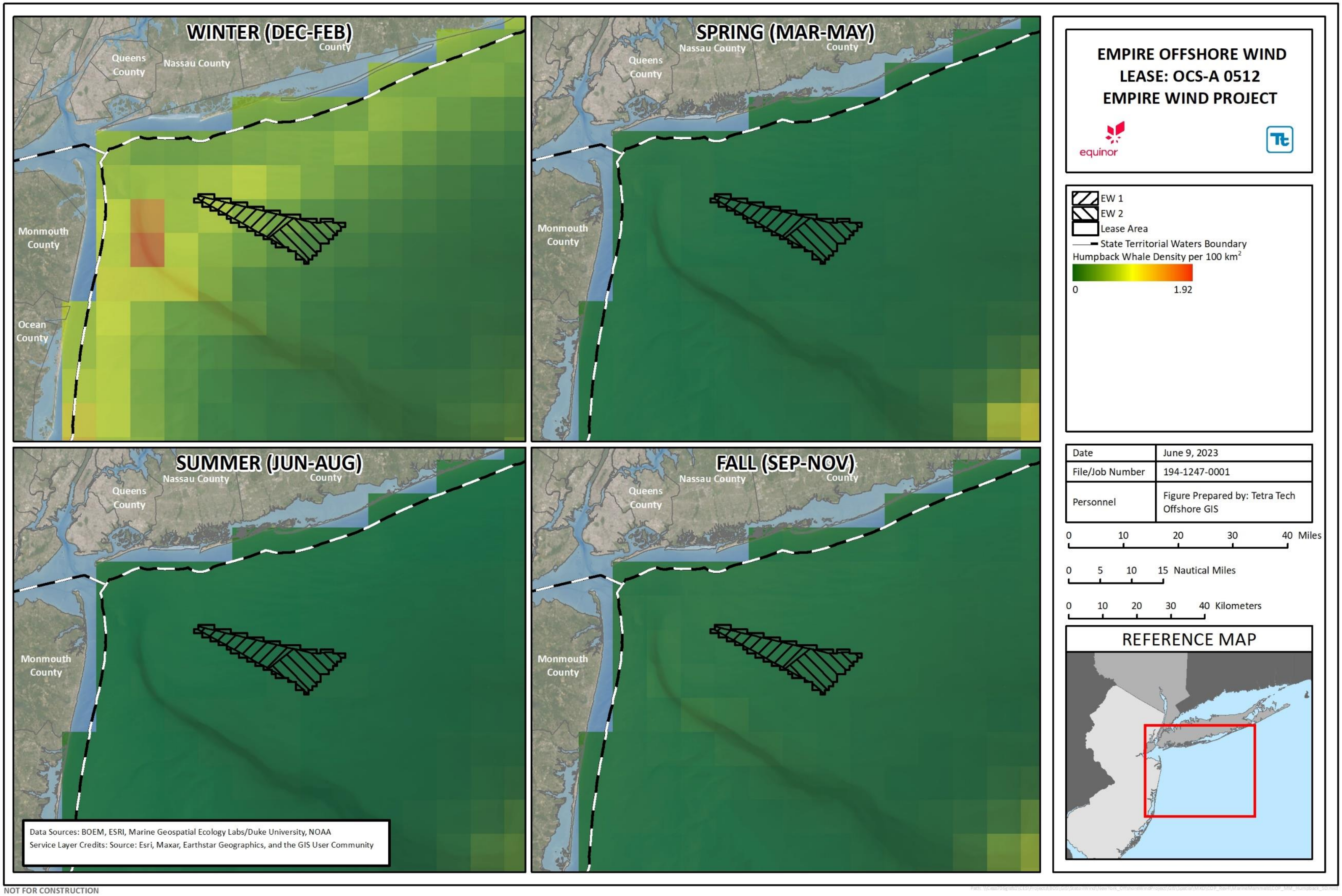

Figure 5.6-6 Seasonal Distribution of the Humpback Whale in the Study Area

Minke Whale (Balaenoptera acutorostrata)

Minke whales are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Common minke whales range between 20 and 30 ft (6 and 9 m), with maximum lengths of 30 to 33 ft (9 to 10 m), and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2010). The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2010). These whales feed below the surface of the water, and calves are usually not seen in adult feeding areas. As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke populations are often segregated by sex, age, or reproductive condition. In the 2015 stock assessment report, the estimate for minke whales in the Canadian East Coast stock was 20,741 (Waring et al. 2015). The population estimate of 20,741 was then substantially decreased to 2,591 individuals because estimates older than eight years were excluded from the newest estimate (Hayes et al. 2019). This downward estimate should not be interpreted as a decline in abundance of this stock, as previous estimates were not directly comparable (Hayes et al. 2020). In the most recent stock assessment report, the population estimate has increased to 24,202 due to the availability of more recent survey data (Hayes et al. 2020). Minke whale hearing is in the low-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Minke whales are sometimes seen in OCS waters off the western Atlantic in winter; however, they are most commonly seen in the fall and are abundant in spring and summer (CETAP 1982; Kenney and Vigness-Raposa 2010). In 2007, a 15-ft (4.6-m) juvenile minke whale made its way up the Gowanus Canal, which was severely polluted at the time. Minke whales have been observed in Study Area waters from aerial and shipboard surveys during all seasons and in 10 out of the 12 months, with the exception of December and October (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020; Whitt et al. 2015). Site-specific aerial surveys and PSO sighting data reported minke whales in the Study Area (**Appendix P**; AOSS 2019), in the Lease Area 2.5-mi (4-km) buffer, and in the offshore area. Empire PSO sighting data specific to the Study Area reported minke whales in the Lease Area (where the majority of sightings were), Lease Area 2.5-mi (4-km) buffer, and offshore area (AOSS 2019; A.I.S. 2019).

Minke whales are impacted by anthropogenic noise, ship strikes, entanglement, and bycatch from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. From 2008 to 2012, the minimum annual rate of reported mortality for the North Atlantic stock from anthropogenic causes was approximately 9.9 per year (Waring et al. 2015). From 2013 to 2017 this decreased to 8.2 per year (Hayes et al. 2020). Outside of U.S. waters, hunting for minke whales continues, by Norwegian whalers in the northeastern North Atlantic and by Japanese whalers in the North Pacific and Antarctic (Reeves et al. 2002). International trade of the species is currently banned. The best recent abundance estimate for this stock is 24,202 (Hayes et al. 2020). Minke whales were confirmed in a recent National Report on Large Whale Entanglements to be among the five most frequently entangled large whale species (NOAA Fisheries 2017b). There was a notable increase in minke whale strandings and entanglements in 2017 and 2018, with numbers higher than in all years ranging from 2007 to 2016 (NOAA Fisheries 2017b; NOAA Fisheries 2018c). Many of these entanglements involved line and pot gear (NOAA Fisheries 2017b). Over the last few years, NOAA Fisheries determined that there is a UME for minke whales along the Atlantic coast between Maine and South Carolina from 2017–present (NOAA Fisheries 2019d). Previous minke whale UMEs occurred in 2003 and 2005 (NOAA Fisheries 2018c).

The minke whale is known to occur and is common in waters of the Study Area year-round, with the highest likelihoods in the fall, spring, and summer. **Figure 5.6-7** details the seasonal distribution of the minke whale within the Study Area.

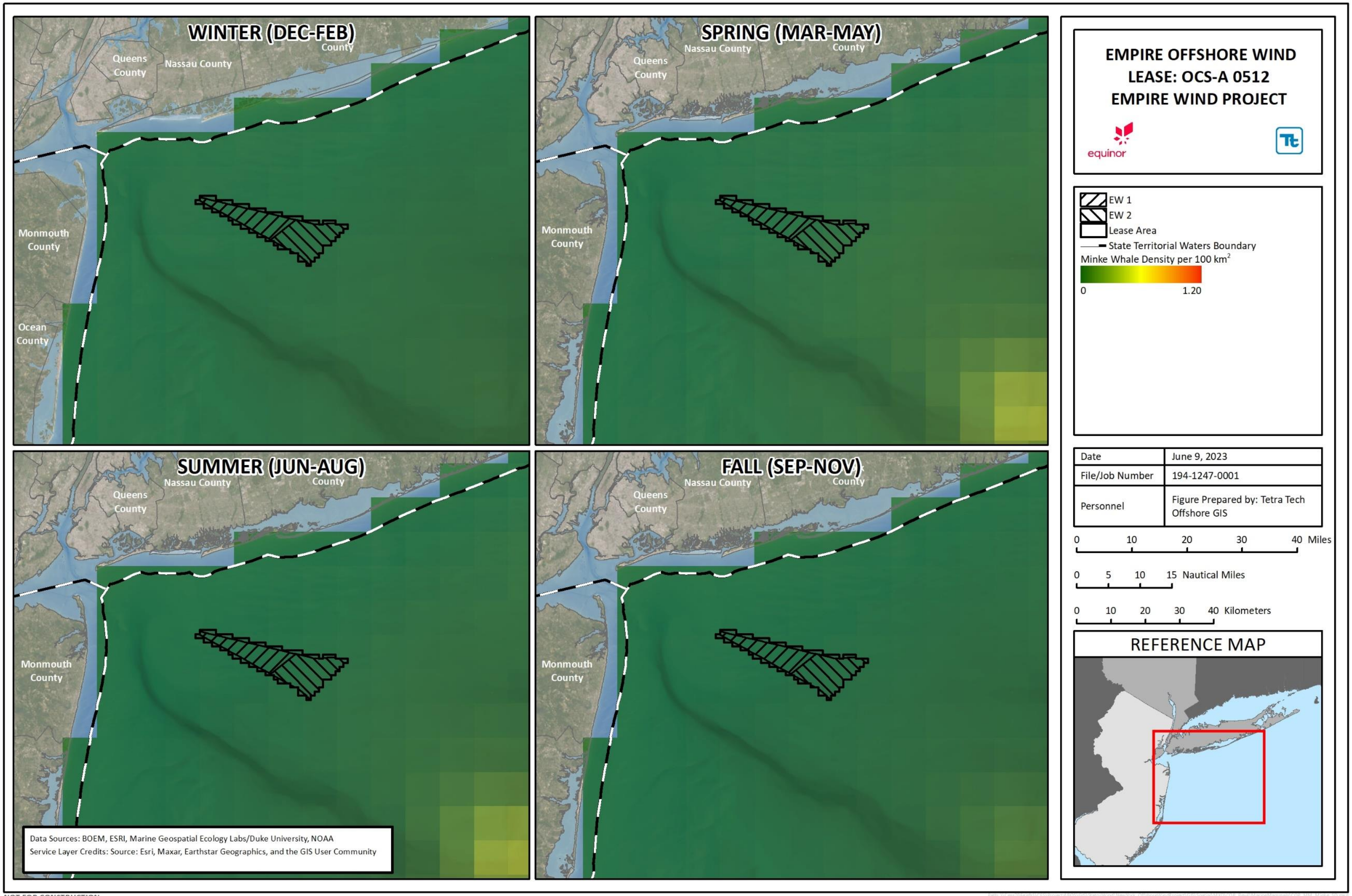

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Figure 5.6-7 Seasonal Distribution of the Minke Whale in the Study Area

Atlantic Spotted Dolphin (Stenella frontalis)

There are two species of spotted dolphin found in the western North Atlantic Ocean: the Atlantic spotted dolphin and the pantropical spotted dolphin (Perrin et al. 1987); only the Atlantic spotted dolphin is expected to occur in the Study Area. In addition, two forms of the Atlantic spotted dolphin exist; one is large, heavily spotted, and usually inhabits the continental shelf, while the other is smaller in size, with less spots, and occurs in the Atlantic Ocean (Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Hayes et al. 2020).

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf, 33 to 650 ft (10 to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a). According to the species stock report, the best population estimate for the Atlantic spotted dolphin is approximately 39,921 individuals (Hayes et al. 2020).

Threats to dolphin species include fisheries interactions, bycatch (accidental or indirect catch), entanglement, ship strikes, anthropogenic noise, chemical pollution, and general habitat deterioration or destruction. The total annual estimated human-caused mortality and serious injury to spotted dolphin was zero; there were no reported deaths from U.S. fisheries observer data (Hayes et al. 2020).

The Atlantic spotted dolphin is known to occur and is common in waters of the Study Area (**Figure 5.6-8**). Empire-collected aerial survey data specific to the Study Area recorded sightings of spotted dolphins in the offshore area; however, there were no PSO sightings (AOSS 2019; A.I.S. 2019). These dolphins are expected to occur in Study Area waters with the highest likelihoods in the fall, spring, and summer.

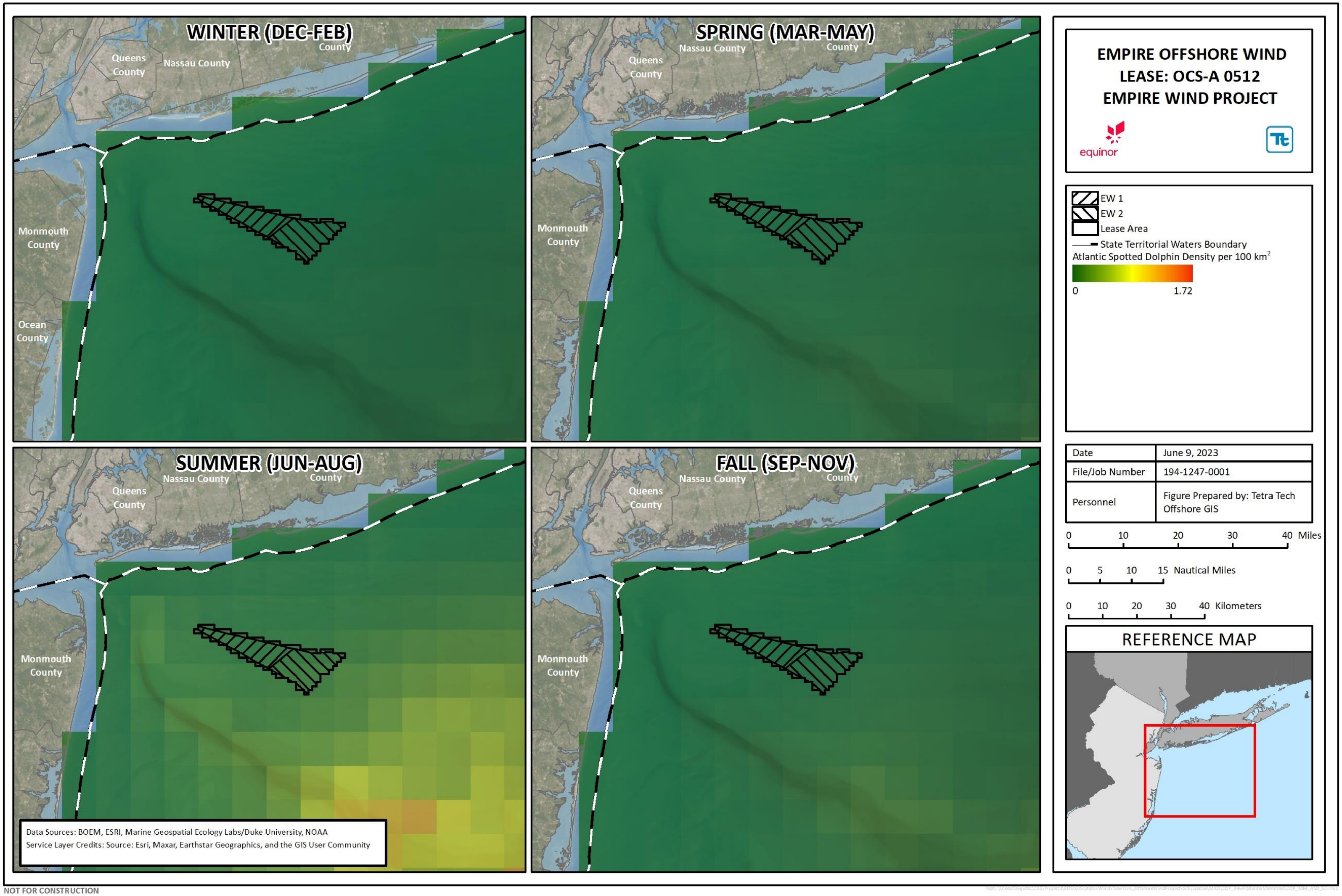

Figure 5.6-8 Seasonal Distribution of the Atlantic Spotted Dolphin in the Study Area

Bottlenose Dolphin (Tursiops truncatus)

The bottlenose dolphin is a light- to slate-gray dolphin, roughly 8 to 12 ft (2.4 to 3.7 m) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F). Its hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

There are two distinct bottlenose dolphin morphotypes: migratory coastal and offshore. The migratory coastal morphotype resides in waters typically less than 65.6 ft (20 m) deep, along the inner continental shelf (within 4.6 mi [7.5 km] of shore), around islands, and is continuously distributed south of Long Island, New York into the Gulf of Mexico. This migratory coastal population is subdivided into seven stocks based largely upon spatial distribution (Hayes et al. 2020). Of these seven coastal stocks, the Western North Atlantic migratory coastal stock is common in the coastal continental shelf waters off the coast of New York (Hayes et al. 2020). These animals often move into or reside in bays, estuaries, the lower reaches of rivers, and coastal waters (Reeves et al. 2002). Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Jefferson et al. 2015). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2002).

Generally, the offshore migratory morphotype is found exclusively seaward of 21 mi (34 km) and in waters deeper than 111.5 ft (34 m). This morphotype is most expected in waters north of New York (Hayes et al. 2020). During the spring and summer months, the offshore population extends along the entire continental shelf-break from Georges Bank to Florida and during the late summer and fall has been observed in the Gulf of Maine. However, the range of the offshore morphotype south of Cape Hatteras has recently been found to overlap with that of the migratory coastal morphotype, sampled as close as 4.5 mi (7.3 km) from the shore in water depths of 42.7 ft (13 m) (Hayes et al. 2020). While bottlenose dolphins have the potential to occur in the Mid-Atlantic waters, most sightings have occurred during summer months and in waters deeper than 131 to 164 ft (40 to 50 m; Kenney 2013). NOAA Fisheries estimates the population of Western North Atlantic offshore bottlenose dolphin stock at approximately 77,532 individuals and the Western North Atlantic migratory coastal stock at approximately 6,639 individuals (Hayes et al. 2020). Recent aerial survey data collected by Empire or NYSERDA reported bottlenose dolphins in the Study Area (APEM and Normandeau Associates 2018 and **Appendix P**) in all areas except for the submarine export cable siting corridor. They were detected from July – December in the Lease Area. Empire collected PSO sighting data specific to the Study Area reported bottlenose dolphin sightings in the Lease Area (the majority of sightings), the Lease Area 2.5-mi (4-km) buffer, nearshore, and offshore areas (AOSS 2019; A.I.S. 2019).

The biggest threat to the population is bycatch because they are frequently caught in fishing gear such as gillnets, purse seines, and shrimp trawls (Hayes et al. 2020). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (Desforges et al. 2016). The total annual human-caused mortality and serious injury for the Northern Migratory Coastal Stock was 28 per year (Hayes et al. 2020).

Bottlenose dolphins are expected to occur year-round in Study Area waters. **Figure 5.6-9** details the seasonal distribution of bottlenose dolphins within the Study Area.

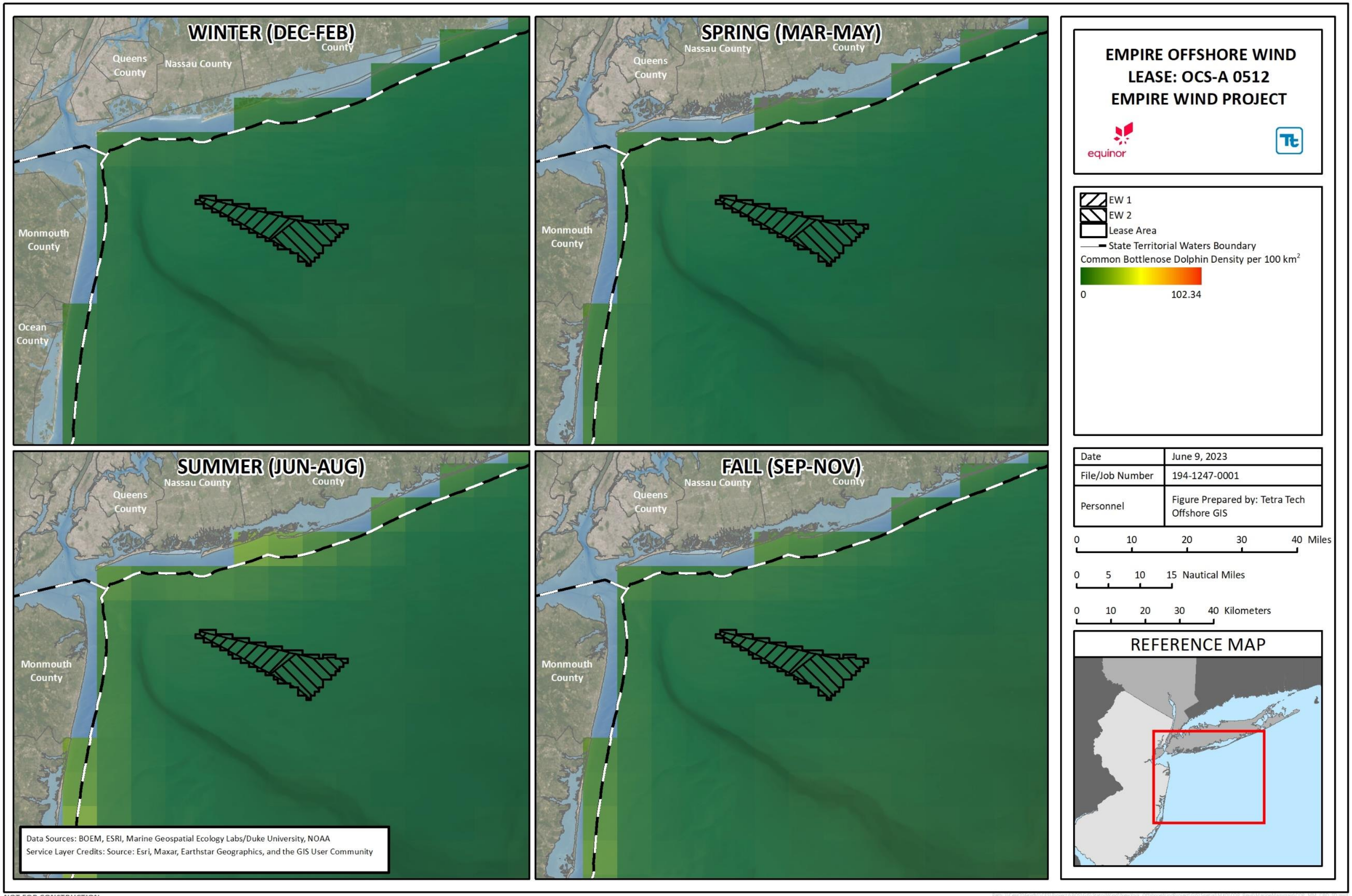

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Figure 5.6-9 Seasonal Distribution of Bottlenose Dolphin in the Study Area

Harbor Porpoise (Phocoena phocoena)

Harbor porpoise are the smallest North Atlantic cetacean, measuring at only 4.6 to 6.2 ft (1.4 to 1.9 m), and feed primarily on pelagic schooling fish, bottom fish, squid, and crustaceans (Reeves and Read 2003; Kenney and Vigness-Raposa 20010). They are likely to occur frequently in Mid-Atlantic waters where they are considered abundant, from fall through spring, reaching their highest densities in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore (Kenney and Vigness-Raposa 2010; DoN 2007; NYSDOS 2013). After April, they migrate north towards the Gulf of Maine and Bay of Fundy.

In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the ESA, as a review of the biological status of the stock indicated that a classification of "Threatened" was not warranted (Waring et al. 2009b). The harbor porpoise is a state-listed species of concern for New York. They are frequently found in shallow, nearshore waters though they sometimes move into deeper offshore waters. In the western Atlantic, they are found from Cape Hatteras north to Greenland. The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 95,833 (Hayes et al. 2020). Its hearing is in the high-frequency range (Southall et al. 2007; NOAA Fisheries 2018a). It has been noted that harbor porpoises display avoidance behavior to sound greater than 140 dB re 1 μPa and tend to avoid vessels at sea (Barlow 1988; Palka and Hammond, 2001; Dyndo et al. 2015).

Sightings have occurred in both the Study Area, including the upper New York Bay, and in the OCS area (Kenney and Vigness-Raposa 2010). In 1995 Okeanos researchers followed a harbor porpoise sighted in the Bay (New York Times 1995). Recent aerial survey data collected by Empire and NYSERDA reported harbor porpoise in the Study Area (APEM and Normandeau Associates 2018; **Appendix P**), in all areas except for the submarine export cable siting corridor. Empire-collected PSO sighting data specific to the Study Area did not sight harbor porpoise (AOSS 2019; A.I.S. 2019).

Harbor porpoise are subject to ship strike, with the most common threat to the harbor porpoise from incidental mortality from fishing activities, especially from bottom-set gillnets (Fenton et al. 2017). It has been demonstrated that the porpoise echolocation system is capable of detecting net fibers, but they either must not have the "system activated" or else they fail to recognize the nets (Reeves et al. 2002). The total annual estimated average human-caused mortality and serious injury to harbor porpoises is 217 per year from U.S. fisheries observer data (Hayes et al. 2020) and strandings have been reported in the Study Area.

Harbor porpoises are expected to occur year-round in Study Area waters. **Figure 5.6-10** details the seasonal distribution of the harbor porpoise within the Study Area.

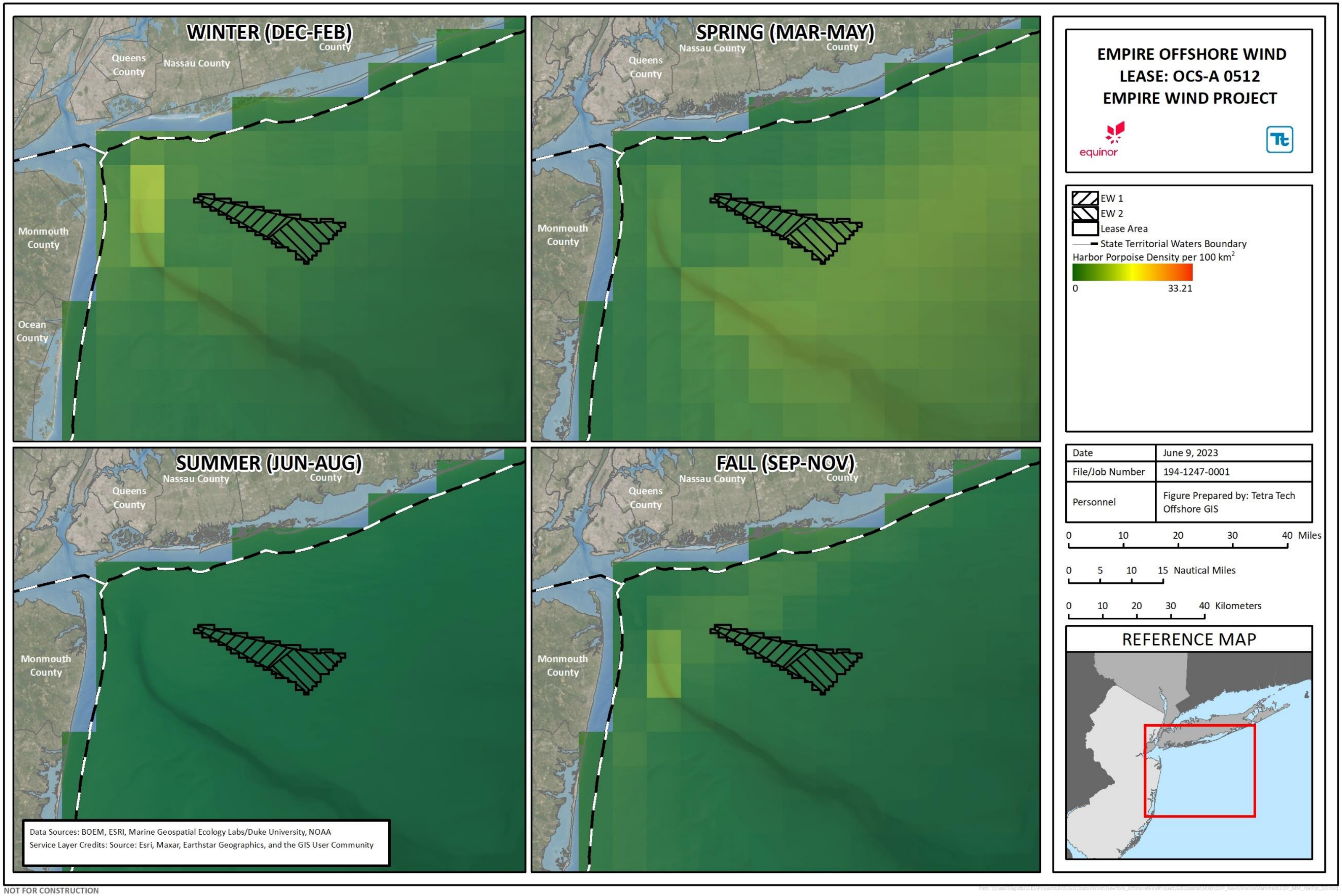

Figure 5.6-10 Seasonal Distribution of the Harbor Porpoise in the Study Area

Harbor Seal (Phoca vitulina)

Harbor seals are the most abundant seals in the waters of the eastern United States and are commonly found in all nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida. Harbor seals occur year-round north of Cape Cod and historically were considered less common south of Cape Cod. However, they are increasingly common southward to the Carolinas (Hayes et al. 2020). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005). Seals are typically most abundant in coastal waters (Ecology and Environment Engineering 2017). Harbor seals are relatively small pinnipeds, with adults ranging between 5.6 and 6.2 ft (1.7 and 1.9 m) in length, with females being slightly smaller than males (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2010). They have an underwater hearing range of 50 Hz to 86 kHz (NOAA Fisheries 2018a).

Harbor seals prey upon small to medium-sized fish, octopus and squid, and sometimes shrimp and crabs (Kenney and Vigness-Raposa 2010). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders (Jefferson et al. 2015). They spend about 85 percent of the day diving, with much of the diving presumed to be active foraging in the water column or on the seabed. They dive to depths of about 30 to 500 ft (10 to 150 m), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes.

Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and fall, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al. 2002). In late fall and winter, harbor seals may be continuously at sea for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al. 2002).

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still legally killed in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). From 2013 to 2017, the average rate of mortality for the Western North Atlantic harbor seal stock from anthropogenic causes was approximately 350 per year (Hayes et al. 2018). Currently, the best abundance estimate for harbor seals is approximately 75,834 for the Western North Atlantic stock (Hayes et al. 2020).

Harbor seals are expected to occur year-round in and around the Study Area, both in the offshore and nearshore waters. This species also has the potential to be found onshore in areas adjacent to the submarine export cable siting corridors and the export cable landfall sites. There are several seal haul out sites in New York. Harbor seals generally predominate in the onshore haul out sites but gray seals intermix and are present as well. In New York, CRESLI (2019) reports 26 haul out sites occur on Long Island with 18,321 harbor seals documented occurring (cumulatively) from surveys completed since 2004. Haul out sites in New York include:

- Cupsogue Beach, approximately 50.3 mi (80.9 km) from the EW 2 Landfall A, 50 mi (80.5 km) from the EW 2 Landfall B, 48.8 mi (78.6 km) from the EW 2 Landfall C, 51.5 mi (82.9 km) from the EW 2 Landfall E, and 37.5 mi (60.3 km) from the Lease Area (CRESLI 2018);

- Swinburne Island, approximately 8 mi (10.1 km) from the EW 1 landfall, 20.5 mi (33 km) from the EW 2 Landfall A, 20.8 mi (33.5 km) from the EW 2 Landfall B, 22.2 mi (35.8 km) from the EW 2 Landfall C, 19.8 mi (32.0 km) from the EW 2 Landfall E, and 27.2 mi (43.8 km) from the Lease Area;
- Little Gull Island, approximately 92.2 mi (148.4 km) from the EW 2 Landfall A, 92 mi (148 km) from the EW 2 Landfall B, 90.4 mi (145.5 km) from the EW 2 Landfall C, 93.2 mi (149.9 km) from the EW 2 Landfall E, and 81.1 mi (130.5 km) from the Lease Area; and
- Jones Beach State Park, approximately 8.0 mi (12.9 km) from the EW 2 Landfall A, 7.7 mi (12.4 km) from the EW 2 Landfall B, 6.4 mi (10.2 km) from the EW 2 Landfall C, 12.3 mi (19.7 km) from the EW 2 Landfall E, and 14.6 mi (23.5 km) from the Lease Area (NYSDEC 2019; Woo and Biolsi 2018; Riverhead Foundation for Marine Research and Preservation 2018; Save Coastal Wildlife Winter Seal Survey 2019).

While there are no known haul out sites directly at or near the proposed export cable landfall sites, it should be noted that harbor seals will occur throughout the New York coastline and have potential to haul out at many beach sites. They may also occur in ports from which Project-associated vessel traffic will move in and out of for transport. Recent aerial survey data collected by Empire and NYSERDA reported harbor seals in the Study Area (APEM and Normandeau Associates 2018; **Appendix P**) in offshore waters. The Empire surveys in the Lease Area found that seals were difficult to identify to a species level; however, for the ones that could be identified, harbor seals were less abundant than gray seals (Ecology and Environment Engineering 2017, **Appendix P**). The vessel-based PSO data reported unidentified pinniped (seal) sightings in the submarine export cable siting corridor, which they could not confirm to a specific species, however a harbor seal was observed by PSOs in the Lease Area (AOSS 2019; A.I.S. 2019). **Figure 5.6-11** details the seasonal distribution of harbor and gray seals within the Study Area.

Gray Seal (Halichoerus grypus)

Gray seals occur in cold temperate to sub-arctic waters in the North Atlantic and are partitioned into three major populations occurring in eastern Canada, northwestern Europe, and the Baltic Sea (Jefferson et al. 2015; Kenney and Vigness-Raposa 2010). The western North Atlantic stock is considered to be the same population as the one found in eastern Canada, and ranges between Mid-Atlantic waters and Labrador (Hayes et al. 2020). As exhibited in harbor seal populations, gray seals occur most often in the waters off Maine during winter and spring and spend summer and fall off northern Maine and in Canadian waters (Hayes et al. 2020). Gray seals exhibit sexual dimorphism, with adult males reaching 7.5 ft (2.3 m) long and females reaching 6.6 ft (2.0 m) (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2010). The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2001). These seals are typically most abundant in coastal waters (Ecology and Environment Engineering 2017).

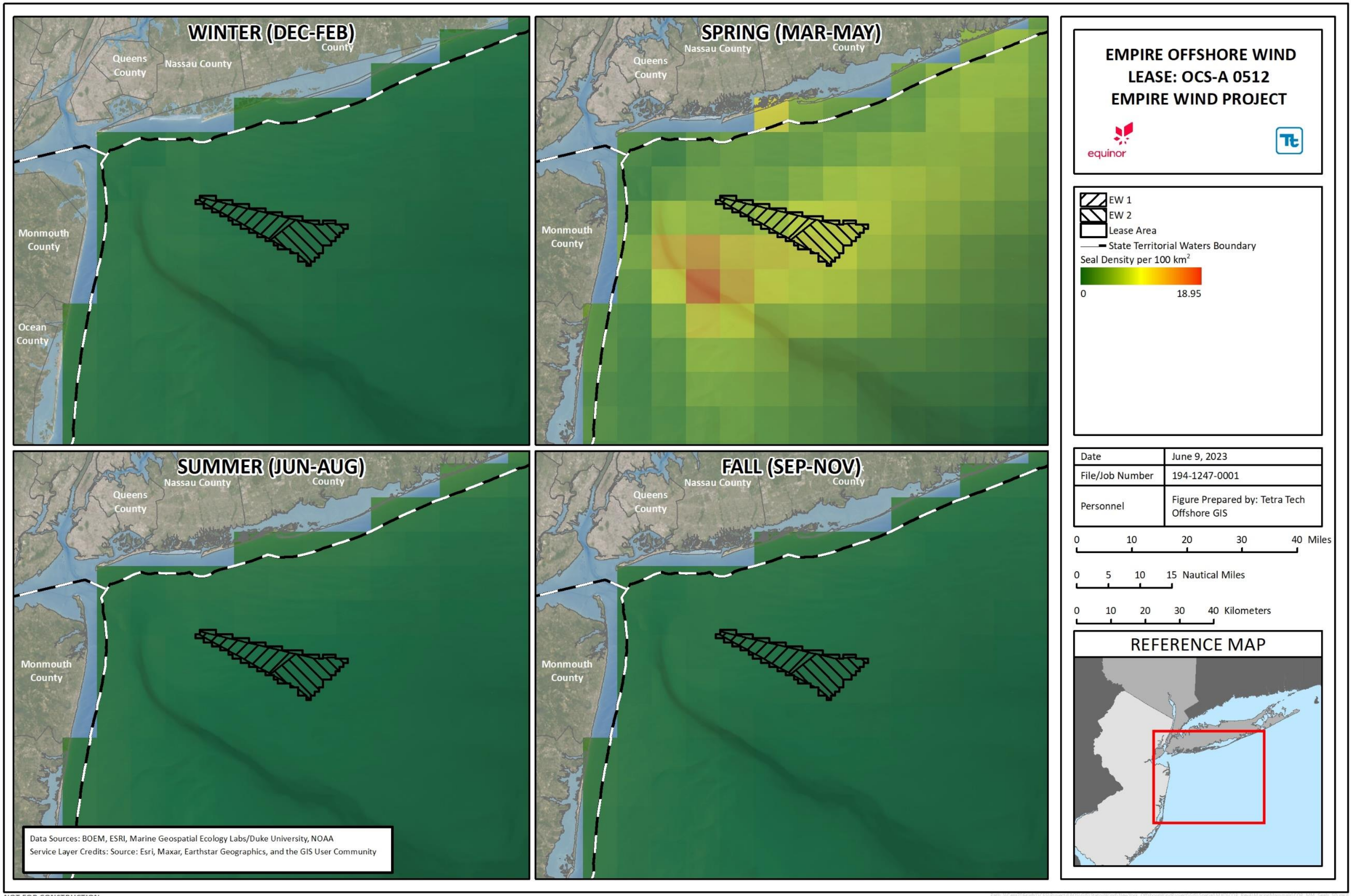

Figure 5.6-11 Seasonal Distribution of Harbor and Gray Seals in the Study Area

Gray seals are gregarious, gathering to breed, molt, and rest in groups of several hundred or more at island coasts and beaches or on land-fast ice and pack-ice floes. They are thought to be solitary when feeding and telemetry data indicates that some seals may forage seasonally in waters close to colonies, while others may migrate long distances from their breeding areas to feed in pelagic waters between the breeding and molting seasons (Reeves et al. 2002). Gray seals molt in late spring or early summer and may spend several weeks ashore during this time. When feeding, most seals remain within 45 mi (72 km) of their haul out sites, feeding on numerous fish species and cephalopods (Kenney and Vigness-Raposa 20010). Gray seal scat samples from Muskeget Island, Massachusetts, included species such as sand lance, skates, flounder, silver hake, and gadids (Kenney and Vigness-Raposa 20010).

Gray seals form colonies on rocky island or mainland beaches, though some seals give birth in sea caves or on sea ice in areas where no rocky shores are available. Gray seals prefer haul out and breeding sites that are surrounded by rough seas and riptides. There are no pupping colonies or known haul out sites in the Study Area. The nearest known pupping sites are greater than 250 nm (463 km) away, at Muskeget Island (Nantucket Sound), Monomoy National Wildlife Refuge, and in eastern Maine (Rough 1995). Similarly, the only known and consistently used haul out locations are along the sandy shoals located closer to Monomoy Refuge and on Nantucket, both in Massachusetts (Kenney and Vigness-Raposa 2010). The total western Atlantic gray seal population estimates is 27,131 (Hayes et al. 2020). This species has been reported with greater frequency in waters south of Cape Cod in recent years, likely due to a population rebound in the Mid-Atlantic, however, most gray seals present are juveniles dispersing in the spring (Kenney and Vigness-Raposa 2010).

The biggest threats to gray seals are entanglements in gillnets or plastic debris (Hayes et al. 2020). From 2013 to 2017, the average annual estimated human-caused mortality and serious injury to gray seals in the U.S. and Canada was approximately 5,410 per year, which includes the removal of nuisance animals in Canada (Hayes et al. 2020).

Gray seals are expected to occur year-round in the Study Area, both in the offshore and nearshore waters. This species also has the potential to be found onshore in areas adjacent to the submarine export cable siting corridors and the export cable landfall sites. Gray seals are seen less often in the coastal waters of the submarine export cable siting corridors, with harbor seals being the most prevalent inshore (Riverhead Foundation for Marine Research and Preservation 2018), although there are seal haul out sites with reported gray seals at:

- Swinburne Island in New York, approximately 6.8 mi (10.1 km) from the EW 1 landfall, 20.5 mi (33 km) from the EW 2 Landfall A, 20.8 mi (33.5 km) from the EW 2 Landfall B, 21.8 mi (35.1 km) from the EW 2 Landfall C, 19.8 mi (32.0 km) from the EW 2 Landfall E, and 27.2 mi (43.8 km) from the Lease Area.

Recent aerial survey data found that seals were difficult to identify to a species level; however, for the ones that could be identified, gray seals were more abundant than harbor seals (APEM and Normandeau Associates 2018). Gray seals were documented in the Lease Area, nearshore, and offshore. PSO-based shipboard visual surveys detected gray seals during their May to July survey (AOSS 2019) and had other unidentified pinniped species sightings in the submarine export cable siting corridor (AOSS 2019; A.I.S. 2019). Additional confirmed gray seals were sighted in the nearshore, Lease Area, and submarine export cable siting corridor. There are a number of haul out beaches throughout the Long Island shoreline as noted in the harbor seal review, thus gray seals may also be found in the nearshore waters and shoreline beaches near the export cable landfall sites on Long Island. There is little documented information for haul out sites for or sightings of gray seals near the EW 1 landfall. They may also occur in ports from which Project-associated vessel traffic will move in and out of for transport. **Figure 5.6-11** details the seasonal distribution of harbor and gray seals within the Study Area.

Atlantic White-Sided Dolphin (Lagenorhynchus actus)

While the range of the Atlantic white-sided dolphin includes waters surrounding the Study Area, they are typically found in water depths of 330 ft (100 m) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Reeves et al. 2002; Jefferson et al. 2015). They are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence, but seem relatively rare along the North Atlantic coast of Nova Scotia (Kenney and Vigness-Raposa 2010).

Atlantic white-sided dolphins range between 8.2 and 9.2 ft (2.5 m and 2.8 m) in length, with females being approximately 7.9 in (20 cm) shorter than males (Kenney and Vigness-Raposa 2010). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a). This species is highly social and is commonly seen feeding with larger whales. White-sided dolphins feed on a variety of small species, such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Kenney and Vigness-Raposa 2010). Sand lance is an important prey species for these dolphins in the Gulf of Maine during the spring. Other fish prey include mackerel, silver hake, herring, smelt, and several other varieties of gadoids (Kenney and Vigness-Raposa 2010). There are seasonal shifts in the distribution of Atlantic white-sided dolphins off the northeastern U.S. Coast, with low abundance in winter between Georges Basin and Jeffrey's Ledge and very high abundance in the Gulf of Maine during spring. Atlantic white-sided dolphins are most abundant during the summer. During the fall, the distribution of Atlantic white-sided dolphins is similar to that in the summer, although they are less abundant (Hayes et al. 2020). Recent population estimates for Atlantic white-sided dolphins in the Western North Atlantic Ocean places this species at 93,233 individuals (Hayes et al. 2020).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An estimated average of 328 dolphins each year were killed by fishery-related activities from 2003 to 2007 (Waring et al. 2010). From 2013 through 2017, the total annual average fishery-related mortality or serious injury to this stock was 26 individuals (Hayes et al. 2020).

There were no sightings of this species in any of the Empire aerial or vessel-based surveys nor in the NYSERDA surveys (APEM and Normandeau Associates 2018; AOSS 2019; A.I.S. 2019; **Appendix P**). This species may be found in waters of the North and Mid-Atlantic during all seasons of the year, but is typically more frequently sighted in areas farther offshore at depth range of 330 ft (100 m; Kenney and Vigness-Raposa 2010; Reeves et al. 2002); therefore, it is unlikely that this species will be found consistently in the Study Area (i.e., less likely in the Lease Area and nearshore within the extent of the submarine export cable siting corridor). **Figure 5.6-12** details the seasonal distribution of the Atlantic white-sided dolphin the Study Area.

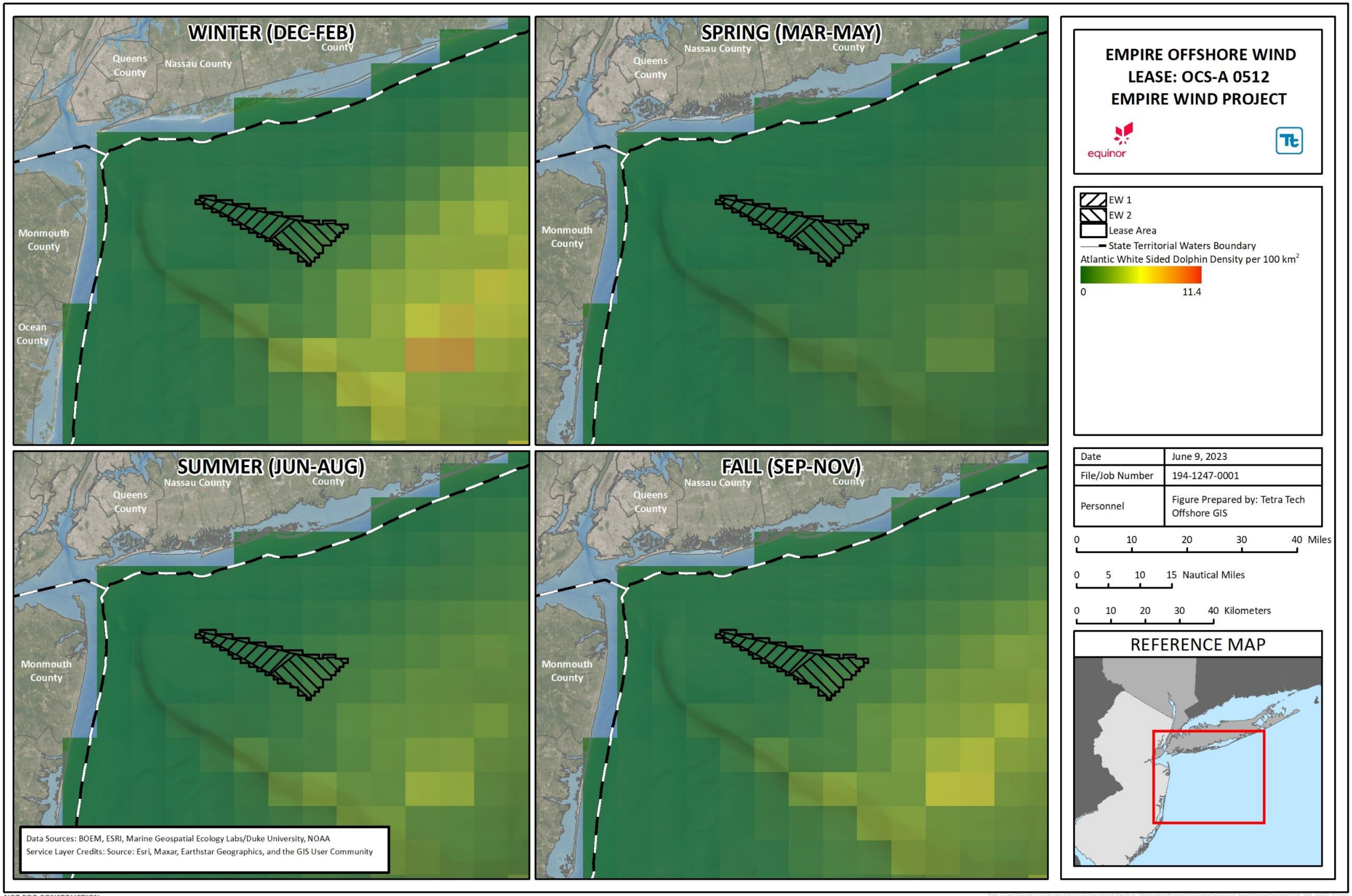

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Figure 5.6-12 Seasonal Distribution of the Atlantic White-Sided Dolphin in the Study Area

Common Dolphin (Delphinus delphis)
The common dolphin is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2015). Historically, the short beaked and long beaked common dolphin were considered one species. In 1994 they were separated into two species (short- and long-beaked); however, advances in taxonomic studies suggest the initial classification was correct and the common dolphin is one species that shows considerable variation throughout its large range. Common dolphins feed on squids and small fish, including species that school in proximity to surface waters, as well as mesopelagic species found near the surface at night (Jefferson et al. 2015). This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Hayes et al. 2020). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). While this dolphin species can occupy a variety of habitats, they occur in greatest abundance within a broad band of the northeast edge of Georges Bank in the fall (Kenney and Vigness-Raposa 20010). According to the species stock report, the best population estimate for the Western North Atlantic Stock, relevant to the Study Area, is approximately 172,825 individuals (Hayes et al. 2020).

Common dolphins can be found either along the 650- to 6,500-ft (200- to 2,000-m) isobaths over the continental shelf, or in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. The common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north and usually inhabit tropical, subtropical, and warm-temperate waters (Hayes et al. 2020). Recent aerial survey data collected by Empire and NYSERDA reported common dolphin in the Study Area (**Appendix P**; APEM and Normandeau Associates 2018) including in the Lease Area, Lease Area 2.5-mi (4-km) buffer, and offshore, with the vast number of sightings occurring in the Lease Area. Empire -collected PSO sighting data specific to the Study Area found common dolphins in the Lease Area (the majority of sightings), Lease Area 2.5-mi (4-km) buffer, and the submarine export cable siting corridors (AOSS 2019; A.I.S. 2019).

The common dolphin worldwide population is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. From 2008 to 2012, it was estimated that on average approximately 289 total dolphins were killed each year by human activities (Waring et al. 2015). This number increased to 419 dolphins from 2013 to 2017 (Hayes et al. 2020). This species is commonly seen stranded (Kenney and Vigness-Raposa 2010). AOSS visual surveys reported sightings of common dolphins in waters near the Lease Area in their May to July, July to September, and September to December surveys (AOSS 2019).

Common dolphins are expected to occur year-round in Study Area waters. This species may be found in waters of the North and Mid-Atlantic during all seasons of the year. **Figure 5.6-13** details the seasonal distribution of common dolphins within the Study Area.

Long-Finned (Globicephala melas) and Short-Finned (Globicephala macrorhynchus) Pilot Whale
Pilot whales are mid-sized odontocetes with sizes ranging up to 19 ft (5.7 m) for females and 22 ft (6.7 m) for the larger males. The two species of pilot whales in the western Atlantic, the long-finned pilot whales and short-finned pilot whales, are difficult to differentiate. Therefore, both species are presented together since much of the data is generalized for *Globicephala* species. The species considered most likely to occur in the Study Area is the long-finned (Hayes et al. 2019); the short-finned pilot whales could occur this far north, they are known from stranding records, but are uncommon in the Study Area.

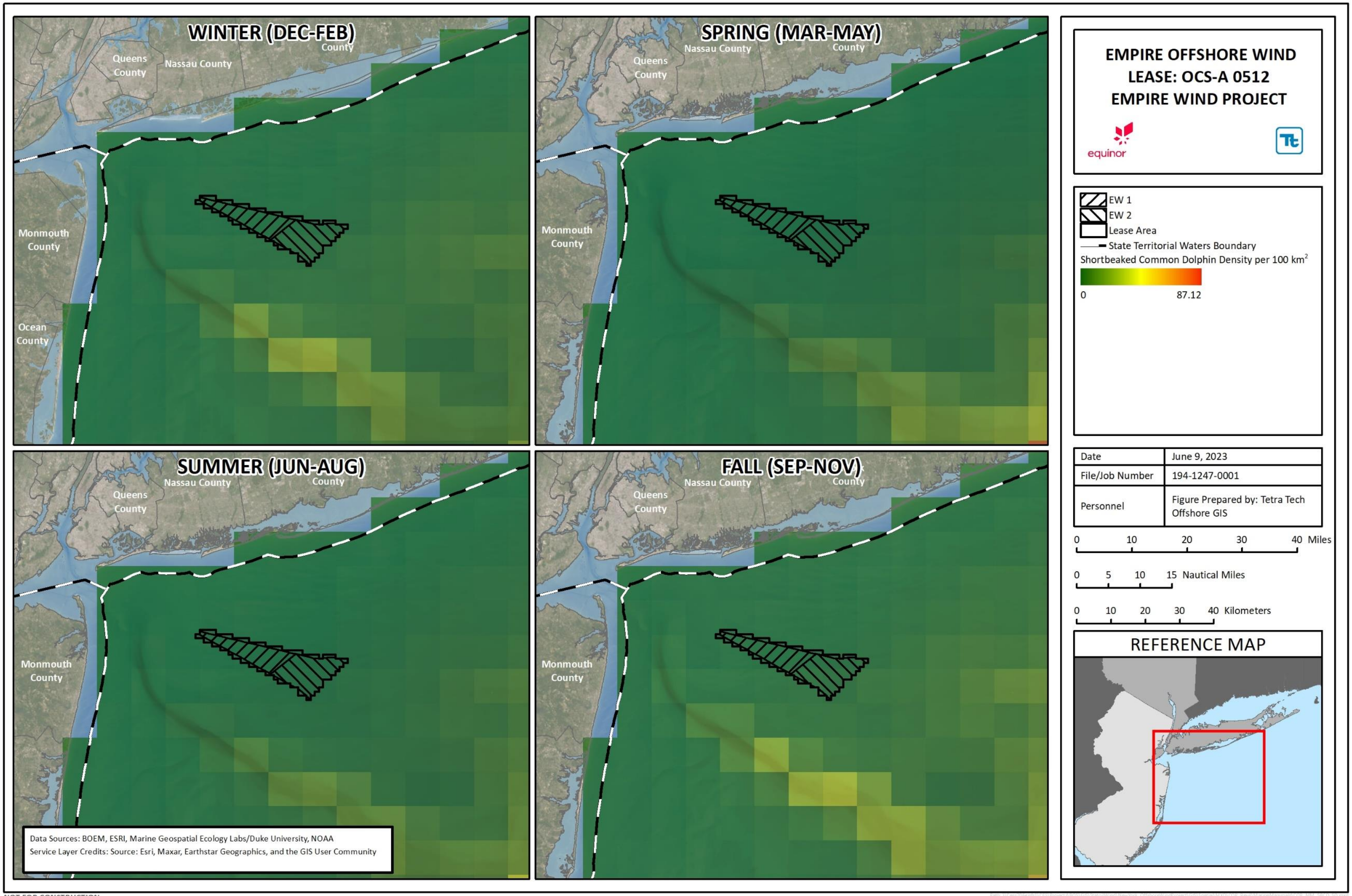

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Figure 5.6-13 Seasonal Distribution of the Common Dolphin in the Study Area

Pilot whales feed preferentially on squid but will eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. They also ingest shrimp (particularly younger whales) and various other fish species occasionally. These whales probably take most of their prey at depths of 600 to 1,650 ft (200 to 500 m), although they can forage deeper if necessary (Reeves et al. 2002). Both species of pilot whale are more generally found along the edge of the continental shelf (a depth of 330 to 3,300 ft [100 to 1,000 m]), choosing areas of high relief or submerged banks. Long-finned pilot whales are pelagic, occurring in especially high densities in winter and spring over the continental slope, then moving inshore and onto the shelf in summer and fall to follow squid and mackerel populations (Reeves et al. 2002). They frequently travel into the central and northern Georges Bank, Great South Channel, and Gulf of Maine areas during the summer and early fall (May to October; Hayes et al. 2020). The best population estimate for long-finned pilot whales is 39,215 individuals and for short-finned, 28,924 (Hayes et al. 2020). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Pilot whales are subject to bycatch in gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. The total observed average annual fishery-related mortality and serious injury from 2013 through 2017 was 21 long-finned pilot whales and 160 for short-finned pilot whales (Hayes et al. 2020). Strandings involving hundreds of individuals are not unusual and demonstrate that these large pods have a high degree of social cohesion (Reeves et al. 2002).

This species may be found in waters of the North and Mid-Atlantic during all seasons of the year but are typically more frequently sighted in areas further offshore, past continental shelf waters. Recent aerial survey data collected by Empire and NYSERDA reported pilot whales in the Study Area (**Appendix P**; APEM and Normandeau Associates 2018) in offshore waters. Empire-collected PSO sighting data specific to the Study Area did not sight pilot whales (AOSS 2019; A.I.S. 2019). **Figure 5.6-14** details the annual distribution of the long-finned pilot whale within the Study Area (seasonal data was not available).

Risso's Dolphin (Grampus griseua)

Risso's dolphins range in size from 8.5 to 13 ft (2.5 to 4 m) and are typically an offshore dolphin; this species is considered uncommon in waters nearer to the coast (near shore; Reeves et al. 2002). Risso's dolphins are usually seen in mid-sized groups with roughly 10 to 40 individuals, although groups of 100 to 200 or even several thousand can occur. Cephalopods and crustaceans are the primary prey for the Risso's dolphins, which feed mainly at night.

Risso's dolphins are commonly found in the deeper waters of the U.S. East Coast continental shelf edge and oceanic waters ranging from Cape Hatteras to Georges Bank, mainly during spring, summer, and fall (Hayes et al. 2020). There is currently no information on stock structure of this species for western North Atlantic, therefore, it is not possible to determine if separate stocks exist in the Gulf of Mexico and Atlantic (Hayes et al. 2020). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a). The best estimate of abundance for the stock of Risso's dolphins is 35,493 animals (Hayes et al. 2020). There are insufficient data to determine the population trend for this stock.

Risso's dolphins have been subject to bycatch during squid and mackerel trawl activities, pelagic drift gillnet activities, pelagic pair trawl fishery, and Mid-Atlantic gillnet fishery (Hayes et al. 2020). Total annual estimated average fishery-related mortality or serious injury to this stock during 2013 to 2017 was 54.3 Risso's dolphins (Hayes et al. 2020). Risso's dolphin strandings have also been observed, and between 2013 and 2017, 38 strandings were recorded along the U.S. Atlantic Coast.

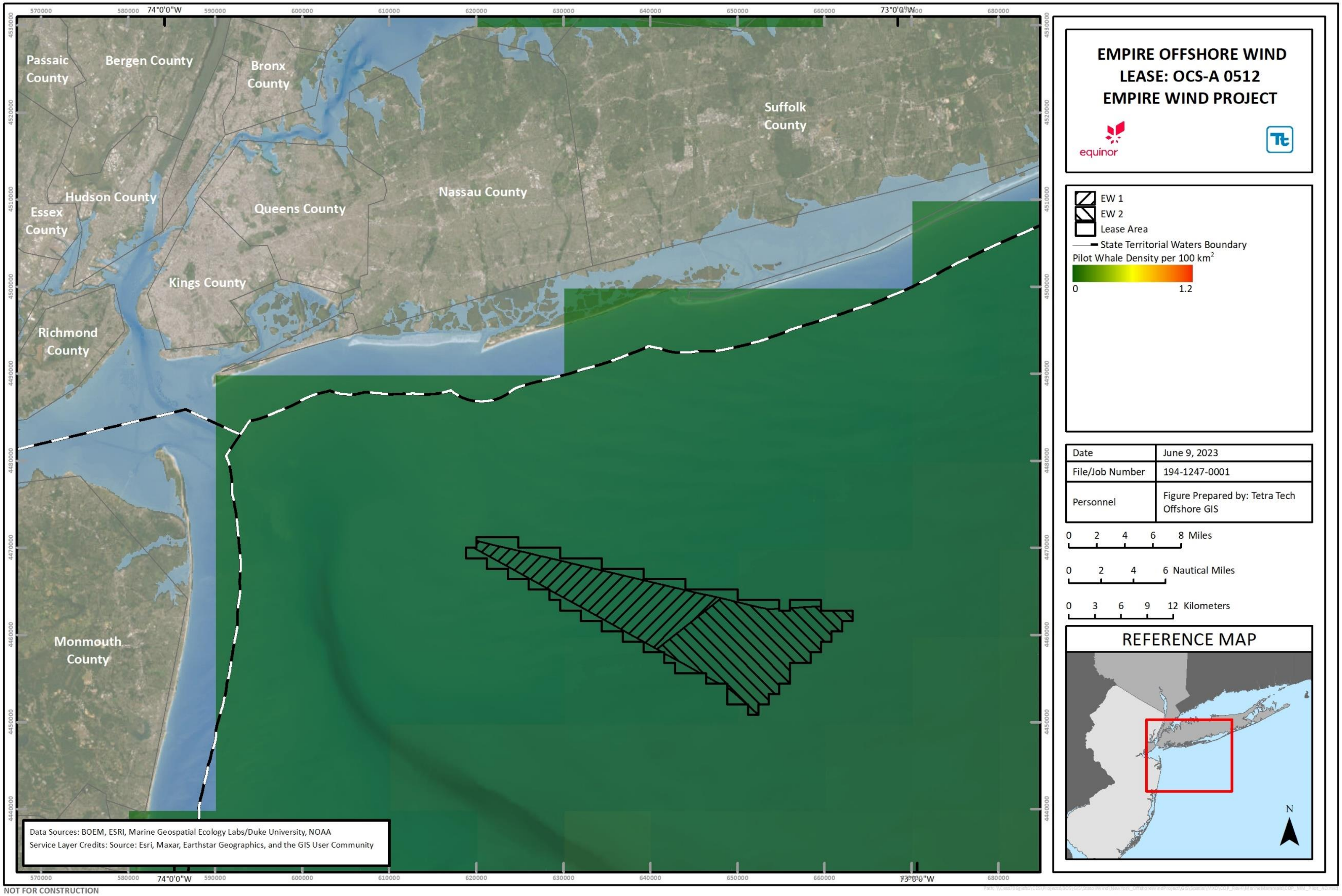

Figure 5.6-14 Annual Distribution of the Long-Finned Pilot Whale in the Study Area

This species may be found in waters of the North and Mid-Atlantic during all seasons of the year but are typically more frequently sighted in areas further offshore, past continental shelf waters. Recent aerial survey data collected by Empire and NYSERDA reported Risso's dolphins in the Study Area (**Appendix P**; APEM and Normandeau Associates 2018) in offshore waters. Empire-collected PSO sighting data specific to the Study Area did not sight Risso's dolphins (AOSS 2019; A.I.S. 2019). **Figure 5.6-15** details the seasonal distribution of the Risso's dolphin within the Study Area.

MMPA Protected Species (Non-ESA Listed) with Uncommon Occurrence in Study Area

The following MMPA protected species are known to be common in North and Mid-Atlantic waters off the coast of the northeastern states of the U.S. However, as noted, these species are more commonly sighted in deeper waters than the depth profile of the Lease Area and the larger Study Area (including the submarine export cable siting corridors). While it is less probable that these species will be found consistently in the Lease Area due to this habitat preference, reference is made to these species herein as they still have potential to be found in waters in or surrounding the Study Area through various seasonal behaviors such as migration, feeding, and breeding.

Beaked Whales (Mesoplodon or Ziphius spp.)

Four beaked whales of the Mesoplodon genus reside in the western North Atlantic. These include the Blainville's beaked whale (*Mesoplodon densirostris*), Gervais' beaked whale (*Mesoplodon europaeus*), Sowerby's beaked whale (*Mesoplodon bidens*), and True's beaked whale (*Mesoplodon mirus*). Of these four species, the Blainville's beaked whale, Sowerby's beaked whale, and True's beaked whale are common. In addition to the beaked species of the Mesoplodon genus, the Cuvier's beaked whale (*Ziphius cavirostris*) resides in the western North Atlantic.

Beaked whales are cryptic species, which means they are difficult to detect visually, mainly due to the length of time spent underwater. Many species of beaked whales are difficult to identify and distinguish at sea because they lack easily discernible physical characteristics. Therefore, much of the available characterization for beaked whales is only at the genus level. There is relatively little information about most individual species, and each stock could potentially contain multiple demographically independent populations (Longhurst 1998; Spalding et al. 2007). Their hearing is in the mid-frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

Sightings of these species are almost exclusively in the continental shelf edge and continental slope areas. The best abundance estimate for Mesoplodon spp. beaked whales are approximately 10,107 individuals, while the estimate for Cuvier's beaked whales is 5,744 individuals (Hayes et al. 2020). There were no sightings of this species in any of the Empire aerial or vessel-based surveys, nor in the NYSERDA surveys (APEM and Normandeau Associates 2018; AOSS 2019; A.I.S. 2019; **Appendix P**). In addition, seasonal distribution data was not available (therefore, a figure is not provided).

Threats to these species include entanglement in fishing gear, ingestion of marine debris, and ocean noise. Unidentified beaked whales (which may include Blainville's beaked whales) have been entangled or captured in the pelagic drift gillnet fishery off the U.S. Atlantic Coast.

Various species of beaked whales are known to occur throughout waters associated with the Study Area and therefore have potential to occur year-round. These species may be found in waters of the North and Mid-Atlantic during all seasons of the year but are typically more frequently sighted in deeper areas farther offshore, past the continental shelf waters, therefore it is unlikely that beaked whale species will be found consistently in the Study Area (i.e., less likely in the Lease Area and nearshore within the extent of the submarine export cable siting corridors).

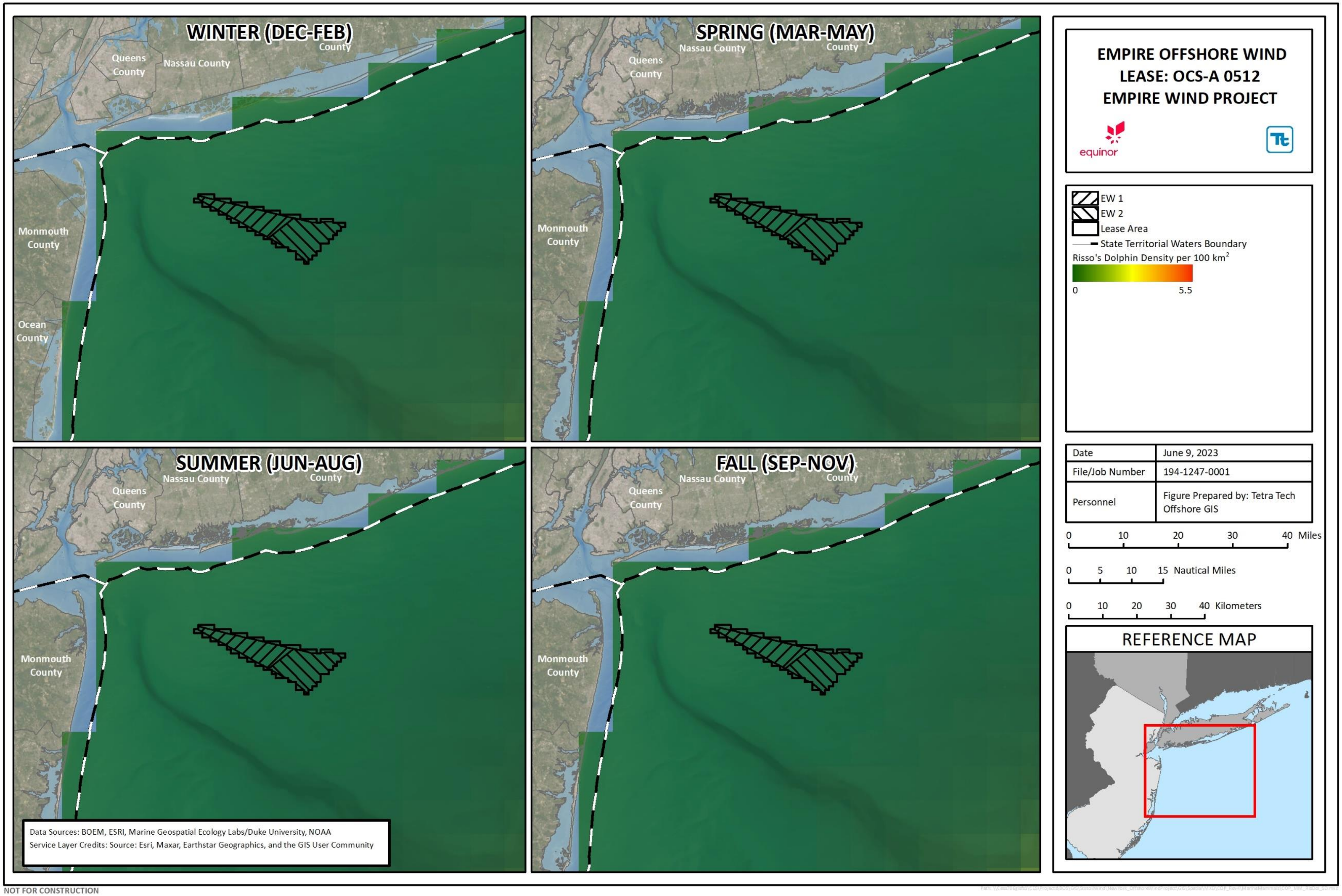

Figure 5.6-15 Seasonal Distribution of the Risso's Dolphin in the Study Area

Striped Dolphin (Stenelle coeruleoalba)

Striped dolphins have a worldwide distribution and can be found in warm-temperate to tropical waters. In the western North Atlantic, they can be found from Nova Scotia south to Jamaica and in the Gulf of Mexico. They are the second most abundant cetacean off the coast of the western North Atlantic; however, their sightings are almost exclusively along the continental shelf edge from Cape Hatteras to Georges Bank. They are also mostly observed in very deep waters of about the 3,281-ft (1,000-m) depth contour (Kenney and Vigness-Raposa 2010; Hayes et al. 2020).

The best abundance estimate for striped dolphins in the western North Atlantic is 67,036, with a minimum population estimate of 52,939 (Hayes et al. 2020). No current population trend is available for this species because of insufficient data.

Striped dolphins are known to occur in waters near the Study Area, however they are typically found further offshore in continental slope waters offshore to the Gulf Stream. Recent aerial survey data collected by Empire and NYSERDA reported striped dolphins in the Study Area (**Appendix P**; APEM and Normandeau Associates 2018) in offshore waters. Empire-collected PSO sighting data specific to the Study Area did not sight striped dolphins (AOSS 2019; A.I.S. 2019). It is considered unlikely that this species will be consistently found in the Lease Area since the waters of the Lease Area are shallower (approximately 65.6 to 131 ft [20 to 40 m] water depth).

5.6.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario, taken from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For marine mammals, the maximum design scenarios for a full Lease Area build-out are described in **Table 5.6-7**. The maximum design scenario for assessments associated with full build-out of EW 1 and EW 2 and incorporates a total of up to 149 structures at up to 176 locations within the Lease Area (made up of up to 147 wind turbines and 2 offshore substations) with 2 distinct submarine export cable routes to EW 1 and EW 2. Two wind turbine foundation types were also considered for benthic impacts: monopiles for the wind turbine foundations and piled jackets for the offshore substation foundations (see **Section 3** for descriptions). Calculations supporting the maximum design scenario are shown in **Table 5.6-8** through **Table 5.6-11**.

Table 5.6-7 Summary of Maximum Design Scenario Parameters for Marine Mammals

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum number of structures for EW 1 and EW 2.
Wind turbine foundation	Monopile	Representative of foundation option that has an installation method that would result in the maximum introduction of underwater noise.

Table 5.6-7 Summary of Maximum Design Scenario Parameters for Marine Mammals (continued)

Parameter	Maximum Design Scenario	Rationale
Wind turbine foundation Installation method Underwater Noise	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Duration Foundation installation	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the longest period of foundation installation via pile driving.
Underwater noise Pile driving – Monopile	Pile diameter: 36 ft (11 m) Max penetration: 180 ft (55 m) Max hammer energy: 5,500 kJ Typical hammer energy: 2,300 kJTotal average pile driving duration per foundation: 3 hours 30 minutes Total duration: 441 hours EW 1: 171.5 hours EW 2: 270.5 hours	The longest temporal duration of impact for monopiles, which equates to the maximum number of pile-driving events.
Underwater noise Pile driving – piled offshore substations (EW 1 and EW 2)	Pile diameter: 8 ft (2.5 m) Max penetration: 295 ft (90 m) Number of piles per foundation: 12 Max hammer energy: 4,000 kJ Typical hammer energy: 3,200 kJ Total max pile driving duration: 3 hours 30 minutes Total number of piles for: EW 1: 12 EW 2: 12 Total duration of pile driving: EW 1: 42 hours EW 2: 42 hours	The longest temporal duration of impact for piled jackets for offshore substations, which would result in the maximum of two offshore substations. 84 hours is considered the maximum amount of time required to pile all pile driven jackets for offshore substations (active pile driving; for EW 1 and EW 2).
Project-related vessels Collision risk Underwater noise	Based on full build-out of EW 1 and EW 2, including foundations (147 wind turbines and 2 offshore substations), submarine export and interarray cables, and associated vessels. EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum predicted Project-related vessels for collision risk and underwater vessel noise.
Operations and Maintenance		
Wind turbines Underwater noise	Based on full build-out of EW 1 and EW 2, which represent the maximum number of machines (147).	Representative of the maximum underwater noise generated by operational wind turbines.

Table 5.6-7 Summary of Maximum Design Scenario Parameters for Marine Mammals (continued)

Parameter	Maximum Design Scenario	Rationale
Project-related vessels Collision risk Underwater noise	Based on a full build-out of EW 1 and EW 2 (147 wind turbines, 2 offshore substations, submarine export cable routes, and associated interarray cables). Based on maximum number of vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels for collision risk and underwater noise.
Loss of habitat Foundation type	Based on the maximum overall footprint (147 x 39,902 ft^2 [3,707 m^2] for monopiles with scour protection and 2 x 93,560 ft^2 [8,692 m^2] for piled jackets with scour protection). Total 6,052,714 ft^2 (562,315 m^2, 139 acres, 56.2 ha) including scour protection.	Representative of the maximum long-term loss of seabed habitat.
EMF Interarray cables	Based on full build-out of EW 1 and EW 2, with the maximum number of structures (147 wind turbines and 2 offshore substations) to connect. EW 1: 116 nm (214 km). EW 2: 144 nm (267 km).	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within the Lease Area.
EMF Submarine export cables	Based on full build-out of EW 1 and EW 2. EW 1: 40 nm (74 km). EW 2: 26 nm (48 km).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable routes.

Table 5.6-8 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Acoustic Impacts of Pile Driving Offshore

Type and size	Number of Wind Turbines	Pile Diameter (m)	Drive Time per Foundation (hr)	Total Drive Time (hr)	Max kJ
Monopile	147	11	3	441	5,500

Table 5.6-9 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Benthic Impacts Offshore

Type and Size	Number of Wind Turbines	Foundation diameter at substrate (m)	Foundation Footprint (m^2)	Total Foundation-Buried Substrate (m^2)	Total Foundation-Buried Substrate (ha)
Monopile	147	11	95	13,970	1.2

Table 5.6-10 Supporting Calculations: Required Scour Protection for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation Area at Substrate (m^2)	Scour protection around each Foundation (m^2)	Total Scour Protection (ha)
Monopile	147	95	3,490	51.3

Table 5.6-11 Supporting Calculations: Total Habitat Conversion to Hard Bottom for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation diameter at substrate (m)	Foundation Footprint with Scour Protection (m^2)	Total Benthic Habitat Conversion (ha)
Monopile	147	11	3.585	52.7

As discussed in Section 5.6.1, there is no Critical Habitat for marine mammals in the Study Area. There are several haul out areas for pinnipeds across New York. None of these are located adjacent to the export cable landfall sites, with the closest approximately 6.8 mi (10.1 km) away. Submarine export cable siting corridor work is not expected to have impacts on marine mammals onshore, because of the distance from the construction area and the short-term duration of the construction itself. Therefore, this section describes potential impacts in the offshore environment, including the waters within and in the vicinity of the submarine export cable routes and the Lease Area.

5.6.2.1 Construction

During construction, the potential impact-producing factors to marine mammal species may include:

- Construction of offshore components, including foundations, wind turbines, offshore substations, submarine export cables, and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Short-term disturbance of habitat;
- Short-term loss of local prey species and availability;
- Short-term increase in marine debris;
- Short-term increased risk for entanglement and entrapment in Project-related equipment;
- Short-term increase in Project-related underwater noise;
- Short-term increased risk for ship strike due to the increase in vessel traffic; and
- Short-term change in water quality, including oil spills.

Short-term disturbance of habitat. Installation of the foundations and submarine export and interarray cables will result in the temporary disturbance the seafloor during the duration of construction activities. The actual area of disturbance at any one time is expected to be localized on the basis that submarine export and interarray cable installation will be linear over time and foundations will be installed on a sequential basis. As described is **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**, there is a large amount of similar quality available alternative suitable habitat in the vicinity of the Study Area indicating that temporary displacement will not necessarily result in a loss of available habitat and prey resource. Meteorological and oceanographic impacts from wind turbines and wind turbine foundations are not expected to impact water circulation or surface mixing (see Section 5.5.2.2). Since marine mammals are mobile, they can move away from the temporary construction sites and return when construction is complete. Thus, no permanent disturbance to or displacement from suitable habitat is anticipated for marine mammal species in the Study Area. Furthermore, the localized disturbance to the seafloor is expected to return to pre-construction conditions within a relatively short time frame; (see **Section 4.2 Water Quality** and **Appendix J Sediment Transport Analysis**). As described in **Section 3** and **Section 5.5**, Empire has actively avoided sensitive benthic habitats, where feasible, in the siting of submarine export and interarray cables and foundations, further minimizing the disturbance of sensitive habitat features.

Short-term loss of local prey species and availability. Construction activities, such as pile driving in the Lease Area and seabed preparation for laying the submarine export and interarray cables and foundations, may also temporarily disturb local prey species due to short-term disturbance of benthic habitat and increased water turbidity, as well as from underwater sound from construction vessels and equipment; this may therefore indirectly impact the ability for marine mammals to forage in these specific areas.

Marine mammals feed throughout the water column from seafloor to surface, though preferences vary by species and prey availability. Seabed preparation for foundations and submarine export and interarray cable installation has the potential to impact species that feed primarily on invertebrates in the benthic (seafloor) habitat (see **Section 5.5**). Others feed in deep foraging dives, not applicable to this Study Area, while some feed subsurface by grouping fish and then conducting surface lunges and are more likely to be impacted by prey species being impacted from pile driving activities (see **Section 4.4.2** and **Appendix M-2**). The marine mammals foraging in the Study Area primarily target copepods, small schooling fish such as capelin, mackerel, or herring; mesopelagic (intermediate depths below the surface) migrators such as squid; or benthic species including crustaceans, cephalopods, and all species of flounders. Primary production and availability of food resources for marine mammals is not expected to be impacted as a result of Project-related construction and installation activities. Underwater portions of foundations are expected to be newly colonized by encrusting and attaching organisms, creating an array of biogenic reefs in the Lease Area, which in turn will attract prey species for marine mammals. Therefore, it is possible that the foundations will provide a beneficial impact for marine mammals.

Copepods, right whale's preferred prey, are planktonic organisms that remain in the water column and are not likely to be impacted by Project related construction activities (including noise and turbidity). Localized Project related construction activities should only temporarily displace prey species. There is also alternative suitable habitat available for prey species both within the Study Area, in portions already constructed and recovered or yet to be disturbed, or outside of the Study Area and within New York Bight where marine mammals would likely find prey. As stated, the seafloor is expected to return to pre-construction conditions within a short time frame (see **Section 4.2** and **Appendix J**). Empire has actively avoided sensitive benthic habitats, where feasible, in the siting of submarine export and interarray cables and foundations, further minimizing the disturbance of sensitive habitat features that may impact marine mammal preferred prey resource. Further detailed assessments on the potential impacts on prey species and embedded and proposed mitigation are described in **Section 5.5**.

Short-term increase in marine debris. Marine debris has the potential to be introduced to the marine environment during construction activities, for example from Project-related construction vessels. This has the potential for marine mammals to become entangled in and/or ingest debris, which could in turn result in injury or death as impacts from marine debris and entanglement on marine mammals are well documented (e.g., Laist 1987, 1997; Derraik 2002; Gregory 2009; NOAA Marine Debris Program 2014; Gall and Thompson 2015). As Project-related personnel and vessel contractors will be required to implement appropriate debris control practices and protocols, as applicable, the release of marine debris into Study Area waters is not anticipated. Furthermore, Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.

Short-term increased risk for entanglement and entrapment in Project-related equipment. During construction, the installation of submarine export and interarray cables and seabed preparation for the installation of foundations could potentially lead to the entrapment and entanglement of marine mammal species, such as seals or larger whales, due to the potential presence of cables associated with installation equipment in the water column. Entanglement occurs when marine wildlife is caught inadvertently, or captured or restrained, by strong, flexible, manmade materials such as fishing line or buoy lines. The lines that will be deployed in support of the Project will be associated with the construction barge anchor cables and cable plow/trencher towing cables and umbilicals. While most scientific studies have focused on entanglement as bycatch, recent work explored the entanglement risk to marine wildlife from offshore renewable developments (Reeves et al. 2013, Benjamins et al. [2012, 2014], and Harnois et al. 2015). The key parameters used in these risk assessments were tension characteristics, line swept volume ratio, and line curvature of moorings. These assessments concluded that taut configurations present a low risk of entanglement to all marine mammals.

Within the Study Area, pinnipeds are commonly entangled in smaller debris such as smaller weight line, netting, and additional construction-related debris (additional impacts associated with marine debris are discussed in the designated subsection). If cables are loose in the water column and whales are feeding, under a combination of coinciding events, an entanglement could potentially occur.

Due to the weight of the lines, and tension under which the cables will be operating, it is unlikely that entanglement will occur with marine mammal species from Project construction materials and activities, including the anchoring associated with the temporary mooring concept. In addition, installation activities will be short-term and localized, and the area of risk will be a very small portion of available habitat. Although some species of marine mammals may be attracted by the presence of installation vessels, for example various dolphin species that are known to sometimes bow ride vessels, the larger baleen whale species, such as right whales, fin whales, and humpback whales, would be expected to have a lower likelihood of being co-located with the vessels due to the implementation of measures, further described in the subsection Collisions from construction vessel traffic. Practices will be in place to avoid commencing or continuing certain installation activities if marine mammals are observed within monitoring and exclusion zones (described in further detail in the underwater noise subsection), as dictated by Level A and Level B harassment standards of the MMPA.

As such, with the likelihood of conditions for entanglement being low and the likelihood for marine mammals to encounter entanglement or entrapment risks low, it is anticipated that entanglement and entrapment will not occur from installation activities. Measures in place to avoid marine mammals before the start-up of activities and avoidance of vessel collisions will also act to reduce the risk of entanglement and entrapment.

Short-term increase in Project-related underwater noise. Construction activities, including for example pile-driving, cable installation, and Project-related vessel noise, will temporarily increase underwater noise in the Study Area; this increase in noise has the potential to impact marine mammals both behaviorally and physiologically.

Underwater noise is an impact concern for marine wildlife, particularly marine mammals. All marine mammals use sound to forage, orient, socially interact with conspecifics, or detect and respond to predators. Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding.

Most marine animals can perceive underwater sounds over a broad range of frequencies, from about 10 Hz to more than 10 kHz (Southall et al. 2019, Southall et al. 2007). Potential effects of anthropogenic noise to marine mammals can include behavioral modification (changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds; Nowacek at al. 2007). Baseline oceanic noise sources occur from various sources around the world and can have varying levels, depending on location. For example, baseline oceanic noise will have higher levels closer to a shoreline or a shipping channel (Studds and Wright 2007).

The primary sources of underwater noise that could be generated by the Project during construction include percussive pile driving of wind turbine foundations and offshore substation foundations, HRG surveys to support final engineering design (pre-construction), HRG surveys to confirm burial of the submarine export and interarray cables (post-construction), coffer dam installation, and Project-related vessels.

In support of this COP, underwater sound propagation modeling was completed in order to predict the level of underwater noise expected during Project-related construction activities in a variety of environments throughout the Study Area (see **Appendix M-1** and **Appendix M-2** for a full description of the modeling methodology and inputs).

Modeling was performed by JASCO and is summarized here. For full details please see the report provided in **Appendix M-2**.

Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as marine mammals, sea turtles, and fish) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

JASCO's physical model of pile vibration and near-field sound radiation (MacGillivray 2014) was used in conjunction with the GRLWEAP 2010 wave equation model (Pile Dynamics Inc. 2010) to predict source levels associated with impact pile driving activities. Piles are modeled with a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. See **Appendix M-2** for a more detailed description.

Forcing functions were computed for the representative monopile and jacket foundations, using GRLWEAP 2010 (Pile Dynamics Inc. 2010). The model assumed direct contact between the representative hammers, helmets, and piles (i.e., no cushion material, which results in a more conservative estimate). The forcing functions serve as the inputs to the pile driving source models used to estimate equivalent acoustic source characteristics. Decidecade spectral source levels for each pile type, hammer energy and modeled location, using an average summer sound speed profile are provided in **Appendix M-2**.

Acoustic propagation modeling used JASCO's Marine Operations Noise Model (MONM) and Full Waveform Range-dependent Acoustic Model (FWRAM) that combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate sound fields. The lower frequency bands were modeled using MONM and FWRAM, which are based on the parabolic equation method of acoustic propagation modeling. For higher frequencies, additional losses resulting from absorption were added to the propagation loss model.

Model Input Parameters

Impact pile driving would occur in a continental shelf environment characterized by predominantly fine to coarse grained sandy seabed sediments, with some clay content. Water depths vary between approximately 79 to 141 ft (24 to 43 m). From June to September, the average temperature of the upper (33 to 49 ft [10 to 15 m]) water column is higher, which can lead to a surface layer of increased sound speeds. This creates a downward refracting environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy during winter, from December through March, results in a sound speed profile that is more uniform with depth. Average summer and winter sound speed profiles were used in the Project acoustic propagation modeling. See **Appendix M-2** for more details on the environmental parameters used in acoustic propagation and exposure modeling.

Empire has committed to noise attenuation applied during all pile driving. Typical performance of 10 dB broadband attenuation was chosen for this analysis as an achievable reduction of sound levels produced during pile driving, noting that a 10 dB decrease means the sound energy level is reduced by 90 percent. For exposure modeling, several levels of attenuation were included for comparison purposes.

Forcing functions were computed for the monopile and pin pile using GRLWEAP 2010 (Pile Dynamics, Inc. 2010). The forcing functions serve as the inputs to JASCO's pile driving source models used to estimate equivalent acoustic source characteristics detailed in **Appendix M-2**.

Hammer energy schedules, including the hammer energies and number of strikes predicted at various embedment depths during the pile driving process, were developed for the range of monopile and OSS jacket pin pile driving scenarios (see **Appendix M-2**). A range of potential monopile diameters remains under consideration; as such, hammer energy schedules were developed for two different monopile diameters (9.6 m and 11 m) to ensure the range of potential diameters was modeled. Model results indicated that the scenario representing maximum impact for marine mammals was the 9.6 m diameter scenario. Results for all modeled scenarios are described in **Appendix M-2**.

Calculation of Range to Regulatory Thresholds

Exposure ranges were calculated for marine mammals (**Table 5.6-12**, **Table 5.6-13**, **Table 5.6-14**, and **Table 5.6-15**). The exposure ranges assume 10 dB broadband attenuation and a summer acoustic propagation environment. Exposure ranges are reported for both 1 and 2 piles per day for monopile foundations, and 2 and 3 pin piles per day for jacket foundations. Results for all exposure estimates, including different seasons and at different attenuation levels, can be found in **Appendix M-2**. Single strike ranges to various isopleths from acoustic modeling can be found in **Appendix M-2**, along with per pile SEL acoustic ranges to isopleths for the hearing groups assuming no movement of animals during pile driving.

Table 5.6-12 Monopile foundation (9.6 m diameter, summer): Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a typical pile

Species		One Pile per Day			Two Piles per Day		
		Injury		Behavior	Injury		Behavior
		LE	*L_{pk}*	*Lp a/*	*LE*	*L_{pk}*	*Lp a/*
LF	Fin whale b/	0.86	0	3.18	0.94	0	3.09
	Minke whale	0.22	0	3.13	0.54	0	3.02
	Humpback whale	0.24	0	3.15	0.33	0	3.01
	North Atlantic right whale b/	0.33	0	2.89	0.47	0	2.87
	Sei whale b/	0.43	0	3.09	0.54	0	3.07
MF	Atlantic white-sided dolphin	0	0	2.98	0	0	2.94
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	3.07	0	0	2.92
	Bottlenose dolphin	0	0	2.46	0	0	2.41
	Risso's dolphin	0	0	3.07	0	0	2.93
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	3.25	0	0	2.96
HF	Harbor porpoise	0	0	3.07	0	<0.01	3.05
PW	Gray seal	0	0	3.33	<0.01	0	3.26
	Harbor seal	0	0	3.02	0	0	2.97

Species		One Pile per Day			Two Piles per Day		
		Injury		Behavior	Injury		Behavior
		LE	*L_{pk}*	*Lp a/*	*LE*	*L_{pk}*	*Lp a/*

Notes:
a/ NOAA 2005
b/ Listed as Endangered under the ESA

Table 5.6-13 Monopile foundation (9.6 m diameter, summer): Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation for a difficult to drive pile

Species		One pile per day			Two piles per day		
		Injury		Behavior	Injury		Behavior
		LE	*L_{pk}*	*Lp a/*	*LE*	*L_{pk}*	*Lp a/*
LF	Fin whale b/	1.35	0	4.74	1.84	0	4.51
	Minke whale	0.89	0	4.46	0.90	0	4.45
	Humpback whale	0.74	<0.01	4.47	0.69	0	4.53
	North Atlantic right whale b/	1.09	0	4.33	1.13	0	4.30
	Sei whale b/	1.04	<0.01	4.47	1.21	0	4.52
MF	Atlantic white-sided dolphin	0	0	4.24	0	0	4.30
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	4.48	0	0	4.42
	Bottlenose dolphin	0	0	3.77	0	0	3.83
	Risso's dolphin	0	0	4.73	0	0	4.41
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	4.59	0	0	4.47
HF	Harbor porpoise	0	0.08	4.52	0	0.04	4.37
PW	Gray seal	<0.01	0	4.91	<0.01	0	4.87
	Harbor seal	0	0	4.68	0	0	4.38

Notes:
a/ NOAA 2005
b/ Listed as Endangered under the ESA

Table 5.6-14 Jacket foundation EW 1 (2.5 m diameter, summer): Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation

Species		Two pin piles per day			Three pin piles per day		
		Injury		Behavior	Injury		Behavior
		LE	L_{pk}	*Lp a/*	*LE*	L_{pk}	*Lp a/*
LF	Fin whale b/	0	0	0.90	0	0	0.79
	Minke whale	0	0	0.89	0	0	0.87
	Humpback whale	0	0	0.73	0	0	0.77
	North Atlantic right whale b /	0	0	0.78	0	0	0.80
	Sei whale b/	0	0	0.83	0	0	0.81
MF	Atlantic white-sided dolphin	0	0	0.75	0	0	0.87
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	0.74	0	0	0.78
	Bottlenose dolphin	0	0	0.80	0	0	0.80
	Risso’s dolphin	0	0	0.78	0	0	0.76
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	0.88	0	0	0.82
HF	Harbor porpoise	0	0	0.86	0	0	0.79
PW	Gray seal	0	0	0.99	0	0	0.99
	Harbor seal	0	0	0.78	0	0	0.91

Notes:
a/ NOAA 2005
b/ Listed as Endangered under the ESA

Table 5.6-15 Jacket Foundation EW 2 (2.5 m diameter, summer): Exposure ranges (ER95%) in km to marine mammal threshold criteria with 10 dB attenuation

Species		Two pin piles per day			Three pin piles per day		
		Injury		Behavior	Injury		Behavior
		LE	L_{pk}	*Lp a/*	*LE*	L_{pk}	*Lp a/*
LF	Fin whale b/	0	0	0.84	0	0	0.84
	Minke whale	0	0	0.75	0	0	0.73
	Humpback whale	0	0	0.62	0	0	0.68
	North Atlantic right whale b /	0	0	0.66	0	0	0.66
	Sei whale b/	0	0	0.60	0	0	0.58
MF	Atlantic white-sided dolphin	0	0	0.77	0	0	0.75
	Atlantic spotted dolphin	0	0	0	0	0	0
	Short-beaked common dolphin	0	0	0.74	0	0	0.74
	Bottlenose dolphin	0	0	0.45	0	0	0.56
	Risso's dolphin	0	0	0.77	0	0	0.74
	Long-finned pilot whale	0	0	0	0	0	0
	Short-finned pilot whale	0	0	0	0	0	0
	Sperm whale b/	0	0	0.54	0	0	0.57
HF	Harbor porpoise	0	0	0.60	0	0	0.67
PW	Gray seal	0	0	0.79	0	0	0.78
	Harbor seal	0	0	0.74	0	0	0.71

Notes:
a/ NOAA 2005
b/ Listed as Endangered under the ESA

Animal Movement Modeling

Animal movement modeling was performed using the JASMINE model to estimate the probability of exposure of animals to sound arising from pile driving operations during construction of the Project. Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3D sound fields with movement rules derived from animal observations (**Appendix M-2**). The parameters used for forecasting realistic behaviors (e.g., diving, foraging, and surface times) were determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species (**Appendix M-2**). The predicted sound fields were sampled by the model receiver in a way that real animals are expected to by programming animats to behave like marine mammal species that may be present near the Project. The output of the simulation is the exposure history for each animat within the simulation. An individual animal's sound exposure levels are summed over a specified duration, i.e., 24 hours (**Appendix M-2**), to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria described in Section 2.4 within each analysis period.

The exposure criteria for impulsive sounds were used to determine the number of animats exceeding exposure thresholds. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 0.5 animats/km^2 over the entire simulation area. Some species have depth preference restrictions, e.g., sperm whales prefer water greater than 1,000 m (Aoki et al. 2007), and the simulation location contained a relatively high portion of shallow water areas. Results were then scaled by actual density of the species.

Appendix M-2 provides a complete description of animal movement modeling and the parameters used in the JASMINE simulations, including a schematic overview of the exposure modeling process.

Mean Monthly Marine Mammal Density Estimates

Mean monthly marine mammal density estimates (animals per 100 square kilometers) for all species are provided in **Appendix M-2**. These were obtained using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b) and include recently updated model results for North Atlantic right whale. The updated model predictions are summarized over three eras, 2003-2018, 2003-2009 and 2010-2018, to reflect the apparent shift in North Atlantic right whale distribution. To be conservative, the modeling conducted in this report relied on the 2010-2018 density predictions, which reflect the highest North Atlantic right whale densities over the three eras described above.

Densities were calculated within a 5.5-km buffered polygon around the lease area perimeter. The buffer size was selected as the largest 10 dB-attenuated exposure range over all species, scenarios, and threshold criteria (with the exception of the Wood et al. [2012] thresholds, which were not included in this estimate because they include a small subset of very long ranges for migrating mysticetes and harbor porpoise) rounded up to the nearest 0.5 km. The mean density for each month was determined by calculating the unweighted mean of all 10 × 10 km (5 × 5 km for North Atlantic right whale) grid cells partially or fully within the analysis polygon (**Figure 5.6-17**). Densities were computed for an entire year to coincide with possible planned activities. In cases where monthly densities were unavailable, annual mean densities were used instead.

Long-finned and short-finned pilot whales were modeled separately, although there is only one density model for pilot whales from Roberts et al. (2016a, 2016b, 2017). Densities were adjusted for these species, based on their relative abundances.

Modeling Scenarios

Foundation pile driving

Exposure estimates were calculated for marine mammals based on proposed construction schedules. To account for possible delays of pile driving from 2025 resulting in additional piles needing to be driven in 2026, Empire estimates 96 monopile foundations and 24 pin piles will be installed in 2025 and 51 monopile foundations (zero pin piles) will be installed in 2026, although some of the monopile foundations expected in 2025 may be delayed until 2026. It is possible but not anticipated that monopile foundations and pin piles could be installed outside of the years described above due to schedule delays. As it is possible that either one or two monopile foundations may be installed per day, and either two or three pin piles may be installed per day, exposure estimates for all possible scenarios were modeled (i.e., one or two monopile foundations installed per day, and two or three pin piles installed per day). To be conservative, the scenario resulting in the greatest potential number of takes of North Atlantic right whales was carried forward for the take request (two monopile foundations installed per day and three pin piles installed per day).

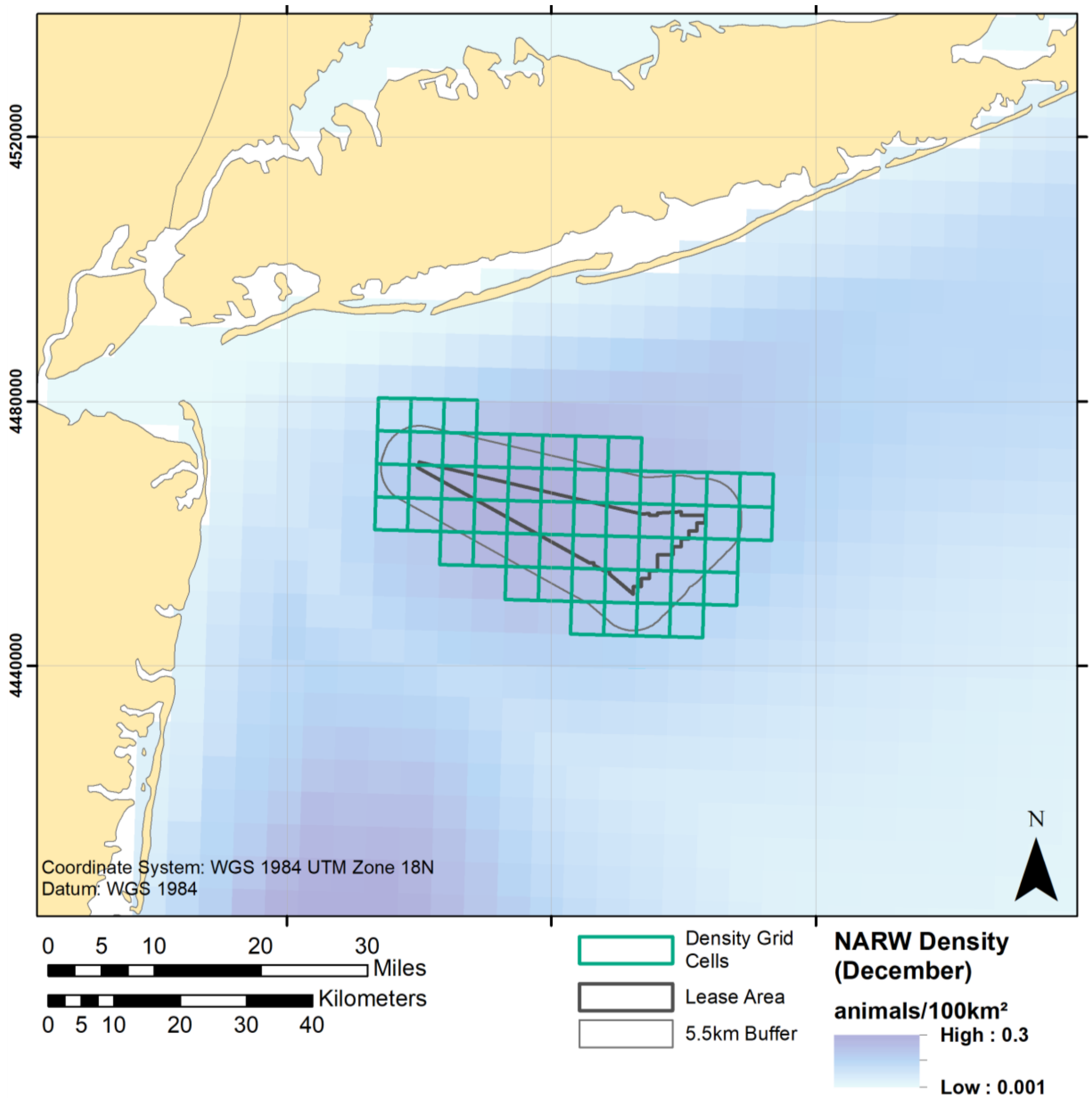

Figure 5.6-17 Marine mammal (e.g., North Atlantic right whale) density map showing highlighted grid cells used to calculate mean monthly species estimates within a 5.5 km buffer around Lease Area OCS-A 0520 (Roberts et al. 2016a, 2021a, 2021b).

The overall construction schedule assumed for exposure modeling purposes is detailed in **Table 5.6-16**. All possible construction scenarios were modeled (i.e., one monopile/two pin piles per day, one monopile/three pin piles per day, two monopiles/two pin piles per day, two monopiles/three pin piles per day; **Appendix M-2**) to ensure the most conservative scenario was carried forward in the application. The resulting exposure estimates for Level A harassment were very similar across all modeled construction scenarios, with minimal differences (**Appendix M-2**). Therefore, the most conservative scenario was driven by the exposure estimates for Level B harassment. Due to the nature of these calculations, the activities with the least piles installed per day had the longer overall durations in terms of total days, and therefore, the greatest resulting modeled exposures by Level B harassment. Consequently, the construction scenario with one monopile and two pin piles installed per day was carried forward for purposes of the exposure analysis.

Table 5.6-16 Construction Schedule (one monopile per day/two pin piles per day) a/

Foundation type	Year 1				Year 2			
	Monthly Density				Monthly Density			
	Highest	Second	Third	Fourth	Highest	Second	Third	Fourth
Monopile, typical, 1 per day	19	20	20	20	24	24	3	0
Monopile, difficult, 1 per day	5	4	4	4	0	0	0	0
Pin pile, OSS1, 2 per day	0	6	0	0	0	0	0	0
Pin pile, OSS2, 2 per day	6	0	0	0	0	0	0	0
Total # of days	**30**	**30**	**24**	**24**	**24**	**24**	**3**	**0**

Note:
a/ Total days of piling per month for each foundation type in each of the four highest density months during May to December for each species, used to estimate the number of marine mammal and sea turtle acoustic exposures for Empire Wind.

Empire estimates that no more than 24 monopiles may be installed in any month, and that no more than 96 monopiles would be installed per year. Therefore, take estimates were generated for up to 24 monopiles per month (maximum 96 monopiles per year) in all possible months of construction (i.e., May through December); to be conservative, the scenario resulting in the greatest potential number of takes of North Atlantic right whales was carried forward. Empire estimates that both offshore substation jacket foundations will be constructed in summer of 2025; thus, to be conservative, it was assumed that all 24 pin piles (12 pin piles per offshore substation) will be installed in May which is the month that would result in the greatest number of takes of North Atlantic right whales. Thus, the construction schedule that was carried forward for the exposure estimate is considered conservative in terms of the modeled number of North Atlantic right whale exposures. Exposure estimates are provided in **Appendix M-2**. A maximum of 147 total monopile foundations may be driven over the course of the Project.

An estimated maximum of 17 foundations may be difficult-to-drive (including as many as 7 difficult-to-drive foundations for EW 1 and as many as 10 difficult-to-drive foundations for EW 2). This number represents a conservative estimate; the actual number will be informed by analysis of geotechnical data that will occur prior to construction. It is expected that difficult-to-drive foundation locations will be known in advance, and efforts will be made to avoid pile installation at those locations where possible. However, to be conservative, exposure estimates were calculated based on an assumption that pile driving would occur at the maximum 17 potential difficult-to-drive foundation locations. Empire expects that all difficult-to-drive foundations would be installed in 2025. It is possible but not anticipated that some difficult to drive foundations could be installed in 2026; however, to be conservative it was assumed all difficult to drive foundations would occur in 2025 as this scenario results in the most conservative exposure estimates for any single year of construction. To be conservative it was assumed that driving of difficult-to-drive foundations would occur in the months of highest density for each species, spread evenly among those months (i.e., of the 24 monopiles driven in the four months of highest density for each species, it was assumed four of those 24 would be considered difficult-to-drive in three months and five of those 24 would be difficult-to-drive in the remaining one month).

Sheetpile driving and goal post installation

Underwater sound propagation modeling for vibratory installation and removal of potential cofferdams was completed using dBSea, a powerful software developed by Marshall Day Acoustics for the prediction of underwater noise in a variety of environments. The 3D model is built by importing bathymetry data and placing noise sources in the environment. Each source can consist of equipment chosen from either the standard or user defined databases. Noise mitigation methods may also be included. The user has control over the seabed and water properties including sound speed profile, temperature, salinity, and current.

Noise levels are calculated throughout the entire Project Area and displayed in 3D. For estimating source levels and frequency spectra, the vibratory pile driver was estimated assuming an 1,800 kilonewton vibratory force. Modeling was accomplished using adjusted one-third-octave band vibratory pile driving source levels cited for similar vibratory pile driving activities conducted during cofferdam installation for the Block Island Wind Farm (Tetra Tech 2012). The assumed sound source level for vibratory pile driving corresponded to 195 dB SEL. For additional details see **Appendix M-1**. Modeling was conducted for the scenarios shown in **Table 5.6-17**.

Table 5.6-17 Underwater Acoustic Modeling Scenarios

Scenario	Description	Location (UTM Coordinates)	Apparent Source Level dB re: dB re 1 μPa²·s
Scenario 1: Cofferdam Installation	Vibratory Pile Driving	EW 1: 583452 m, 4501772 m EW 2-1: 613965 m,4492769 m EW 2-2: 617063 m, 4493259 m EW 2-3: 616467 m, 4492268 m EW 2-4: 615730 m, 4492964 m	195 $L_{E,\,1sec}$
Scenario 2: Goal Post Installation	Impact Pile Driving	Representative Location	200 $L_{p,pk}$ a/ 174 $L_{E,\,1sec}$ a/ 184 L_{p} a/
Scenario 3: EW 2 Onshore Substation C Marina Bulkhead Work (Sheetpile installation)	Vibratory Pile Driving	Representative Location	160 $L_{E,\,1sec}$
Scenario 4: EW 2 Onshore Substation C Marina Berthing Pile Removal	Vibratory Pile Driving	Representative Location	165 $L_{E,\,1sec}$

Notes:
a/ Source levels based on the GARFO Acoustics Tool pile type information (NOAA Fisheries 2019e)

The results of the modeling for vibratory pile driving for cofferdam installation, goal post pile driving, and marina work are presented in **Table 5.6-18**, **Table 5.6-19,** and **Table 5.6-20**. Either cofferdams or goal post installation may occur as part of cable landfall activities, but not both for any one cable landfall. Acoustic modeling results demonstrated that acoustic impacts from cofferdam installation activities were greater than that of the alternative goal post installation (**Table 5.6-18** and **Table 5.6-19**). Therefore, to be conservative, the cofferdam installation scenario was carried forward for the analysis of potential takes by harassment from cable landfall activities.

Table 5.6-18 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Cofferdam Vibratory Pile Driving

Location	PTS onset by Hearing Group a/				Behavioral Response
	LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	All
	199 $L_{E,\,24hr}$	198 $L_{E,\,24hr}$	173 $L_{E,\,24hr}$	201 $L_{E,\,24hr}$	120 SPL RMS
EW 1	122	0	44	62	1,985
EW 2-1	75	0	43	0	2,083
EW 2-2	32	0	20	0	2,044
EW 2-3	81	0	52	0	2,191
EW 2-4	13	0	12	11	1,535

Source: NOAA Fisheries 2018a

Note:
a/ Injury

Table 5.6-19 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Goal Post Impact Pile Driving

Pile	PTS onset by Hearing Group a/								Behavioral Response
	LF cetaceans		MF cetaceans		HF cetaceans		Phocid pinnipeds		All
	219 $L_{p,pk}$	183 $L_{E,\,24hr}$	230 $L_{p,pk}$	185 $L_{E,\,24hr}$	202 $L_{p,pk}$	155 $L_{E,\,24hr}$	218 $L_{p,pk}$	185 $L_{E,\,24hr}$	160 SPL RMS
12 inch steel	0.0	632.1	0.0	22.5	7.4	752.9	0.0	338.3	398.1 (ZOI = 0.048 km^2)

Source: NOAA Fisheries 2018a

Note:
a/ Injury

Table 5.6-20 Distances (meters) to the Level A and Level B Harassment Threshold Isopleth Distances for Vibratory Driving at Onshore substation C Location Marina

Location	PTS onset by Hearing Group a/				Behavioral Response
	LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	All
	199 $L_{E,\,24hr}$	198 $L_{E,\,24hr}$	173 $L_{E,\,24hr}$	201 $L_{E,\,24hr}$	120 SPL RMS
Marina Bulkhead Work (Sheetpile installation)	43.2	3.8	63.8	26.2	1,000
Marina Berthing Pile Removal	43.5	3.9	64.3	26.5	1,600

Source: NOAA Fisheries 2018a

Note:
a/ Injury

Estimates of take are computed according to the following formula as provided by NOAA Fisheries in a personal communication on November 24, 2015.:

$$\text{Estimated Take} = D \times ZOI \times (d) \qquad (1)$$

Where:

D = average highest species density (number per km²)
ZOI = maximum ensonified area to MMPA threshold for impulsive noise (160 dBRMS90% re 1 µPa)
d = number of days

The ensonified area specific to Level B harassment, as well as the projected duration of installation at each respective vibratory pile driving location, was then used to produce the resulting exposure estimates, which are detailed in **Appendix M-1**.

Empire proposes to implement the following measures during construction to avoid, minimize, and mitigate impacts of underwater noise at noise thresholds that present potential impacts through:

- Clearance and shutdown zones as appropriate to underwater noise assessments and impact thresholds, enforced by:
  - Qualified NOAA Fisheries approved PSOs;
  - Real-time monitoring systems, as appropriate;
  - Use of PAM systems;
  - Use of reduced visibility monitoring tools/technologies (e.g., night vision, infrared and/or thermal cameras); and
  - Ramping up on noise generating activities for an agreed upon duration based on consultation with the authorities;
- Empire will consider the potential use of commercially available and technically feasible noise reducing technologies, in accordance with associated authorizations; and

Impact pile driving will be initiated only during daylight hours, (no more than 1.5 hours before sunset).

Underwater noise generated from Project-related vessels used during construction can also be a stressor to marine mammals. Many studies have documented short-term responses to both vessel sound (see **Section 4.4.2 Underwater Acoustic Environment**) and vessel traffic in whales (impacts resulting from an increase in vessel traffic in discussed; Watkins 1986; Baker et al. 1983; Magalhães et al. 2002). Unfortunately, it is not always possible to determine whether a marine mammal exhibiting a behavioral change is responding to the physical presence of the vessel itself, to the noise generated by the vessel, or to some unknown unrelated but synchronous factor, such as proximity to "conspecifics" (other animals of the same species) or predators (e.g., killer whales), vocalizations from other animals, particular behavior states that shift normally, or other human-induced sounds surrounding the sound source from the Project. Reactions could also vary based on factors such as the behavioral or reproductive states of the species in proximity to the vessel or if calves are present. It is anticipated that additional vessels in transit from construction related vessels will slightly increase oceanic noise from its current baseline (Blair et al. 2016).

Recent studies on behavioral responses to anthropogenic noise clearly indicate that animals will show variable responses to noise dependent on species, behavioral contexts, and likely the distance from animals to the sound source (Ellison et al. 2012). Responses to vessel disturbances can include behaviors such as changes to their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions (Au and Green 2000; Richter et al. 2003; Williams et al. 2002). The New York Bight is known to have a significant baseline noise level due to shipping lanes that occur in the area (Muirhead et al. 2018; Estabrook et al. 2019). Project-related vessels will follow existing shipping lanes to the extent feasible and practicable. Based on the maximum design scenario in the PDE for Project-related construction vessels, which is build-out of EW 1 and EW 2, there will be an insignificant increase in vessel traffic associated with the Project. The increase in Project-related vessel activity will not be a combined increase occurring all at once and will be sporadic throughout the construction period (both in the 24-hour work period, and the season). It is unlikely that the noise impact of vessel traffic from Project-related construction vessels will create a significant increase in baseline conditions in underwater noise enough to impact marine mammal hearing groups.

Short-term increased risk for ship strike due to the increase in vessel traffic. An increase in Project-related construction and support vessel traffic within the Lease Area, along the submarine export cable routes, and along the transit routes to and from the staging and construction areas is anticipated during construction, with an insignificant increase of vessel traffic in the area above baseline conditions anticipated. A summary of the anticipated types of vessels is provided in **Table 5.6-21** (see **Appendix K Air Quality Calculations and Emissions** for the number of transits and ports of origin). As part of the Navigation Safety Risk Assessment (**Appendix DD**), the average number of unique vessels recorded per day with the Study Area were assessed for 12 months of AIS data. An average of 53 unique vessels were recorded per day within the Study Area, with a total of 102 vessels recorded on the busiest day. The busiest month was July 2018, when an average of 68 unique vessels were recorded per day. In comparison, Project-related vessel trips will represent a small increase to this existing traffic. Project vessel round trips will average less than 2 trips per day during construction.

Empire has assumed that SBMT will be the local port and staging area for all purposes during construction and operations of the Project, with the following exceptions:

- Monopile foundations could be sourced from overseas and either staged in Canada or brought directly to their offshore installation locations;
- Port of Coeymans, on the Hudson River in upstate New York, is assumed to be the starting point for the transit of the scour protection for each foundation;
- Port of Albany, also on the Hudson River in upstate New York, is assumed to be the starting point for the transit of the transition pieces for each turbine foundation, as well as for the wind turbine towers;
- A submarine cable factory just north of Charleston, South Carolina is assumed to be the starting point for the transit of submarine cables;
- A yet-to-be-determined port in the Corpus Christi, Texas area is assumed to be the starting point for transporting the offshore substation topsides for EW 1 and EW 2, to the installation locations in the Lease Area. These will be brought directly to their offshore construction locations by a heavy transport vessel; and
- Halifax, Nova Scotia is assumed to be the starting point for the transit of scour protection rock and gravel. Rock and gravel will be brought directly to the offshore construction locations by a fall pipe vessel.

Empire notes that the supply chain for the offshore wind industry is in its nascent stages, but is quickly developing. Therefore, U.S. ports could be selected for supply of major offshore wind components, instead, as construction planning continues. Project-related vessels will follow existing shipping lanes to the extent feasible and practicable. Marine mammals near surface waters within these areas would be susceptible to vessel strikes or collisions and physical disturbances, all of which may inflict injury or result in mortality.

Table 5.6-21 Preliminary Summary of Offshore Vessels for Construction

		Foundations						
Vessel	**Description**	**Monopile**	**Piled Jacket**	**Wind Turbines**	**Offshore Substation Topside and Foundation**	**Submarine Export Cables**	**Interarray Cables**	**Scour Protection**
Heavy Lift Vessel	Vessel for installation of foundations (0-10 kts)	X	X		X			
Monopile Supply Vessel	Vessel for transport of monopile foundations (0-10 kts)	X						
Wind Turbine Installation Vessel	Vessel for installation of Wind Turbine components (0-10 kts)			X				
Wind Turbine Supply Vessel	Vessel for transport of Wind Turbine components (0-10 kts)			X				
Cable Lay Vessel/Barge	Vessel for installation of submarine cables (0-10 kts)					X	X	
Heavy Transport Vessel	Vessel for transport of offshore substation topside (0-10 kts)	X	X		X			
Cable Lay Support Vessel	Support vessel for cable lay operations (0-10 kts)					X	X	
Pre-Lay Grapnel Run Vessel	Vessel for seabed clearance along cable routes (0-10 kts)					X	X	
Fall Pipe Vessel	Vessel for installation of scour protection (0-10 kts)	X	X			X	X	X
Crew Transfer Vessel	Vessel for transporting workers to and from shore (0-10 kts)	X	X	X		X	X	
Construction Support Vessel	Vessel for general construction support (0-10 kts)	X	X			X	X	
Tugboat	Vessel for transporting and maneuvering barges (0-5 kts)	X	X	X	X	X		
Barge	Vessel for transport of construction materials (0-5 kts)	X	X	X	X			
Safety Vessel	Vessel for protection of construction areas (0-10 kts)	X	X			X	X	

Ship strike occurs when marine mammals and vessels fail to detect one another and collide, causing injury and/or mortality. This is a growing issue for most marine mammals and has the potential to significantly affect the population of a species (Laist et al. 2001; Van Waerebeek et al. 2007; Conn and Silber 2013; Van der Hoop et al. 2013; Laist et al. 2014). Factors that influence the potential for collision include vessel speed, vessel size, and visibility. Research indicates that most vessel collisions that result in serious injury or death to marine mammals occur at speeds of over 14 knots (25.9 km/h) (Laist et al. 2001; ASCOBANS 2003; Silber et al. 2014; Conn and Silber 2013; Van der Hoop et al. 2013; Laist et al. 2014). Lethal ship strikes dramatically increase as vessel speed increases, with a statistically significant reduction in lethal ship strike at speeds below 10 knots (18.5 km/h). Vanderlaan and Taggart (2007) found the probability of a strike resulting in mortality increased from 20 percent to 100 percent at speeds between 9 and 20 knots (16.7 and 37 km/h). Lethality from ship strike increased most rapidly between 10 and 14 knots: 35 to 40 percent at 10 knots (18.5 km/h), 45 to 60 percent at 12 knots (22.2 km/h), and 60 to 80 percent at 14 knots (25.9 km/h). Studies showed that increased vessel speed also increased the hydrodynamic draw of vessels that could result in right whales being pulled towards vessels, making them more vulnerable to collisions (Silber et al. 2010; Conn and Silber 2013; Laist et al. 2014).

Conn and Silber's (2013) assessment of lethality of ship strikes showed an 80 to 90 percent decrease in total ship strike mortality risk level when vessel speed restrictions are required. The Ship Strike Reduction Rule (50 CFR § 224.105) mandates that ships longer than 65 ft (20 m) and subject to U.S. jurisdiction are restricted to speeds of 10 knots (18.5 km/h) or less between November 1 and April 30 in the SMAs for right whales. The restrictions apply to all vessels greater than or equal to 65 ft (20 m) in overall length and subject to the jurisdiction of the United States and/or entering or departing a port or place subject to the jurisdiction of the United States. Note these restrictions do not apply to U.S. vessels owned or operated by, or under contract to, the federal government or to law enforcement vessels of a state, or political subdivision thereof, when engaged in law enforcement or search and rescue duties. Ship strike deaths in U.S. waters averaged about one per year during the 18 years of documentation before the 2008 rule. Since the 2008 rule, ship strike deaths have averaged less than half (i.e., 0.47 deaths per year) for right whales even including these two recent deaths (MMC 2018). In 2017 there was one confirmed ship strike mortality of right whales in U.S. waters, which was likely caused by right whales occurring in areas without speed restrictions and increased vessel traffic (NOAA Fisheries 2018a).

All species of marine mammal are at risk of ship strike: however, large whale species (right whale, humpback whale, fin whale, sei whale, and minke whale) are more prone to vessel strike. Incidences of strike for these large whales tend to be higher than other marine mammals due to their large size, slower movements, breathing patterns (longer surface respiration bouts), slower moving travel, lengthy surface rest periods, their long-range movements during their migrations, and their feeding patterns, which for most of the large whales (excluding right whales) typically includes periods of surface lunges. North Atlantic right whales are particularly prone to ship strike and disturbance for these reasons. Smaller dolphin and seal species are less vulnerable to ship strike as their agility in the water and ability for fast moving responses to vessel traffic.

Vessels during construction will consist of both large, slow-moving installation support vessels and smaller, faster moving vessels that will be required to transit to and from the Project Area from the proposed construction and staging areas (see **Section 3** for additional information on the proposed construction vessels and the construction and staging areas). The New York Bight SMA and Block Island SMA are located within and in the vicinity of the Study Area; all Project-related vessels that are larger than 65 ft (20 m) in length, transiting within these SMAs will be required to abide by this speed restriction. The New York shipping channel designated TSS navigation lanes entering and exiting New York Harbor are highly trafficked areas under current existing conditions. The Right Whale Sighting Advisory System is a NOAA Fisheries program designed to reduce collisions between ships and the critically endangered right whale, and is in place for any DMA or SMA.

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10 knot (<18.5 km/h) speed restrictions in any DMA;
- Vessel collision avoidance mitigation measures for Project-related vessels working in or in transit to and from the Lease Area, including a 328-ft (100-m) separation distance from all marine mammals, except for the North Atlantic right whale, which requires a 1,640-ft (500-m) separation;
- Any vessel larger than 300 gross tonnes moving into right whale habitat will report in as part of the right whale Mandatory Ship Reporting System, where they will be immediately responded to with updated reports of right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area. In the event of contact with a right whale, a report must be made immediately to NOAA's National Marine Mammal Stranding Network; and
- Marine mammal observers and/or Project personnel will check NOAA's website for any update on DMAs/Slow Zones and will respond with vessel movement strategies or work hours accordingly.

Short-term change in water quality, including oil spills. Construction activities, including foundation and submarine export and interarray cable installation, would result in short-term temporary increases in turbidity and sedimentation in the Project Area. As studies indicate that marine mammals often inhabit turbid waters (Hanke and Dehnhardt 2013) and are able to forage in low visibility conditions (Fristrup and Harbison 2002; Cronin et al. 2017), this short-term temporary increase will be localized as the construction area moves and is not expected to have any long-term impacts to these species, as described in habitat and prey species resource impacts subsection. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2** and **Appendix J**.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills and releases, for example, from grout used to seal the monopile to the transition piece. During cable lay and seabed preparation activities, there is also the potential to re-release historical constituents of concern due to resuspending sediment, both from seabed surface sources, but also from seabed depths not normally exposed and resuspended during natural storm events. As part of the site selection work for submarine export cable routing, Empire selected cable routes that avoid existing or historic dumping grounds or hazardous waste to the greatest extent possible, as described in **Section 2 Project Design Development**.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills. Oil spills pose a risk to marine mammals through direct contamination and destruction of foraging and reproductive habitats. Most petroleum products that would be carried on the construction vessels would be light, remaining on the surface of the water and evaporating in the event of a spill. These spills would be expected to adversely affect any marine mammals in the area that are co-located with the toxins. Heavier petroleum products that create a sheen and remain on the water's surface could affect marine mammals diving through the water's surface when breathing or looking for food. Ingestion of oil and dispersants directly, or indirectly via feeding on contaminated prey sources that have eaten dispersants, can lead to short- or long-term effects from inflammation, bleeding, and possible damage to liver, kidney, and brain tissue in marine mammals (Godard-Codding and Collier 2018.). Exposure to oil spills may cause marine mammals acute or chronic impacts with lethal or sub-lethal effects depending on the size and duration of the spill. For large baleen whales, oil can foul the baleen they use to filter-feed, decreasing their ability to eat, and resulting in the ingestion of oil (Godard-Codding and Collier 2018). Impacts from exposure may also include reproductive failure, lung and respiratory impairments, decreased body condition and overall health, and increased susceptibility to other diseases.

Empire has developed an Oil Spill Response Plan (**Appendix F**) that details measures proposed to avoid inadvertent releases and spills and a protocol to be implemented should a spill event occur. Furthermore, Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.

5.6.2.2 Operations and Maintenance

During operations, the potential impact-producing factors to marine mammal species may include:

- Presence of new permanent structures (i.e., foundations, wind turbines, and offshore substations); and
- Presence of new buried submarine export and interarray cables.

With the following potential consequential impact-producing factors:

- Modification of habitat;
- Project-related EMF;
- Project-related marine debris;
- Project-related underwater noise;
- Short-term increased risk for ship strike due to the increase in vessel traffic; and
- Changes in water quality, including oil spills.

Modification of habitat. Based on the maximum design scenario, the installation of the foundations and scour protection will result in the conversion of the seafloor to hardbottom habitat. As described in **Section 5.5**, in addition to the remaining equivalent habitat in the Project Area, alternative equivalent habitat exists outside of the Project Area. As discussed in **Section 5.5**, converting sandy bottom habitat to 'hard' habitat areas as a result of the foundations would effectively create artificial reef habitat, or what is known as "reef effect" in the submerged portions of the installations. The formation of hard habitat for biofouling sessile invertebrates attracts benthic and pelagic fish species to the area, which could in turn increase prey availability for marine mammals (Miller et al. 2013; Langhamer et al. 2009). The habitat alteration would provide a long-term beneficial impact to marine mammals as prey species would be attracted to Project structures. Studies have also observed seals (Russell et al. 2014, 2016) foraging by offshore wind farm structures since they aggregate prey resources. Harbor porpoises and seals have been observed utilizing offshore wind farm structures for feeding (Todd et al, 2015; O'Leary 2014).

This artificial hardbottom habitat created by the proposed foundation types could increase the abundance of commercially and recreationally important fish and invertebrate species, in turn increasing fishing activity in the Project Area. Increased fishing activity may pose an indirect adverse effect to marine mammals when considering an increase in netted fishing gear, longlines, ropes, traps, or buoy lines. Although unlikely, there would be potential for entanglement or ingestion of line by marine mammals in the vicinity.

Project-related EMF. The installation of submarine export and interarray cables in the Project Area may result in the introduction of EMF (see **Section 8.12 Public Health and Safety** and **Appendix EE Offshore Electric and Magnetic Field Assessment** for additional information). Literature suggests cetaceans can be affected by magnetic fields but not by electric fields. Some evidence suggests certain marine mammals may be able to sense geomagnetic fields and use the fields during migrations, although it is not clear which components they are sensing or how potential disturbances to the geomagnetic field caused by EMF near the buried submarine export and interarray cables in the Project Area may affect migrations of marine mammals (Normandeau et al. 2011). Strandings of marine mammals have been statistically linked to variations in localized geomagnetic anomalies (Oregon Wave Energy Trust 2010). There is no evidence indicating magnetic sensitivity in seals, but other marine mammals appear to have a detection threshold for magnetic sensitivity gradients of 0.1 percent of the Earth's magnetic fields and are likely to be sensitive to minor changes (Normandeau et al. 2011, Walker et al. 2003, Kirschvink 1990). Variations of the geomagnetic field caused by cable EMF in HVDC cables may have the potential to elicit a reaction from marine mammals, including changes in swimming direction or detours during migration. As the Project proposes to use HVAC cables, however, this effect is not anticipated to occur as with direct-current cables (Gill et al. 2005). Additionally, existing data indicates that any EMF effect on marine mammals is unlikely to be significant (Normandeau et al. 2011; Oregon Wave Energy Trust 2010). There is no data indicating that heat generated from the cables may affect marine mammals (Ospar 2012).

Indirect effects on marine mammals from alterations in prey due to EMF are also unlikely, as the average magnetic-field strengths in the vicinity of the submarine export and interarray cables are below levels documented to have adverse impacts to fish behavior. As detailed in **Section 5.5**, impacts to mid-water fish species including small schooling fish (e.g., mackerel, herring, capelin) consumed by marine mammals would not be affected by the EMF associated with Project cables.

In similar windfarm operations, modeling determined that the intensity of the magnetic fields generated by the submarine export cables is expected to be low and localized. Generally, electric and magnetic fields are not considered to directly affect marine mammals.

Introduction of marine debris. Marine debris has the potential to be generated during operations activities, which could result in a marine mammal species becoming entangled in or ingesting debris. This could result in injury or death. As offshore personnel will be required to implement appropriate practices and protocols, the release of marine debris into Project Area waters is not anticipated.

Change in water quality, including oil spills. During operations, routine maintenance activities have the potential to result in temporary increases in turbidity and sedimentation in the Project Area, which may directly or indirectly affect marine mammals. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2** and **Appendix J**. As shown, the increase in turbidity and or release of constituents of concern from re-suspended sediments is not expected to exceed background levels during natural events and will be short-term and temporary in nature. As such, marine mammals are not expected to be exposed to conditions exceeding their current environment.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills. For reasons described earlier, such spills have impacts on marine mammals. Empire has developed an OSRP (**Appendix F**) that details the measures proposed to avoid inadvertent releases and spills and a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.12**. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts on marine mammals from impacts to water quality and spills:

- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an OSRP.

Underwater noise. Operational wind turbines and operations and maintenance activities will result in a slight increase in the ambient underwater noise in the Project Area (see **Appendix M** for additional information on the anticipated increase in noise levels). Studies have shown that offshore wind facilities produce minimal noise both in air and in the water from spinning blades, though the main impacts of noise and vibrations occur during the construction phases (Eco RI News 2018). Operational noise from turbine structures may occur but is likely to be only measurable above ambient levels at frequencies below 500 Hz and is likely be confined to the immediate vicinity around the wind turbines (Tougaard et al. 2009). Additionally, studies from an offshore wind farm in 2017 showed no significant displacement of harbor porpoise post-construction, compared to pre-construction surveys (Vallejo et al. 2017; Dahne et al. 2017; Graham et al. 2017).

Noise from Project-related operations and support vessel traffic is not anticipated to be greater than the ambient noise levels in the Project Area, as vessel traffic is expected to have an insignificant increase above the existing baseline conditions as a result of the Project. Vessel traffic will increase during operations mainly for the transportation of supplies and maintenance crews. Given the amount of existing vessel traffic in the area, the noise associated with supply vessels transiting to the offshore facilities will have a negligible contribution to total ambient underwater sound levels. Similarly, nearshore vessel activity will be generally concentrated in established shipping channels and near industrial port areas and will be consistent with the existing noise environment in those areas. Therefore, impacts from underwater sound due to Project construction, including vessel activity, will be negligible and are unlikely to affect biological resources in the Project Area. As described in detail in Section 5.6.1, multiple marine mammal species are known to be co-located with the existing shipping levels in the New York area and the changes in vessel traffic proposed herein do not rise to the level of a scalable change for these species (i.e., it will not be meaningfully greater than existing vessel patterns and traffic).

Therefore, as discussed previously, impacts from Project-related vessel traffic noise may elicit short term, localized behavioral changes in individuals near vessels, however, due to the existing noise from traffic in the TSS lanes, the effects are not expected to be significantly greater than ambient conditions.

Project-related vessel traffic. The increase in Project-related operations and support vessel traffic within and transiting to and from the Lease Area is anticipated to have an insignificant increase above existing baseline conditions, based on a crew transfer vessel-only concept. The increase is negligible in comparison to the average traffic observed in the Project Area due to the presence of high traffic shipping lanes throughout the New York Bight (see **Section 8.7 Marine Transportation and Navigation** and **Appendix DD Navigation Safety Risk Assessment** for additional information). Marine mammals near surface waters within these areas would be susceptible to vessel strike, which may inflict injury or result in mortality and disturbance that may alter behavior.

Empire's preferred O&M solution for EW 1 and EW 2 is a SOV concept, supported by a crew transfer vessel. The SOV is expected to remain offshore in the project site for a period of approximately two weeks, returning to the O&M Base every two weeks for 24 hours for refueling, re-supplying and crew changes. The SOV concept therefore significantly reduces the overall vessel transits from Project site to base, compared to the maximum design scenario of multiple crew transfer vessels making daily return trips. Therefore, under these conditions, there is a resulting reduction of vessel traffic that will minimize the risk of ship-strike and vessel noise. However, Empire still requires the ability to select alternatives described in the PDE, and to be assessed in the EIS, should an SOV concept not be technically and commercially suitable. Final construction and vessel traffic protocol will be outlined and assessed through NOAA Fisheries, and any associated mitigation measures will be outlined in the NOAA Fisheries Incidental Harassment Authorization (IHA) for the Project.

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10 knot (<18.5 km/h) speed restrictions in any DMA;
- Vessel collision avoidance (ship strike) mitigation measures for Project-related vessels working in or in transit to and from the Lease Area, including a 328-ft (100-m) separation distance from all marine mammals, except for the North Atlantic right whale, which requires a 1,640-ft (500-m) separation, as well as adherence to all vessel strike avoidance measures as advised by NOAA fisheries;
- Any vessel larger than 300 gross tonnes moving into right whale habitat will report in as part of the right whale Mandatory Ship Reporting System. They will be immediately responded to with updated reports of right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area. In the event of contact with a right whale, a report must be made immediately to NOAA's National Marine Mammal Stranding Network; and
- Marine mammal observers and/or Project personnel will check NOAA's website for any update on DMAs/Slow Zones and will respond with vessel movement strategies or work hours accordingly.

5.6.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.6.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. Additionally, marine mammal species abundance and distribution may also have changed, requiring updated analysis; further data on the spatial and temporal distribution of marine mammals will also collected during the operations phase and will be used to inform a decommissioning assessment. A full decommissioning plan will be submitted to BOEM for approval prior to any decommissioning activities, and potential impacts will be re-evaluated at that time, in addition to any documentation and approval by NOAA Fisheries for an amendment to the IHA for Construction and Operations. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.6.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described, Empire has implemented the following embedded mitigation measures to avoid, minimize, and mitigate impacts through project siting and design. Note that Empire intends to continue discussions and engagement with regulatory agencies and environmental nongovernmental organizations (ENGOs) throughout the life of the Project to develop an adaptive mitigation approach that allows for flexibility while providing the best and most protective mitigation measures.

5.6.3.1 Construction

During construction, Empire will commit to the following avoidance, minimization, and mitigation measures to mitigate impacts described in Section 5.6.2.1. Additional Project activity-specific mitigation measures will be added to EW 1 and EW 2 protocols upon receipt of an IHA from NOAA Fisheries:

- Continued engagement with regulatory agencies, ENGOs, and other stakeholders on potential mitigation and best practices, as appropriate;
- Seasonal pile driving closures;
- Ramp-up measures when impact pile driving is initiated;
- Pre-clearance prior to the initiation of pile driving to ensure marine mammals are not located within relevant impact zones when pile driving begins;

- Shutdown of impact pile driving based on confirmed detection of marine mammals within relevant impact zones, when feasible;
- Establishment of clearance and shutdown zones s enforced by:
  - Qualified NOAA Fisheries approved PSOs;
  - Real-time monitoring systems, as appropriate;
  - Use of PAM systems;
  - Use of reduced visibility monitoring tools/technologies (e.g., night vision, infrared and/or thermal cameras); and/or
- PSOs will be stationed at the pile driving platform/vessel as well as on a dedicated PSO vessel;
- Use of commercially available and technically feasible noise attenuation technologies to reduce pile driving noise;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMAs for North Atlantic right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10 knot (<18.5 km/h) speed restrictions in any visually triggered Slow Zone/DMA;
- Project-related vessels 65 ft (20 m) or greater will comply 10 knot (18.5 km/s) speed restrictions when any mother/calf pairs, pods, or large assemblages of cetaceans are in the vicinity;
- Vessel collision avoidance mitigation measures for Project-related vessels working in or in transit to and from the Lease Area, including a 500-m separation distance from North Atlantic right whales, a 100-m separation distance from all other large whales and a 50-m separation distance from all other marine mammals, as well as adherence to vessel strike avoidance measures as advised by NOAA Fisheries ;
- Marine mammal observers and/or Project personnel will check NOAA's website regularly for updates on DMAs/Slow Zones and will respond with vessel movement strategies or work hours accordingly;
- Reference materials will be provided on board all Project vessels for identification of marine mammals;
- Any vessel larger than 300 gross tonnes moving into right whale habitat will report in as part of the NOAA Fisheries Northeast marine mammal and sea turtle stranding and entanglement hotline: (866) 755-NOAA (866-755-6622). They will be immediately responded to with updated reports of right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area;
- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste;
- The development and enforcement of an OSRP (**Appendix F**); and
- Sightings of North Atlantic right whales will be immediately reported the NOAA Fisheries North Atlantic Right Whale Sighting Advisory System: (866) 755-6622 (sightings in any location may also be reported to the U.S. Coast Guard via channel 16); and

All crew members responsible for navigation duties must receive site-specific training on protected species sighting/reporting and vessel strike avoidance measures prior to the start of in water construction activities. In addition, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in Section 5.6.2.1:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances; and
- Siting of Project-components to avoid and minimize impacts to sensitive benthic habitat and habitat of high value to marine mammals, directly and indirectly.

5.6.3.2 Operations and Maintenance

During operations, Empire will commit to the avoidance, minimization, and mitigation measures to mitigate impacts described in Section 5.6.2.2:

- Continued engagement with regulatory agencies, ENGOs, and other stakeholders on potential mitigation and best practices, as appropriate;
- Project-related vessel will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for North Atlantic right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10 knot (<18.5 km/h) speed restrictions in any visually triggered Slow Zone/DMA;
- Vessel collision avoidance mitigation measures for Project-related vessels working in or in transit to and from the Lease Area, including 500-m separation distance from North Atlantic right whales, 100-m separation distance from all other large whales and 50-m separation distance from all other marine mammals as well as adherence to vessel strike avoidance measures as advised by NOAA Fisheries;
- Any vessel larger than 300 gross tonnes moving into right whale habitat will report in as part of the right whale Mandatory Ship Reporting System. They will be immediately responded to with updated reports of right whale sightings in the area, in addition to reminders of safe vessel speeds and movements within the management area;
- Marine mammal observers and/or Project personnel will check NOAA's website regularly for updates on Slow Zones/DMAs and will respond with vessel movement strategies or work hours accordingly;
- Reference materials will be provided on board all Project vessels for identification of marine mammals;
- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste;
- The development and enforcement of an OSRP (**Appendix F**);
- Sightings of North Atlantic right whales will be immediately reported the NOAA Fisheries North Atlantic Right Whale Sighting Advisory System: (866) 755-6622 (sightings in any location may also be reported to the U.S. Coast Guard via channel 16); and
- All crew members responsible for navigation duties must receive site-specific training on protected species sighting/reporting and vessel strike avoidance measures prior to the start of in water construction activities.

In addition, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in Section 5.6.2.2:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances;
- Use of SOV concept, supported by a CTV, to reduce vessel traffic associated with Operations and Maintenance for the Project, if technically and commercially feasible; and
- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.

As indicated in the list of measures above, Empire proposes to assist as feasible in monitoring efforts to clarify baseline conditions and to assess changes in distribution or abundance of marine mammals. During the COP review process, Empire will work with regulatory agencies and stakeholders in development of appropriate program(s).

5.6.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in Section 5.6.3.1 and Section 5.6.3.2. A full decommissioning plan will be submitted for approval to BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.6.4 References

Table 5.6-22 Data Sources

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
Marine Geospatial Ecology Labs/ Duke University	MDAT Cetacean Density	http://seamap.env.duke.edu/models/mdat/	http://seamap.env.duke.edu/models/mdat/Mammal/MDAT_Mammal_Model_Metadata.pdf
NOAA NCEI	Bathymetry	https://www.ngdc.noaa.gov/mgg/coastal/crm.html	N/A
OBIS SEAMAP	OBIS SEAMAP Sightings	http://seamap.env.duke.edu/species/	N/A
NOAA NMFS	Biologically Important Areas for Cetaceans: North Atlantic Right Whale Migration	http://cetsound.noaa.gov/Assets/cetsound/data/CetMap_BIA_WGS84.zip	https://inport.nmfs.noaa.gov/inport/item/23643
NOAA NMFS	North Atlantic Right Whale Seasonal Management Area	http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/management_areas/geodata/right_whale_sma_all.zip	http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/management_areas/geodata/right_whale_sma_all_po.htm

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5.7 Sea Turtles

This section describes the sea turtle species known to be present, traverse, or incidentally occur in the waters within and surrounding the Project Area, which includes the Lease Area and waters adjacent to the submarine export cable routes. Potential impacts to sea turtles resulting from construction, operations, and decommissioning of the Project are discussed. Proposed Project-specific measures adopted by Empire are also described that are intended to avoid, minimize, and/or mitigate potential impacts to sea turtle species.

Other resources and assessments detailed within this document that are related to sea turtles include:

- Water Quality (Section 4.2 and Appendix J);
- Underwater Acoustic Environment (Section 4.4.2 and Appendix M);
- Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat (Section 5.5 and Appendix T);
- Marine Mammals (Section 5.6); and
- Ornithological and Marine Fauna Aerial Survey (Appendix P).

Data Relied Upon and Studies Completed

For the purposes of this section, the Study Area includes the offshore waters and coastlines within and in the vicinity of the Lease Area and the EW 1 and EW 2 submarine export cable routes (see **Figure 5.7-1**).

In accordance with BOEM's site characterization requirements in 30 CFR § 585.626(3) and BOEM's *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F* (Marine Mammal and Sea Turtle Guidelines; BOEM 2019), this section relies on several sources of data and information in its assessment of sea turtles, which may be present in the Project Area. These include regionally specific and Empire led focused studies, including:

- Avian site-specific aerial surveys by Empire that included sea turtle data (**Appendix P Ornithological and Marine Fauna Aerial Survey)**;
- PSO marine wildlife collected data (A.I.S. 2019; AOSS 2019);
- Digital aerial baseline surveys by NYSERDA of marine wildlife in support of offshore wind energy (Normandeau Associates and APEM 2018b);
- NYSDEC aerial survey data (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020);
- Geospatial sighting information retrieved from the OBIS datasets (Roberts et al. 2016a, 2016b, 2017, 2018, 2020; Halpin et al. 2009); and
- Publicly available or published literature on locally specific sighting data findings including:
    - NOAA surveys: Atlantic Marine Assessment Program for Protected Species surveys (AMAPPS I and II surveys);
    - Compendium Reports or Technical Reports (e.g., NJDEP 2006, 2010; NYSERDA 2017); and
    - Published peer reviewed studies including CETAP 1982, WCS Ocean Giants 2020 (on baseline noise levels), Burke et al. 1991 and 1994, and other sources.

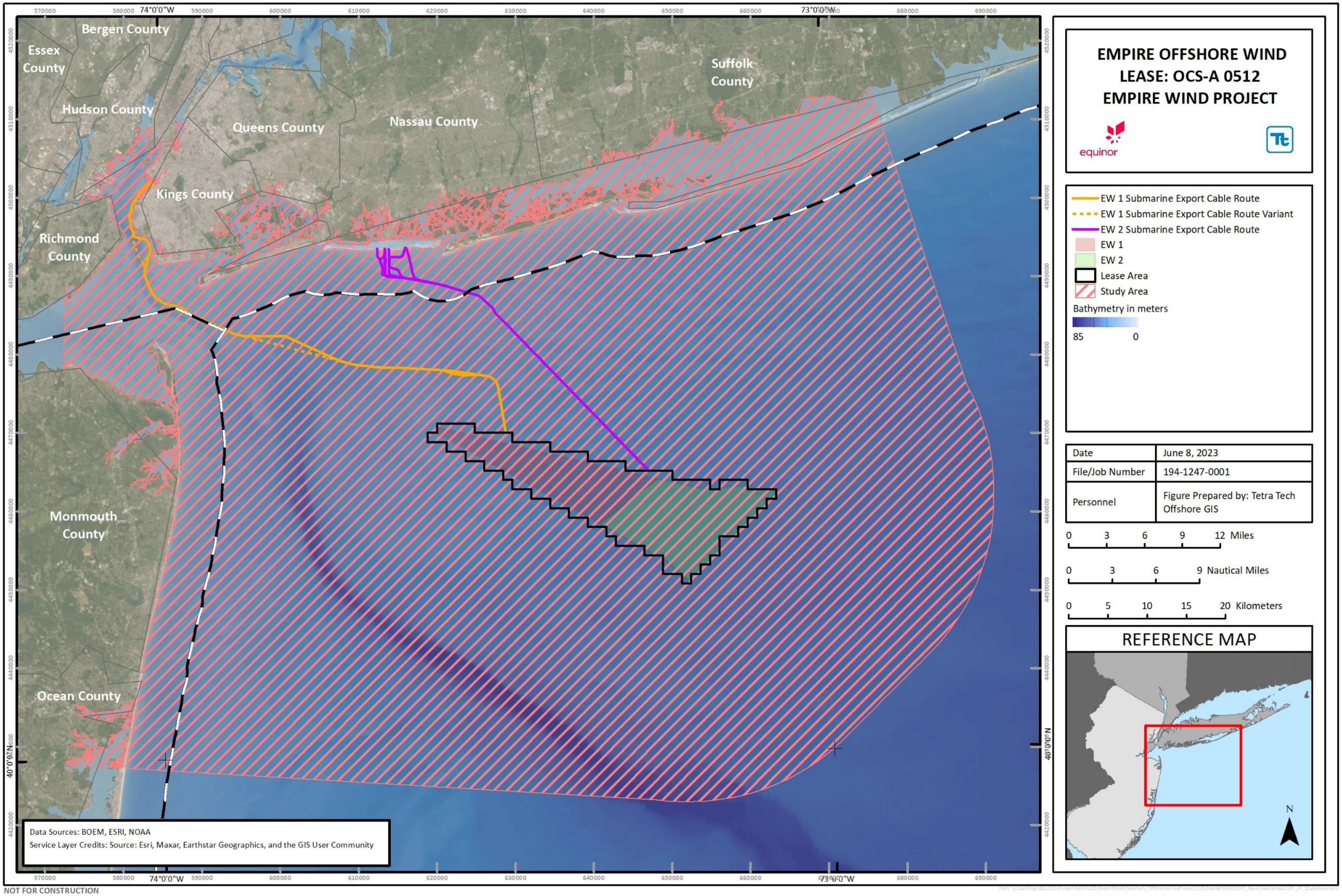

Figure 5.7-1 Sea Turtle Study Area

Empire supported the collection of Project-specific digital camera aerial survey sighting data and vessel-based visual sighting data that encompassed the Lease Area plus a 2.5-mi (4-km) buffer around it (see **Appendix P** for additional information). The aerial surveys were conducted monthly over the course of a year, from November 2017 to October 2018, and recorded sightings of avian, marine mammal, sea turtle, and other species, including sharks, rays, and large fish assemblages. The digital camera aerial data collected by Empire is intended to supplement the data collected by other entities, including the aerial survey data collected by NYSERDA (Normandeau Associates and APEM 2018b), which collected digital camera data within a larger area in New York Bight (encompassing the Lease Area). Data are also included from a visual observer line transect aerial survey project performed by Tetra Tech over the Lease Area and surrounding vicinity (these surveys fly directly over the Lease Area as part of a much larger study area located in the New York Bight) under contract to NYSDEC (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020).

PSO visual sighting data specific to the Project Area were also collected during Project-related vessel-based survey activities; Alpine Oceanic and Seismic Survey Inc.'s PSO sighting reports and A.I.S.'s PSO reports (A.I.S. 2019; AOSS 2019) include sightings from the Lease Area and surrounding waters. These sighting data are summarized in **Table 5.7-1** (aerial survey digital imagery data) and **Table 5.7-2** (PSO visual sighting data). Sighting data from these aerial surveys were organized by categorical regions defined as follows:

- Lease Area (sighting fell within Lease Area);
- Lease Area 6.2-mi (10-km) buffer (sighting fell within this buffer area of Lease Area [not including the Lease Area itself])[12];
- Submarine export cable siting corridor (sighting occurred along the submarine export cable route, within a corridor from 1,640 ft [500 m]) to 3,280 ft [1,000 m]) wide);
- Nearshore (sighting fell outside of Project Area and within state waters [within the 3-nm {5.56-km} limit from the coast]); and
- Offshore (sighting fell outside of the Project Areas in federal waters [outside the 3-nm {5.56-km} limit from the coast]).

Table 5.7-1 Aerial Survey Sighting Data Summary

Species	Lease Area	Lease Area 10 km buffer	Submarine Export Cable Siting Corridor	Nearshore	Offshore
Kemp's Ridley Sea Turtle	6	8	0	2	57
Loggerhead Sea Turtle	20	57	1	5	1,336
Green Sea Turtle	0	0	0	0	1
Leatherback Sea Turtle	0	2	0	1	45
Sea Turtle (unid.)	6	16	1	0	264

Sources: Normandeau Associates and APEM 2018b; site-specific surveys (**Appendix P**)

[12] Note that the digital camera aerial data collected by Empire (**Appendix P**) is limited to 2.5 mi (4 km) around the Lease Area while the digital camera aerial data collected by NYSERDA (Normandeau Associates and APEM 2018b) extends out to 6.2 mi (10 km).

Table 5.7-2 PSO Sighting Data Summary

Species	Lease Area	Lease Area 10 km buffer	Submarine Export Cable Siting Corridor	Nearshore	Offshore
Kemp's Ridley Sea Turtle	2	0	0	0	0
Loggerhead Sea Turtle	5	6	1	0	1
Green Sea Turtle	3	2	0	1	0
Leatherback Sea Turtle	1	1	0	0	0
Sea Turtle (unid.)	13	1	3	0	1

Sources: AOSS 2019; A.I.S. 2019

In addition, this section relies on publicly available information (including existing literature or reporting on sightings such as from newspaper or other historical accounts), including NOAA Species Directory data (NOAA Fisheries 2019a), scientific publications or technical reports, and geospatial sighting information retrieved from the OBIS datasets (Roberts et al. 2016a, 2016b, 2017, 2018, 2020; Halpin et al. 2009).

Additional data sources utilized include both general Mid-Atlantic sources to account for sea turtle general presence, as well as reports highly specific to the New York Bight data collection efforts. The general data sources include, but were not limited to; the NOAA Fisheries aerial and vessel-based AMAPPS (Atlantic Marine Assessment Program for Protected Species) surveys I and II and associated passive acoustic monitoring studies for marine mammals and/or sea turtles along the East Coast of the U.S., which includes sea turtle sighting data. Additional data sources include NOAA Fisheries 2017 and 2019b, CETAP 1982, NOAA Fisheries ESA Section 7 mapper tool (NOAA Fisheries 2018), Kraus et al. 2016, Kenney and Vigness-Raposa 2010, and data from entities such as the New York Audubon Society, New England Aquarium Marine Animal Rescue Program, and the Riverhead Foundation. Baseline data on ambient noise in the Study Area comes from acoustic buoys deployed in the area. WHOI and WCS deployed an acoustic buoy in the New York Bight (WHOI 2018) known as the "Blue York" buoy, deployed near the eastern boundary of the Lease Area. As part of a collaborative grant agreement with WCS and WHOI, Empire funded the deployment of two other real-time detection and monitoring buoys. The underwater noise measurements taken by these buoys will provide data on ambient baseline underwater noise within the Lease Area. They are planned to be active for at least two years and are deployed in the southeast quadrant of the Lease Area (known as the SE buoy) and in the northwest quadrant of the Lease Area (the NW buoy; WCS Ocean Giants 2020). Empire is open to future collaborations on relevant regional studies and is actively engaged with Regional Wildlife Science Entity efforts to gain additional information as feasible.

Findings from multiple surveys indicate that sea turtles may occur in the Project Area. Multiple studies or published findings show that sea turtles have been documented to occur in and around the Lease Area and along the submarine export cable routes, generally with seasonal presence. More information on species-specific details are described in **Section 5.7.1**.

5.7.1 Affected Environment

The affected environment, as described, is defined as the coastal and offshore areas where sea turtles are known to be present, traverse, or incidentally occur and have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the Project. This includes, but is not limited to, the Lease Area, submarine export cable siting corridors, and export cable landfall sites. Permits necessary for the improvement of port and construction/staging facilities will be the responsibility of the owners of these facilities. Empire expects such improvements will broadly support the offshore wind industry and will be governed by applicable environmental standards, which Empire will comply with in using the facilities.

5.7.1.1 Occurrence in the Study Area

There are five species of sea turtles that have been documented in or within the Northwest Atlantic OCS region waters, which includes waters of the Study Area. These species include Kemp's ridley (*Lepidochelys kempii*), loggerhead (*Caretta caretta*), followed by green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and the Atlantic hawksbill (*Eretmochelys imbricate*). The hawksbill is considered unlikely to occur and if seen would be as incidental transients; therefore, the hawksbill will not be discussed further in this section. **Table 5.7-3** provides a summary of key information for these species and their potential to occur in or near the Study Area. Sea turtle sightings within the Study Area are detailed in **Table 5.7-4** and **Figure 5.7-2**, and likelihoods of occurrence within the Study Area are described in species-specific sections. There is no Critical Habitat for sea turtles in the Study Area. **Figure 5.7-3** illustrates the sea turtle sightings collected by Empire (**Appendix P**) during quarterly aerial surveys and is presented as incidental sighting seasonal data.

In Study Area waters, these four sea turtle species (i.e., Kemp's ridley, loggerhead, green and leatherback) are likely to occur near the continental shelf edge and the outer edge of the Lease Area, with higher densities during summer and fall (June through November; NYSERDA 2017; AOSS 2019). However, they have the potential to be present year-round, albeit in very low numbers in the winter (winter sightings would be rare and due to cold-stunning). It is possible that any of these four species of sea turtles could also occur near the onshore portions of the Project, near the export cable landfall, as these areas may contain algae or eelgrass habitat, as well as benthic habitat for species of mollusks and arthropods that are the preferred diet of juvenile sea turtles (Morreale et al. 1992; Burke et al. 1994; Morreale and Standora 1998). Scoping for the Project locations included surveys of benthic habitat in order to identify if similar, alternative habitat was available and to avoid impacting sensitive foraging habitat for these species.

Sea turtles spend their life at sea, other than during nesting periods. There are no current habitual nesting sites in New York coastline habitat; sea turtles migrate over 1,000 miles (1,600 km) from their northern latitude feeding grounds to nesting grounds either in the southern U.S. or other countries to reproduce. Typically, the furthest north that sea turtle nesting occurs is in the southeastern U.S. (as far north as North Carolina), but there are exceptions. In what is thought to be the first of its kind, a Kemp's ridley nest was documented on Queen's Beach, New York, in 2018, where 96 eggs hatched and were released. Given that sea turtles return to natal beaches, this beach could be used for nesting again in 10 to 15 years (although it is acknowledged that there is a low probability that non-natal turtles also have the potential to nest on this and other similar beaches; Phorn 2018). In New York, sea turtles are known to occur throughout the nearshore waters as far north and west as the Lower Bay portion of Gowanus Bay.

Table 5.7-3 Sea Turtles Known to Occur in the Study Area

Name	Species Name	New York Status	Federal Status	Estimated Population	Known New York and New Jersey Distribution	Likelihood of Occurrence in Study Area	Seasonal Occurrence
Kemp's ridley	*Lepidochelys kempii*	E	E	N/A	Nearshore	Common	Spring to Fall with peak in Summer
Loggerhead	*Caretta*	T	T	588,000	Nearshore and Offshore (Continental Shelf)	Common	Spring to Fall with peak in Summer
Green	*Chelonia mydas*	T	T a/	N/A	Coastal	Regular, less common	Spring to Fall with peak in Summer
Leatherback	*Dermochelys coriacea*	E	E	20,000-30,000	Coastal; and Offshore (Continental Shelf)	Common	Spring to Fall with peak in Summer
Atlantic Hawksbill	*Eretmochelys imbricate*	E	E	N/A	Unlikely – northern reach of range	Unlikely/Rare	Summer

Sources: Shoop and Kenney 1992; UDSG 2000; Bass and Witzell 2000; DoN 2005; NYSDOS 2013; NYSERDA 2017, 2018; NOAA Fisheries 2019a,b,c; Normandeau Associates and APEM 2018b

E = endangered, T = threatened

Note

a/ Green sea turtle juveniles from the threatened population of the North Atlantic District Population Segment are most common

Table 5.7-4 Seasonal Sea Turtle Sightings in the Study Area

Name	Species Name	Empire Sightings a/	AOSS Data Sightings b/	NYSDOS Data Sightings c/	NYSERDA Data Sightings d/
Kemp's Ridley	*Lepidochelys kempii*	8 (Summer)	1 (May–Jul) 1 (Jul–Sep)	73 (Annual)	205 (Summer) 11 (Fall) 13 (Spring)
Loggerhead	*Caretta*	18 (Summer) 5 (Fall)	5 (May– Jul) 1 (Sep–Dec)	1,236 (Annual)	5,301 (Summer) 67 (Fall) 11 (Winter) 66 (Spring)
Green	*Chelonia mydas*	–	5 (Jul–Sep)	7 (Annual)	14 (Summer)
Leatherback	*Dermochelys coriacea*	–	2 (May–Jul)	169 (Annual)	123 (Summer) 315 (Fall)
Atlantic Hawksbill	*Eretmochelys imbricate*	–	–	-	-
Unidentified Turtle	N/A	1 (Summer) 5 (Summer) e/	11 (May–Jul) 7(Jul –Sep)	154 (Annual)	1,872 (Summer 45 (Fall) 27 (Spring)

Sources: NYSDOS 2013; Normandeau Associates and APEM 2018b; AOSS 2019; **Appendix P**

Notes:
a/ Empire sightings were from aerial surveys performed in 2017-2018 (see **Appendix P**)
b/ AOSS Data sightings were from visual and acoustic shipboard surveys from 2018-2019
c/ NYSDOS 2013 Sightings include total numbers comprised of thousands of surveys between 1978 and 2011
d/ Normandeau Associates and APEM 2018b sightings include total numbers of abundance from Summer 2016-Spring 2017
e/ Five turtles were documented as either Loggerhead or Kemp's ridley sea turtles, but identity was not confirmed, and is therefore kept as a separate statistic.

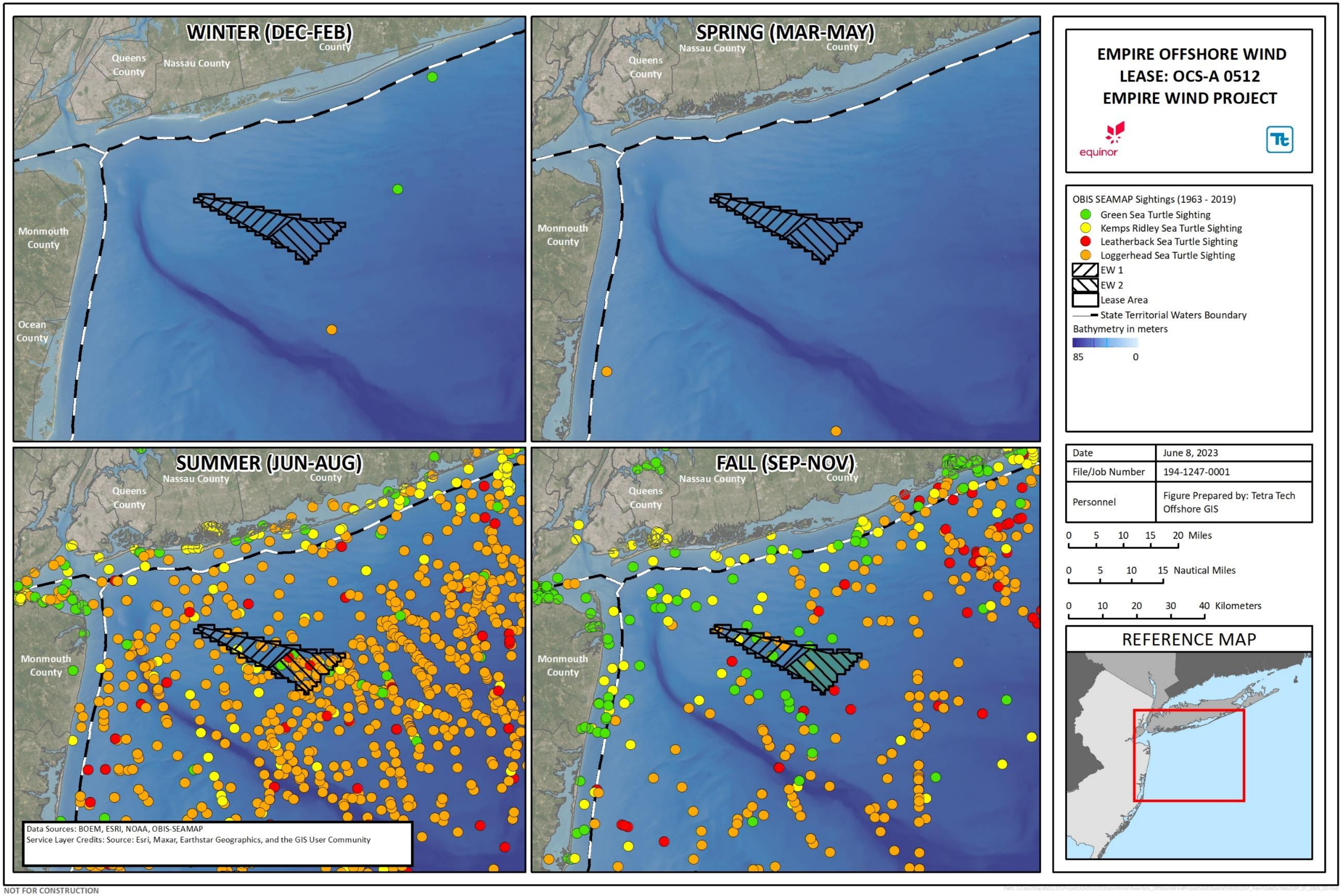

Figure 5.7-2 Seasonal Sea Turtle Sightings in the Study Area

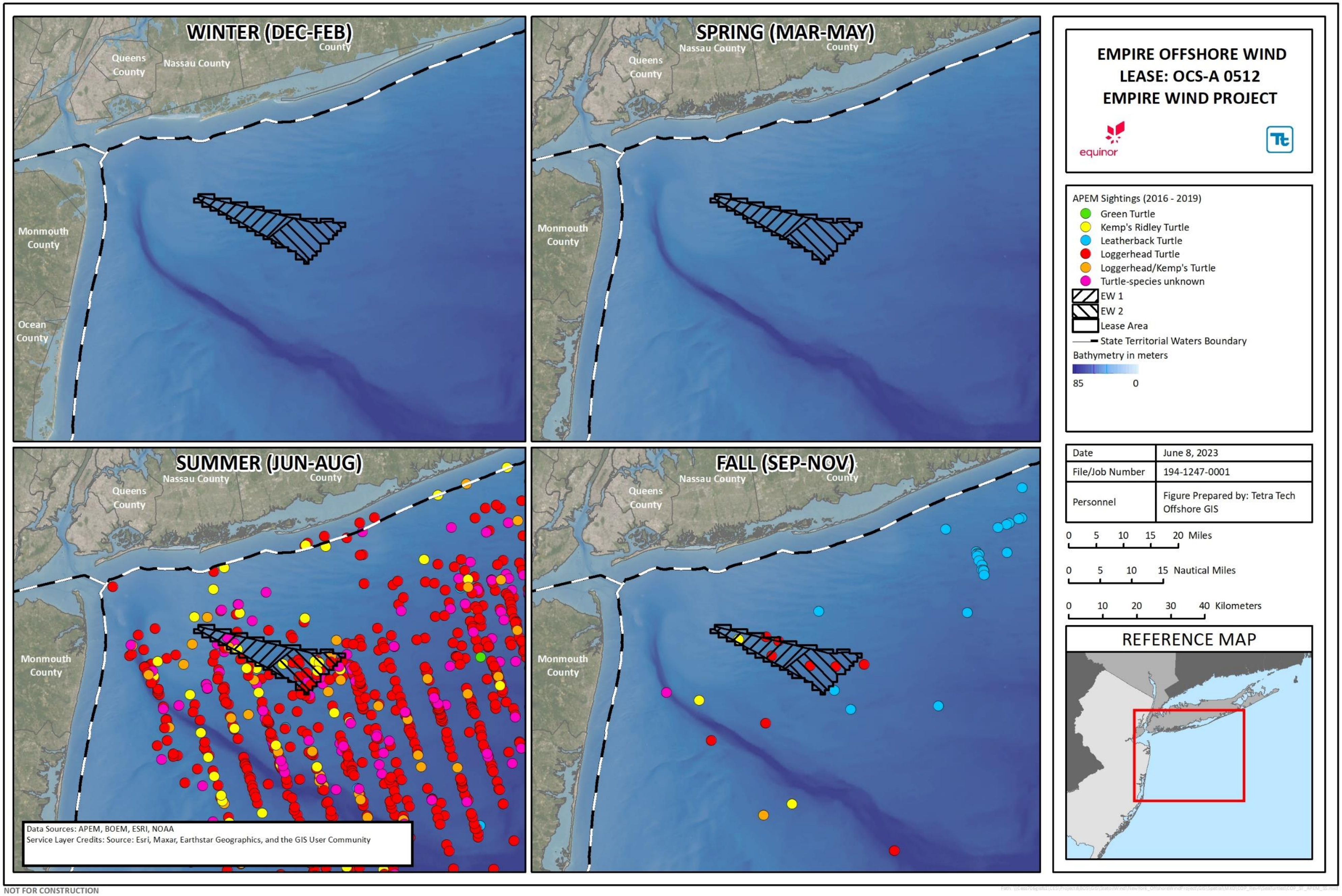

Figure 5.7-3 Empire-Collected Aerial Survey Sea Turtle Sightings in the Study Area (Normandeau Associates and APEM 2018b)

As ocean temperatures increase in the spring, sea turtles typically migrate from southeastern U.S. waters to the estuarine habitats of the Mid-Atlantic where an abundance of algae and eelgrass occurs (Morreale and Standora 1998; Lazell 1980). Peak occurrence of sea turtles in the Northeast U.S. Continental Shelf Large Marine Ecosystem (which includes the Study Area) is in the summer and fall months, with a peak density in September (Kenney and Vigness-Raposa 2010), but with occurrences through early winter. Turtles may be present in the spring, heading into summer, and can occur in the winter if they are cold-stunned, which is described in further detail in the following paragraph. Historically, sea turtles begin migrating south to North Carolina in October, and most individuals are gone by the first week of November. There is some evidence that sea turtle numbers are increasing in the New York Bight and New York coastal waters (NYSDEC 2018) and that occurrence durations are longer. Due to regional temperature trends, it is less likely that sea turtles are present in the Study Area from late fall through early spring as waters get colder, although cold-stunned turtles can occur. As the water continues to lower in temperature into the late fall and early winter, sea turtles typically migrate southward, following these warmer waters. Kemp's ridley and loggerhead sea turtles are the most likely to be present in the Study Area. While they are most abundant during summer and fall seasons, they also have the potential to occur year-round in the Study Area (Tetra Tech and SES 2018; Tetra Tech and LGL 2019 and 2020).

Some sea turtles do not migrate southward in the fall for unknown reasons. It is possible that some turtles may forage in shallow bays and inlets and do not migrate in time prior to water temperature dropping (NOAA Fisheries 2012). As described, sea turtles that remain in northern waters after the first week of November can be affected by "cold stunning", which occurs when temperatures drop rapidly or unexpectedly. Cold stunning refers to the hypothermic reaction that occurs when sea turtles are exposed to prolonged cold water temperatures and as a result undergo symptoms that may include decreased heart rate, decreased circulation, lethargy, shock, pneumonia, and possibly death. Cold stunning in the Study Area typically peaks in the month of November, with a reduction in incidents through December and January (Morreale et al. 1992; Burke et al. 1994; Morreale and Standora 1998). Depending on the source and time period reported, numbers of cold-stunned sea turtles have varied, although overall there has been an increase over time. Kenney and Vigness-Raposa (2010) reported that in 1985, 56 sea turtles were found cold-stunned in eastern Long Island. Griffin et al. (2019) states that before 2009, there were only two years in which numbers of cold-stunned turtles exceeded 100. However, in 2014, Griffin et al. (2019) reported more than 1,100 Kemp's ridley sea turtles stranded in New England waters.

Cold stunning typically affects juveniles more than adults (Kenney and Vigness-Raposa 2010). Models show that higher cold stunning years will occur when sea surface temperatures are warmer, since warmer temperatures are likely to modify seasonal distributions; affect currents, eddies, and thermoclines that factor into sea turtle movements and presence; and cause sea turtles to occur in more northerly areas. A mismatch between typical foraging periods and colder temperatures can occur. As sea turtles are cold-blooded and depend on external sources of heat to determine their body temperature, cold water is not a preferred or optimal habitat.

There are also several other existing threats that are shared among all sea turtle species. Along the U.S. Atlantic Coast, anthropogenic threats that pose the greatest population-level effects on sea turtles are from fisheries bycatch and habitat loss, which have both indirect and direct effects (82 Federal Register 57565). Other threats include (USFWS 2018a-d):

- Entanglement with fishing gear (ghost nest, discarded line or gear);
- Vessel strikes;
- Degradation of nesting habitat in other portions of their range, either from physical reduction or from lighting effects;

- Predation and harvest of sea turtle eggs and adult turtles, which continues to be a threat in many parts of the world;
- Degradation of foraging habitat; and
- Disease.

5.7.1.2 Species Overview

Of the five species of sea turtles that have been documented in or within the Northwest Atlantic OCS region waters, the juvenile Kemp's ridley and loggerhead are the most abundant species that occur and are likely to occur within the Study Area (NYSERDA 2017, 2018; NYSDOS 2013; AOSS 2019). They are found in nearshore waters, where they are known to forage during their early life years of three to seven (Morreale et al. 1992; Burke et al. 1994; Morreale and Standora 1998). Green and leatherback sea turtles are also known to regularly occur in the Study Area. While sea turtles are most common in the Study Area in the summer and fall, they have been sighted year-round (NYSERDA 2017; NYSDOS 2013; Normandeau and APEM 2018b; AOSS 2019; Tetra Tech and SES 2018, Tetra Tech and LGL 2019 and 2020). Sea turtle age classes present in the Study Area include both juveniles and adults; however, juveniles typically occur in larger numbers (Morreale et al. 1992; Burke et al. 1994; Morreale and Standora 1998; NOAA Fisheries 2019c). A brief natural history species description is provided in the subsequent species-specific sections.

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

The Kemp's ridley sea turtle is the smallest of the Cheloniidae sea turtles (in the family of larger marine turtles, having a flat, wide, and rounded shell and paddle-like flippers). It is federally listed under the ESA and state-listed as endangered in New York (NOAA Fisheries 2019a). Adults average a carapace (top shell) length of about 2 ft (65 cm), a weight of 99 pounds (lbs) (45 kilograms [kg]) and typically have a rounded shape and light gray coloring.

During early life stages, Kemp's ridley turtles inhabit open-ocean areas within the North Atlantic Ocean. The northern extent of this species' range is considered to be Nova Scotia, although northern travel is typically only noticed during the juvenile stage. Primary habitation tends to be in the Gulf of Mexico, with large juveniles and adults moving towards benthic, nearshore habitats along the U.S. Atlantic and Gulf coasts (Lazell 1980). This stage typically includes sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters within warm-temperate to subtropical conditions (Lutcavage and Musick 1985). Within the Study Area, primarily juveniles occur (NYSERDA 2017; Normandeau Associates and APEM 2018b). During summer months, feeding areas for this species are found in nearshore waters where blue crabs (a prey species) can be found (DoN 2005; UDSG 2000). In addition to crabs, Kemp's are also known to feed on mollusks, shrimp, fish, and plant material (Ernst et al. 1994).

Kemp's are found within the continental shelf waters of the northeast U.S. mainly during the summer or fall, though they can be found in the area at any time of the year (DoN 2005; USFWS 2018a; Kenney and Vigness-Raposa 2010). They are one of the most commonly seen sea turtles in the New York Bight. They also are the most common sea turtle species subject to cold stunning (NOAA Fisheries 2019d; NYSDEC 2019). Recent aerial survey data recorded Kemp's in New York waters; there were 73 sighted (six in the Lease Area; six in the Lease Area 2.5-mi (4-km) buffer; two in the nearshore area, and 59 in the offshore area); the largest numbers were documented offshore. PSO data from Empire-collected visual shipboard surveys specific to the Project Area had three sightings (two in the Lease Area and one along the submarine export cable siting corridor).

Globally, the Kemp's ridley turtle is considered the most endangered sea turtle, as this species faces a number of threats from fisheries bycatch, entanglement, marine debris, noise pollution, vessel strike, and habitat loss

(NOAA Fisheries and USFWS 1992a; DoN 2005; NYSERDA 2017; Normandeau Associates and APEM 2018b; NOAA Fisheries 2019a).

In the Study Area, densities are highest from June through November (Hofstra 2017). The annual density of Kemp's in the Study Area is depicted on **Figure 5.7-4**. Empire (**Appendix P**), Tetra Tech and SES (2018), and Tetra Tech and LGL (2019, 2020) surveys sighted Kemp's in the Study Area in the summer months (July and August). Therefore, the Kemp's ridley turtle is likely to be present in the Study Area, with highest likelihood of occurrence in the warmer months.

Loggerhead Sea Turtle (*Caretta caretta*)

The loggerhead sea turtle is federally listed under the ESA as threatened and state-listed as endangered in New York (NOAA Fisheries 2019a). This species derives its name from its relatively large head size. It is a larger hard-shell species that has a typical carapace length of 3 ft (92 cm) and an average weight of 249 lbs (113 kg). Adult coloring tends to be a red-brown surface with golden coloring underneath (DoN 2005). Post-hatchling loggerheads have been observed feeding on zooplankton, jellyfish, larval shrimp, and crabs (Carr and Meylan 1980). Adult turtles are believed to maintain a carnivorous diet of nearshore benthic invertebrates while juveniles are considered omnivores, feeding on crabs, mollusks, vegetation, and jellyfish (Dodd 1988).

The loggerhead can be found globally in both nearshore waters, including coastal estuaries, and offshore habitats throughout their lifespan (Dodd 1988). Continental shelf waters in the Mid-Atlantic have been identified as juvenile loggerhead feeding territory (USFWS 2018b). Throughout the U.S., loggerheads are considered to be one of the most abundant sea turtles. Along with the Kemp's, loggerheads (especially juveniles) are commonly observed in the Study Area (see **Figure 5.7-5** for the annual density). They are most common during the summer and along the continental shelf (NYSDEC 2019; Normandeau Associates and APEM 2018b; NYSERDA 2017). Recent aerial survey data documented loggerheads in New York waters. They were sighted in the Lease Area and 2.5-mi (4-km) buffer, along the submarine export cable siting corridors, and in the nearshore and offshore areas. The largest numbers (over 1,400) were documented offshore, in significantly higher numbers than in any of the other areas. PSO data from Empire-collected visual shipboard surveys specific to the Project Area had 14 sightings (five in the Lease Area; two in the Lease Area 2.5-mi (4-km) buffer; six along the submarine export cable routes; and one offshore).

Threats to loggerhead turtle populations include bycatch, entanglement, vessel strikes, ingestion of marine debris, habitat loss, and harvest (NOAA Fisheries and USFWS 1991a, NJDEP 2006).

It is estimated that approximately 8,000-11,000 loggerheads can be found in northeastern U.S. waters in the summer, with a 1998 aerial survey finding that approximately 73 percent of all western North Atlantic loggerheads live within the waters of the U.S. Atlantic Coast (TEWG 1998; Shoop and Kenney 1992). Empire (**Appendix P**), Tetra Tech and SES (2018), and Tetra Tech and LGL (2019, 2020) surveys sighted loggerheads in the Project Area in the summer and fall. Therefore, loggerhead sea turtles are likely to occur in the Study Area, with the highest likelihood in the warmer months.

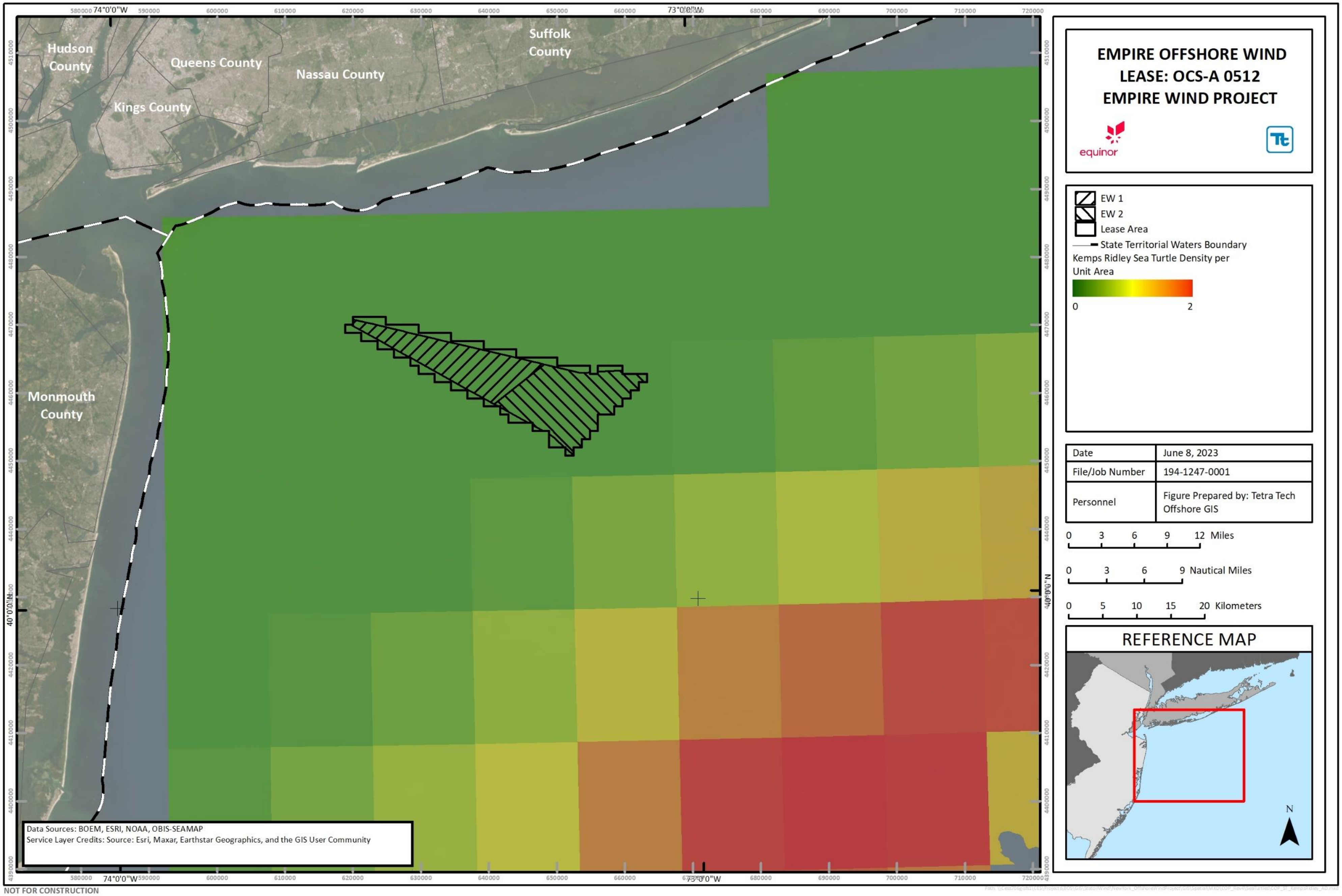

Figure 5.7-4 Annual Density of Kemp's Ridley Sea Turtles in the Study Area

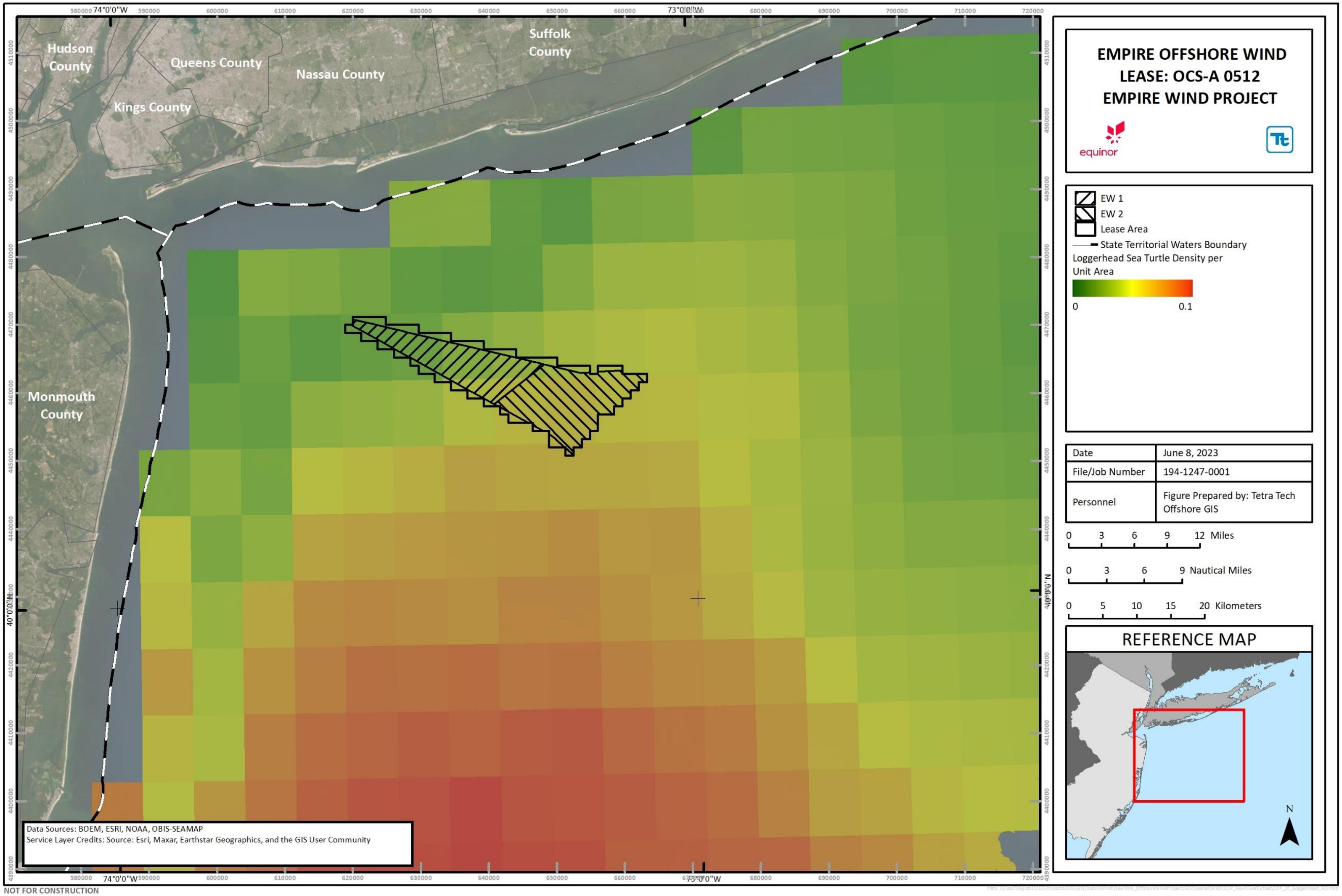

Figure 5.7-5 Annual Density of Loggerhead Sea Turtles in the Study Area

Green Sea Turtle (*Chelonia mydas*)

Green sea turtles are divided into several DPSs that have different federal (ESA) status. The most common individuals found in the Study Area (either as juveniles or adults) are from the North Atlantic DPS, which are federally listed as threatened under the ESA and state-listed by New York as threatened. A second DPS derived from nesting populations from the Florida and Mexican Pacific coasts also has the potential to be found in the Study Area, though is less likely to occur. This DPS is federally listed as endangered (NOAA Fisheries and USFWS 1991b). State listings are not broken down by DPS. As such, green turtles found in the Study Area could be a mix of offspring from both the federally threatened DPS and the federally endangered juvenile nesting population individuals (Bass and Witzell 2000).

As the largest species of the hard-shelled sea turtles, green sea turtle adults can reach a size of up to 330 lbs (150 kg) and a 3.3-ft (100-cm) carapace (NOAA Fisheries and USFWS 1991b). "Green" refers to the color of their subdermal (beneath the skin) fat deposits and not to their external coloring. At birth, green turtles are typically about 2 in (50 mm) long and approximately 0.05 lbs (25 g). As adults, their appearance can vary with carapaces ranging in colors, including solid black, gray, yellow, green, and brown patterns. While hatchlings have a black dorsal (upper side/back) surface and white ventral (underneath/'belly') coloring, adults are typically found with a light yellow or white plastron (bottom shell) (DoN 2005). Adult shells have five bony plates along the middle and four additional plates on each side, along with two large scales found between the eyes (NOAA Fisheries 2019a). During the post-hatchling and early juvenile phase, green turtles have an omnivorous diet and are known to eat algae, invertebrates, and small fishes (Ernst et al. 1994). However, late-juvenile and adult turtles maintain a primarily herbivorous diet of algae, seagrasses, and occasionally sponges and invertebrates (NOAA Fisheries 2019a).

Green turtles can be found globally in both tropical and subtropical waters (Ernst et al. 1994). Generally, hatchlings are found in offshore areas for several years before traveling to nearshore foraging areas as juveniles (NOAA Fisheries 2019a). As adults, green turtles typically live in nearshore environments, bays, lagoons, reefs, and seagrass beds (NOAA Fisheries 2019a). Within the United States, the species can be found near the U.S. Virgin Islands, Puerto Rico, and within the waters from Texas to Massachusetts (NOAA Fisheries and USFWS 1991b). Typically, individuals found north of Florida during the warmest months of the year are likely to be juveniles (Herren et al. 2018). Along the East Coast of the U.S., this species accounts for 10 to 20 percent of the inshore sea turtle fauna throughout the year (DoN 2005).

The major threats facing this species include bycatch, harvesting of eggs, loss of nesting habitat, entanglement, vessel strikes, and disease (NJDEP 2006; NYSERDA 2017; USFWS 2018c; NOAA Fisheries 2019a). While not legal in the U.S., some countries allow for the killing of green turtles and harvesting of their eggs, which contributes to a global decline in population (NOAA Fisheries 2019a). The species also faces a loss of nesting habitat due to coastal development, sea level rise, and light pollution (NOAA Fisheries 2019a). Green sea turtles are also subject to fibropapillmatosis, a disease that causes both internal and external tumors. These tumors are generally benign, though can be debilitating and thus indirectly responsible for fatalities. They are more common in juvenile turtles (NOAA Fisheries 2019a).

Recent aerial survey data documented one green sea turtle in New York waters in the offshore area. PSO data from Empire-collected visual shipboard surveys specific to the Study Area had six sightings (three in the Lease Area; two in the Lease Area 2.5-mi (4-km) buffer; and one nearshore). Green sea turtles are most commonly observed migrating through Study Area waters during the mid-summer months for feeding (Hofstra 2017), and are therefore likely to occur in the Study Area during these months.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is federally and state-listed in New York as endangered. It is the largest of the sea turtle species, with a range in carapace length of 4 to 6 ft (130 to180 cm) and weight of 440 to 1,543 lbs (200 to 700 kg) The leatherback has a unique carapace that lacks the common scute (bony plate) structure seen in other sea turtles, and instead is made up of a pliable dermal bones in a tapered, barrel shape with seven dorsal ridges. Leatherback coloring is typically black with some spotting and a unique dot located on the dorsal side of the animal's head (McDonald and Dutton 1996). Leatherbacks tend to maintain a diet heavily focused on jellyfish (primarily lion's-mane and arctic) and salps, but have also been known to prey upon other species and will feed throughout the water column (Bjorndal 1997).

Currently, it is estimated that there are about 20,000-30,000 leatherbacks in the North Atlantic Ocean (Coren 2000). It is believed that habitat preferences for early life stages of this species are likely entirely oceanic. However, adult leatherbacks can typically be found in both mid-ocean to continental shelf and nearshore waters (NOAA Fisheries and USFWS 1992b; Schroeder and Thompson 1987). The northern extent of the leatherback range is considered to be Nova Scotia, Newfoundland, Labrador, Iceland, and Norway (Ernst et al. 1994). The leatherback is unique in that it moves into cooler water more than any other turtle species. It is estimated that at least 100-900 leatherbacks reside within the northeastern U.S. continental shelf waters seasonally each summer (Shoop and Kenney 1992). Leatherbacks display significant migration patterns and can be seen off the Mid-Atlantic beginning in the spring and early summer months (Shoop and Kenney 1992). While most abundant in the summer, leatherbacks could be present within the Study Area region at any time of year. Leatherbacks tend to be most concentrated near southern New Jersey and the southeastern end of Long Island (Shoop and Kenney 1992).

The biggest global threats to the leatherback population include bycatch in fishing gear such as gillnets, longlines, trawls, and traps, and ingestion of marine debris (NOAA Fisheries and USFWS 1992b; USFWS 2018d; NOAA Fisheries 2019a; NJDEP 2006, 2010). Bycatch in commercial fisheries is a known impact on leatherback sea turtles (Lewison et al. 2004). Incidental capture in longline and coastal gillnet fisheries has caused a substantial number of leatherback sea turtle deaths, likely because leatherback sea turtles dive to depths targeted by longline fishermen and have less maneuverability than other sea turtle species due to their size. Since leatherback sea turtle distribution is closely associated with jellyfish aggregations, as they are a major prey source, any changes in jellyfish distribution or abundance would likely also be a threat to this species. Leatherback turtles also face threats due to the harvest of their eggs (outside of the U.S.), vessel strikes, and habitat loss (NOAA Fisheries 2019a).

Leatherback sea turtles are most commonly observed when they migrate through the Project Area waters during the mid-summer months for feeding (Hofstra 2017). Recent aerial survey data documented 48 leatherback sea turtles in New York waters: one in the Lease Area 2.5-mi (4-km) buffer, one nearshore, and 46 offshore. PSO data from Empire-collected visual shipboard surveys specific to the Project Area had two sightings (one in the Lease Area and one in the Lease Area 2.5-mi (4-km) buffer). Leatherbacks in the Study Area are most likely to be juveniles and adults (NJDEP 2006). Tetra Tech and SES (2018) and Tetra Tech and LGL (2019, 2020) surveys sighted this species in the spring, summer, and fall in the Study Area. **Figure 5.7-6** details the annual density of leatherback sea turtles within the Study Area.

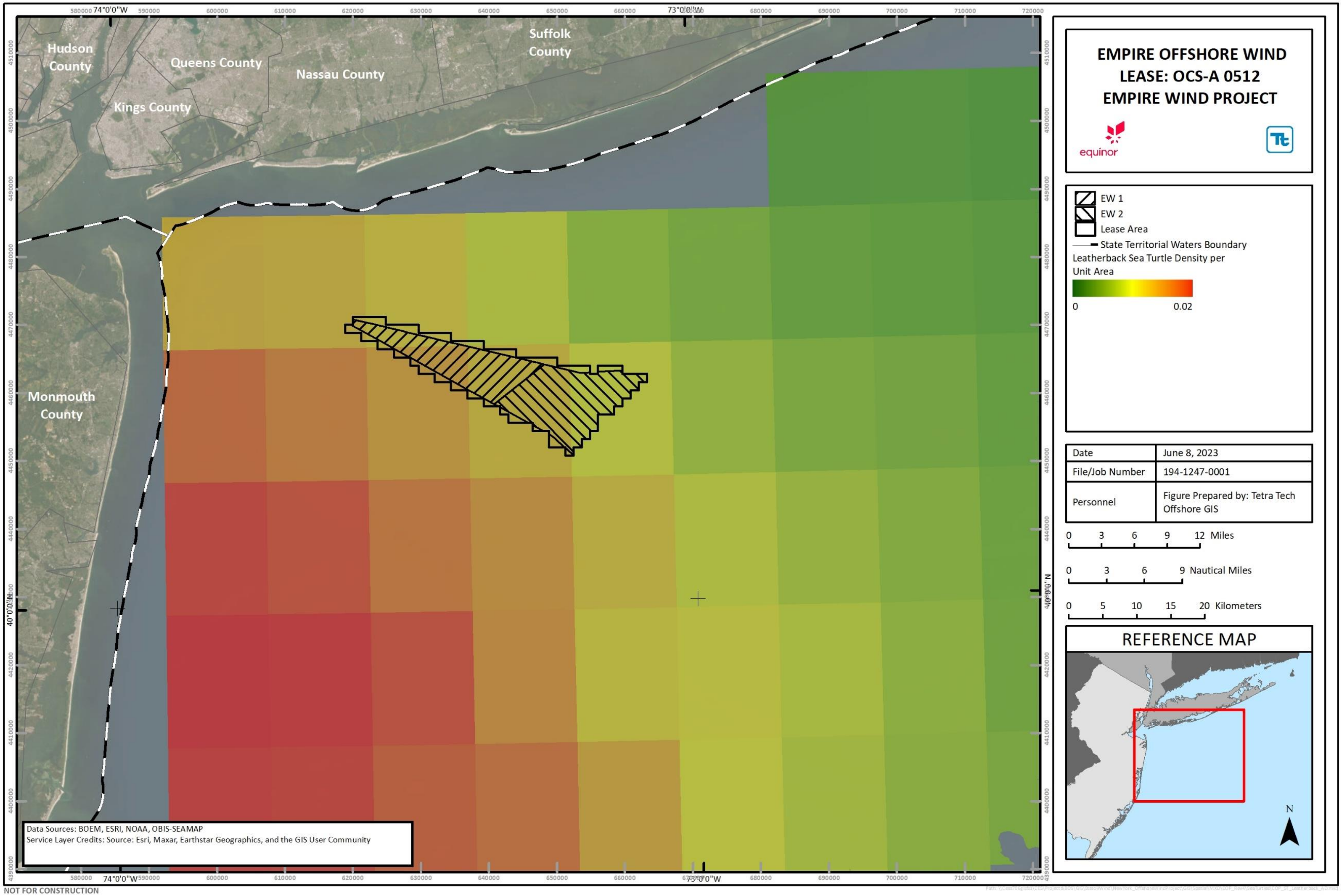

Figure 5.7-6 Annual Density of Leatherback Sea Turtles in the Study Area

5.7.2 Impacts Analysis for Construction, Operations, and Decommissioning

The potential impacts resulting from the construction, operations, and decommissioning of the Project are based on the maximum design scenario from the PDE (for a complete description of the construction, operations, and decommissioning activities that Empire anticipates will be needed for the Project, see **Section 3**). For sea turtles, the maximum design scenario is the maximum number of wind turbines, and therefore fixed structures in the water, as described in **Table 5.7-5**. The maximum design scenario for assessments associated with full build-out of EW 1 and EW 2 and incorporates a total of up to 149 structures at 176 locations within the Lease Area (made up of up to 147 wind turbines and 2 offshore substations) with two distinct submarine cable routes to EW 1 and EW 2. Two wind turbine foundation types were also considered for benthic impacts; monopiles for wind turbine foundations and piled jackets for offshore substation foundations (see **Section 3** for descriptions). Calculations supporting the maximum design scenario are shown in **Table 5.7-6** through **Table 5.7-9**.

Table 5.7-5 Summary of Maximum Design Scenario Parameters for Sea Turtles

Parameter	Maximum Design Scenario	Rationale
Construction		
Offshore structures	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum number of structures for EW 1 and EW 2.
Wind turbine foundation	Monopile	Representative of foundation option that has an installation method that would result in the maximum introduction of underwater noise.
Wind turbine foundation Installation method Underwater Noise	Pile driving	Representative of the installation method that would result in the loudest underwater noise generated.
Duration Foundation installation	Based on full build-out of EW 1 and EW 2 (147 wind turbines and 2 offshore substations). EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the longest period of foundation installation via pile driving.

Table 5.7-5 Summary of Maximum Design Scenario Parameters for Sea Turtles (continued)

Parameter	Maximum Design Scenario	Rationale
Underwater noise Pile driving – Monopile	Pile diameter: 36 ft (11 m) Max penetration: 180 ft (55 m) Max hammer energy: 5,500 kJ Typical hammer energy (monopiles): 2,300 kJ Total average pile driving duration per foundation: 3 hours 30 minutes Total duration: 441 hours EW 1: 171.5 hours EW 2: 270.5 hours	The longest temporal duration of impact for monopiles, which equates to the maximum number of pile-driving events.
Underwater noise Pile driving – piled offshore substations (EW 1 and EW 2)	Pile diameter: 8 ft (2.5 m) Max penetration: 295 ft (90 m) Number of piles per foundation: 12 Max hammer energy: 4,000 kJ Typcial hammer energy: 3,200 kJ Total max pile driving duration: 3 hours 30 minutes Total number of piles for: EW 1: 12 EW 2: 12 Total duration of pile driving: EW 1: 42 hours EW 2: 42 hours	The longest temporal duration of impact for piled jackets for offshore substations, which would result in the maximum of two offshore substations. 176 hours is considered the maximum amount of time required to pile all pile driven jackets for offshore substations (active pile driving; for EW 1 and EW 2).
Project-related vessels Collision risk Underwater noise	Based on full build-out of EW 1 and EW 2, including foundations (147 wind turbines and 2 offshore substations), submarine export and interarray cables, and associated vessels. EW 1: 57 wind turbines and 1 offshore substation. EW 2: 90 wind turbines and 1 offshore substation.	Representative of the maximum predicted Project-related vessels for collision risk and underwater vessel noise.
Operations		
Wind turbines Underwater noise	Based on full build-out of EW 1 and EW 2, which represent the maximum number of machines (147).	Representative of the maximum underwater noise generated by operational wind turbines.
Project-related vessels Collision risk Underwater noise Anchor snags	Based on a full build-out of EW 1 and EW 2 (147 wind turbines, 2 offshore substations, submarine export cable routes, and associated interarray cables). Based on maximum number of vessels and movements for servicing and inspections.	Representative of the maximum predicted Project-related vessels for collision risk, underwater noise, and anchor snags.

Table 5.7-5 Summary of Maximum Design Scenario Parameters for Sea Turtles (continued)

Parameter	Maximum Design Scenario	Rationale
Loss of habitat Foundation type	Based on the maximum overall footprint (147 x 39,902 ft^2 [3,707 m^2] for monopiles with scour protection and 2 x 93,560 ft^2 [8,692 m^2] for piled jackets with scour protection). Total 6,052,714 ft^2 (562,315 m^2, 139 acres, 56.2 ha) including scour protection.	Representative of the maximum long-term loss of seabed habitat.
EMF Interarray cables	Based on full build-out of EW 1 and EW 2, with the maximum number of structures (147 wind turbines and 2 offshore substations) to connect. EW 1: 116 nm (214 km). EW 2: 144 nm (267 km).	Representative of the maximum length of interarray cables, which would result in the maximum exposure to EMF within the Lease Area.
EMF Submarine export cables	Based on full build-out of EW 1 and EW 2. EW 1: 40 nm (74 km). EW 2: 26 nm (48 km).	Representative of the maximum number and length of submarine export cables, which would result in the maximum exposure to EMF on the cable routes.

Table 5.7-6 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Acoustic Impacts of Pile Driving Offshore

Type and Size	Number of Wind Turbines	Pile Diameter (m)	Drive Time per Foundation (hr)	Total Drive Time (hr)	Max Energy (kJ)
Monopile	147	11	3	441	5,500

Table 5.7-7 Supporting Calculations: Maximum Design Scenario for Wind Turbine Foundations for Benthic Impacts Offshore

Type and Size	Number of Wind Turbines	Foundation Diameter at Substrate (m)	Foundation Footprint (m^2)	Total Foundation-Buried Substrate (m^2)	Total Foundation-Buried Substrate (ha)
Monopile	147	11	95	13,965	1.4

Table 5.7-8 Supporting Calculations: Required Scour Protection for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation Area at Substrate (m^2)	Scour Protection Around each Foundation (m^2)	Total Scour Protection (ha)
Monopile	147	95	3,490	51.3

Table 5.7-9 Supporting Calculations: Total Habitat Conversion to Hard Bottom for Wind Turbine Foundations

Type and Size	Number of Wind Turbines	Foundation Diameter at Substrate (m)	Foundation Footprint with Scour Protection (m^2)	Total Benthic Habitat Conversion (ha)
Monopile	147	11	3,707	52.7

As discussed in Section 5.7.1, until very recently there were no known nesting sites in the Study Area. In 2018, the first Kemp's ridley nest was documented on Queen's Beach, New York. There is potential for this beach to be used for nesting again in 10 to 15 years (Phorn 2018). However, the Project facilities, in particular the submarine export cable routes and export cable landfall sites, are not located in Queen's Beach. There is no Critical Habitat for sea turtles in the Study Area. No impacts are expected for sea turtles onshore (the known nesting area would be subject to rigorous protections and no onshore Project actions would occur in proximity); as such, this section will only describe potential impacts in the offshore environment.

5.7.2.1 Construction

During construction, the potential impact-producing factors to sea turtle species will be similar to those described for marine mammals in **Section 5.6 Marine Mammals**. It is also important to note that the four sea turtle species observed in the Study Area are present in the highest numbers from late spring through early fall (April through October), when these potential impacts are likely to have the greatest effect. Combined annual sea turtle density estimates for the waters of the Study Area for leatherback, loggerhead, and Kemp's ridley are less than one animal per 100 square kilometers (km^2) (BOEM 2018)[13]. Broken out by species, where data are available, the estimates are as follows: leatherbacks have a seasonal density of 0.03 animals/km^2 for spring, fall and winter (there is no estimate for summer); loggerhead have a seasonal density of 0.11 animals/km^2 for all four seasons; and Kemp's ridley have a seasonal density of 0.01 animals/km^2 for all four seasons. These are low statistical densities based on calculations that account for effort data (hours of observations combined with distance observed) and sightings. However, documented occurrences of all five species are known from the Study Area based on multiple studies and surveys. Overall, there is a potential for sea turtles to be co-located with Project activities, especially in the summer and fall.

During construction, the potential impact-producing factors to sea turtle species may include:

- Construction of offshore components, including foundations, wind turbines, offshore substations, submarine export cables, and interarray cables.

The following impacts may occur as a consequence of factors identified above:

- Short-term disturbance of habitat;
- Short-term loss of local prey species and availability;
- Short-term increase in construction-related lighting;
- Short-term increase in marine debris;
- Short-term increased risk for entanglement and entrapment in Project-related equipment;
- Short-term increase in Project-related underwater noise;
- Short-term increased risk for ship strike due to the increase in vessel traffic; and
- Short-term potential for a change in water quality, including oil spills.

Short-term disturbance of habitat. Installation of the foundations and submarine export and interarray cables, including associated activities such as cable laying, dredging and burial activities, and cable armoring, will result in the temporary disturbance of the seafloor during construction activities. Disturbance of seabed sediments during offshore construction and installation activities could have effects on marine water quality resulting in short-term increases in turbidity and sedimentation due to increases in total suspended solids in the water column resulting from sediment resuspension and dispersal; however, impacts on water quality are

[13] Data was not available for the Green sea turtle.

expected to be short-term and localized (Latham et al. 2017). To evaluate the impacts of submarine export and interarray cable installation, a conservative analytical sediment transport model was developed using publicly available data to quantify potential maximum plume dispersion and sediment concentrations and potential maximum sediment deposition thicknesses (see **Appendix J** for a full description of the methodology and results). The model simulated jet plow, mass flow excavation, and dredging installation methodologies, which would result in the greatest disturbance of marine sediments and therefore provide the maximum expected disturbance of seabed sediment in the Study Area. The Sediment Transport Analysis predicted that the plume would typically travel between 328 ft (100 m) and 1,640 ft (500 m) during flood and ebb conditions along the majority of the submarine export cable routes and in the Lease Area. In some areas with stronger currents, the plume could travel more than 3,280 ft (1,000 m). The plume was expected to stay near the substrate layer and not reach the surface. Maximum plume concentrations at 3,280 ft (1,000 m) were below 30 mg/L at all stations, with the exception of the two stations with strong currents. Along the submarine export cable route, jet plowing would likely disturb areas of sediments. The plume could temporarlily displace individuasl from foraging habitat. However, the actual area of disturbance at any one time is expected to be localized, since cable installation will be linear over time and foundations will be installed on a sequential basis; therefore, similar habitat would be available nearby for foraging. In addition, the seabed and near-bottom water column in the Study Area are highly dynamic environments, with suspension and redeposition of sediment occurring continuously due to storms and tidal currents. Water quality impacts from these processes and other anthropogenic processes, such as trawling and commercial vessel anchoring, are similar to or much larger than any potential Project effects. Impacts to sea turtle habitat are most likely to occur in the nearshore portions of the Project, which may contain the preferred prey of juvenile sea turtles (NYSERDA 2017, Morreale et al. 1992, Burke et al. 1994, Morreale and Standora 1998). While there are eelgrass habitats documented throughout the coastline of Long Island, a high frequency of juvenile Kemp's ridley and loggerhead turtles have been observed foraging in Moriches and Shinnecock Bays, located approximately 31 nm (58 km) from the Lease Area (NYSDOS 2013). Furthermore, Empire has sited the submarine export cables to avoid impacts to eelgrass habitats with no potential overlap with known locations of eelgrass. As described in **Section 5.5 Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat**, however, there is a large amount of similar-quality, available, alternative, suitable habitat in the vicinity of the Project Area, indicating that temporary displacement and turbidity will not necessarily result in a loss of available habitat and prey resource. While the offshore facilities will not have any significant impacts to the affected environment, it should be noted that localized negligible downstream changes in direction and intensity may occur in a phenomenon known as the wake effect (see Section 5.5.2.2). Since sea turtles are mobile, they can move away from the temporary construction sites and return when construction is complete. Thus, no permanent disturbance to or displacement from suitable habitat is anticipated for sea turtle species in the Project Area. Furthermore, the localized disturbance to the seafloor is expected to return to pre-construction conditions within a relatively short time frame (see **Section 4.2 Water Quality** and **Appendix J Sediment Transport Analysis**). As described in **Section 3** and **Section 5.5**, Empire has actively avoided sensitive benthic habitats (including eelgrasses), where feasible, in the siting of submarine export cables and foundations, further minimizing the disturbance of sensitive habitat features, especially in shallow water or nearshore areas adjacent to the submarine export cable siting corridors. Any resulting habitat affects from wind turbine foundations and potential attraction to foundations by turtles for shelter and foraging opportunities are addressed in Section 5.7.2.2.

Short-term loss of local prey species and availability. Construction activities may temporarily disturb local prey species, which may therefore impact the ability for sea turtles to forage in these specific areas (see **Section 5.5** for additional information on the impacts anticipated for local prey species). While most sea turtle species in the Study Area are likely to occur near the continental shelf edge on the outer edge of the Study Area, it is possible that some adults and juveniles could occur near the onshore portions of the Project, where eelgrasses and small invertebrates are located and may contain the preferred diet of juvenile sea turtles (NYSERDA 2017; Morreale et al. 1992; Burke et al. 1994; Morreale and Standora 1998). While it is difficult to determine which areas are currently utilized for juvenile feeding, there is ample habitat available for sea turtle juveniles to forage in the vicinity of the Project Area, as there are eelgrass habitats documented throughout the coastline of Long Island, with a high frequency of juvenile Kemp's ridley and loggerhead turtle foraging in Moriches and Shinnecock Bays (NYSDOS 2013). Furthermore, the Project has been sited to avoid impacts to seagrass beds and other submerged aquatic vegetation, a diet staple for many sea turtle species, in order to avoid and minimize impacts. There are no documented eelgrass habitats within the Lease Area or submarine export cable siting corridors.

Short-term increase in construction-related lighting. Project-related construction and support vessels located within and transiting to and from the Lease Area, the submarine export cable routes, and the staging and construction areas will contain deck and safety lighting. This lighting has the potential to impact sea turtles, though effects vary by species and by age (Gless et al. 2008). Loggerheads show more attraction than leatherbacks (Wang et al. 2007), especially with younger animals. Impacts from lighting are most harmful as hatchlings leave the natal beach for the open ocean. However, as no sea turtles nest in or in the vicinity of the Project Area, impacts are not expected to affect this life stage of sea turtles. Furthermore, as Project-related vessel deck and safety lighting would not intentionally illuminate surrounding waters, this lighting is not expected to have an effect on sea turtle activities and behavior.

Short-term introduction of marine debris. Marine debris has the potential to be introduced to the marine environment during construction activities, for example from Project-related construction vessels. This has the potential for sea turtles to become entangled in and/or ingest debris, which could result in injury or death; impacts from marine debris and entanglement on sea turtles are well documented (e.g., Carr 1987; Bjorndal et al. 1994; Bugoni, et al. 2001; Lazar and Gračan 2011). As all offshore personnel and vessel contractors will be required to implement appropriate debris control practices and protocols, the release of marine debris into Project Area waters is not anticipated. Furthermore, Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.

Short-term increased risk for entrapment and entanglement in Project-related equipment. During construction, the installation of submarine cables and seabed preparation for the installation of foundations could potentially lead to the entrapment and entanglement of sea turtle species, due to the potential presence of cables associated with installation equipment in the water column and the temporary mooring concept. These activities are a known source of impact on sea turtles, though impact is unlikely, as it would only occur if an individual is in the direct path of the jet plow or seabed preparation activities (Murray 2011). Jet plowing and other cable installation methods as described in **Section 3** could potentially disturb and/or harm resting sea turtles offshore or in bay and estuary areas; nearshore areas are known to be utilized by juveniles and adult loggerheads. It is possible that sea turtles foraging benthically on prey, such as crustaceans, mollusks, or vegetation could be potentially disturbed as well. This is especially a concern for loggerheads, green, and Kemp's ridley sea turtles, as their diving and feeding patterns place them in direct contact with the bottom. While the majority of sea turtles located in the Project Area during cable-laying and seabed preparation operations would be expected to be capable of moving out of the area, in the very unlikely event that any species are caught (entrained) or restricted in movement by this equipment, they could experience injury or mortality.

Short-term increase in Project-related underwater noise. Construction activities, including, for example, pile driving, jet-plowing, and Project-related vessel noise, will temporarily increase underwater noise in the Project Area; this increase in noise would have the potential to impact sea turtles both behaviorally and physiologically. As discussed in **Section 4.4.2**, the Project has also completed an underwater acoustic assessment to assist in evaluating potential impacts to sea turtles due to noise generated during construction. The results of the assessment, which includes modeling, can be found in **Appendix M-1** and **Appendix M-2**.

Little is known about how sea turtles use sound in their environment. Due to insufficient data on the hearing capabilities of sea turtles, impacts of sound are not well documented. Available data does suggest that sea turtles detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues, and can respond to acoustic cues (Piniak et al. 2012). Research examining the ability of sea turtles to avoid collisions with vessels shows that they may rely more on their vision rather than auditory cues (Hazel et al. 2009). Sea turtles may rely on acoustic cues (e.g., from breaking waves) to identify nesting beaches and are also likely to rely on non-acoustic cues for navigation, such as magnetic fields and light. Sea turtles are not known to produce sounds underwater for communication. As such, sound likely plays a limited role in a sea turtle's environment and natural history.

There are a few studies on sea turtle hearing, and overall, research indicates that hearing in sea turtles is in the lower frequencies, typically below 1,600 Hz. One study indicated that the range of highest sensitivity is between 100 and 700 Hz (Piniak et al. 2012). Research indicates that adult sea turtles hear frequencies ranging from 50 to 1,200 Hz, while juveniles can hear frequencies up to 1,600 Hz (Lavender et al. 2012, 2014; Martin et al. 2012; Piniak et al. 2012; Bartol et al. 1999; Bartol and Ketten 2006; Ridgway et al. 1969). There are studies reporting hearing ranges and thresholds for different species and life stages of sea turtles, but the data is limited because of the small number of individuals tested and is not definitive. Known hearing ranges are as follows: leatherbacks from 50 to 1,200 Hz (Piniak et al. 2012); loggerheads, depending on the study, between 50 and 100 Hz on the lower end and up to 800 to 1,120 Hz on the upper end (Martin et al. 2012); Kemp's ridley from 100 to 500 Hz (Bartol and Ketton 2006); and green sea turtles from 50 to 1,600 Hz. (Piniak et al. 2012). A behavioral study in loggerhead sea turtles indicated startled responses were elicited from sources between 50 and 800 Hz (Martin et al. 2012).

An extensive review of current scientific literature and studies revealed no known sea turtle deaths or injuries caused by pile driving. The injury and behavioral thresholds for sea turtles are set by NOAA Fisheries at 180 dB re 1 μPa and 166 dB re 1 μPa, respectively. Field observations made during seismic surveys indicated avoidance behaviors when in the vicinity of impulsive sound (a broadband signal characterized by sudden onset and short duration) (DeRuiter and Doukara 2012; Weir 2007; Holst et al. 2006). During pile driving operations associated with installation of the Block Island Wind Farm in 2015, the distances to measured sea turtle behavioral threshold isopleths ranged from 3,314 to 7,382 ft (1,010 to 2,250 m) from the pile source; distances to the injury threshold isopleths ranged from less than 33 to 243 ft (10 to 74 m) from the pile source (Tetra Tech 2016). This data indicates that there is the potential for an individual to be affected by pile driving noise. Impacts would most likely occur during summer and fall when sea turtle abundance in the Project Area peaks. However, sea turtles in the vicinity of the Project Area during pile driving activities would likely relocate temporarily to areas outside of the zone of influence. It is generally expected that, as sea turtles have ample available oceanic habitat outside of the Project Area, these species would move into other open ocean habitat or adjust course during migration when in the vicinity of noise-producing activities.

Modeling was performed by JASCO and is summarized here. For full details please see the report provided in **Appendix M-2**.

Piles deform when driven with impact hammers, creating a bulge that travels down the pile and radiates sound into the surrounding air, water, and seabed. This sound may be received as a direct transmission from the sound source to biological receivers (such as marine mammals, sea turtles, and fish) through the water or as the result of reflected paths from the surface or re-radiated into the water from the seabed. Sound transmission depends on many environmental parameters, such as the sound speeds in water and substrates. It also depends on the sound production parameters of the pile and how it is driven, including the pile material, size (length, diameter, and thickness) and the make and energy of the hammer.

JASCO's physical model of pile vibration and near-field sound radiation (MacGillivray 2014) was used in conjunction with the GRLWEAP 2010 wave equation model (Pile Dynamics, Inc. 2010) to predict source levels associated with impact pile driving activities. Piles are modeled with a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. See **Appendix M-2** for a more detailed description.

Forcing functions were computed for the representative monopiles and pin piles for jacket foundations, using GRLWEAP 2010 (Pile Dynamics, Inc. 2010). The model assumed direct contact between the representative hammers, helmets, and piles (i.e., no cushion material, which results in a more conservative estimate). The forcing functions serve as the inputs to the pile driving source models used to estimate equivalent acoustic source characteristics. Decidecade spectral source levels for each pile type, hammer energy and modeled location, using an average summer sound speed profile are provided in **Appendix M-2**.

Acoustic propagation modeling used JASCO's MONM and FWRAM, which combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate sound fields. The lower frequency bands were modeled using MONM and FWRAM, which are based on the parabolic equation method of acoustic propagation modeling. For higher frequencies, additional losses resulting from absorption were added to the propagation loss model.

Model Input Parameters

Impact pile driving would occur in a continental shelf environment characterized by predominantly fine to coarse grained sandy seabed sediments, with some clay content. Water depths vary between approximately 79 to 141 ft (24 to 43 m). From June to September, the average temperature of the upper (33 to 49 ft [10 to 15 m]) water column is higher, which can lead to a surface layer of increased sound speeds. This creates a downward refracting environment in which propagating sound interacts with the seafloor more than in a well-mixed environment. Increased wind mixing combined with a decrease in solar energy during winter, from December through March, results in a sound speed profile that is more uniform with depth. Average summer and winter sound speed profiles were used in the Project acoustic propagation modeling. See **Appendix M-2** for more details on the environmental parameters used in acoustic propagation and exposure modeling.

Empire has committed to noise attenuation applied during all pile driving. Typical performance of 10 dB broadband attenuation was chosen for this analysis as an achievable reduction of sound levels produced during pile driving, noting that a 10 dB decrease means the sound energy level is reduced by 90 percent. For exposure modeling, several levels of attenuation were included for comparison purposes.

Forcing functions were computed for the monopile and pin pile using GRLWEAP 2010 (Pile Dynamics, Inc. 2010). The forcing functions serve as the inputs to JASCO's pile driving source models used to estimate equivalent acoustic source characteristics detailed in **Appendix M-2**.

Calculation of Range to Regulatory Thresholds

Exposure ranges were calculated for sea turtles. The exposure ranges assume 10 dB broadband attenuation and a summer acoustic propagation environment. Exposure ranges are reported for both 1 and 2 piles per day for monopile foundations, and 2 and 3 pin piles per day for jacket foundations. Results for all exposure estimates, including different seasons and at different attenuation levels, can be found in **Appendix M-2**. A summary of findings is included in **Table 5.7-10**, **Table 5.7-11**, **Table 5.7-12**, and **Table 5.7-13**. Single strike ranges to various isopleths from acoustic modeling can be found in **Appendix M-2**, along with per pile SEL acoustic ranges to isopleths for the hearing groups assuming no movement of animals during pile driving.

Table 5.7-10 Monopile Foundation (9.6 m diameter, summer): Exposure Ranges (ER95%) in km to Sea Turtle Threshold Criteria with 10 dB Attenuation for a typical pile

Species	One Pile per Day			Two Piles per Day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle a/	<0.01	0	0.47	0	0	0.57
Leatherback turtle a/	0	0	0.68	0	0	0.68
Loggerhead turtle	0	0	0.38	0	0	0.49
Green turtle	0	0	0.36	0	0	0.57

Note:
a/ Listed as Endangered under the ESA.

Table 5.7-11 Monopile Foundation (9.6 m diameter, summer): Exposure Ranges (ER95%) in km to Sea Turtle Threshold Criteria with 10 dB Attenuation for a difficult to drive pile

Species	One Pile per Day			Two Piles per Day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle a/	0.10	0	1.27	0.12	0	1.23
Leatherback turtle a/	0.15	0	1.54	0.31	0	1.52
Loggerhead turtle	0	0	1.00	0.03	0	1.09
Green turtle	0.17	0	1.34	0.11	0	1.50

Note:
a/ Listed as Endangered under the ESA.

Table 5.7-12 Jacket Foundation EW 1 (2.5 diameter, summer): Exposure Ranges (ER95%) in km to Sea Turtle Threshold Criteria with 10 dB Attenuation

Species	Two Pin Piles per Day			Three Pin Piles per Day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle a	0	0	0.11	0	0	0.11
Leatherback turtle a/	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0
Green turtle	0	0	0	0	0	0

Note:
a/ Listed as Endangered under the ESA.

Table 5.7-13 Jacket Foundation EW 2 (Summer): Exposure Ranges (ER95%) in km to Sea Turtle Threshold Criteria with 10 dB Attenuation

Species	Two Pin Piles per Day			Three Pin Piles per Day		
	Injury		Behavior	Injury		Behavior
	L_E	L_{pk}	L_p	L_E	L_{pk}	L_p
Kemp's ridley turtle a/	0	0	0.07	0	0	0.07
Leatherback turtle a/	0	0	0	0	0	0
Loggerhead turtle	0	0	0	0	0	0
Green turtle	0	0	0	0	0	0

Note:
a/ Listed as Endangered under the ESA.

Animal Movement Modeling

Animal movement modeling was performed using the JASMINE model to estimate the probability of exposure of animals to sound arising from pile driving operations during construction of the Project. Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3D sound fields with movement rules derived from animal observations (**Appendix M-2**). The parameters used for forecasting realistic behaviors (e.g., diving, foraging, and surface times) were determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species (**Appendix M-2**). The predicted sound fields were sampled by the model receiver in a way that real animals are expected to by programming animats to behave like marine mammal species that may be present near the Project. The output of the simulation is the exposure history for each animat within the simulation. An individual animal's sound exposure levels are summed over a specified duration, i.e., 24 hours (**Appendix M-2**), to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria described in Section 2.4 within each analysis period.

The exposure criteria for impulsive sounds were used to determine the number of animats exceeding exposure thresholds. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 0.5 animats/km^2 over the entire simulation area. Some species have depth preference restrictions, e.g., sperm whales prefer water greater than 1,000 m (Aoki et al. 2007), and the simulation location contained a relatively high portion of shallow water areas. Results were then scaled by actual density of the species.

Appendix M-2 provides a complete description of animal movement modeling and the parameters used in the JASMINE simulations, including a schematic overview of the exposure modeling process.

Sea Turtle Density Estimates

There are limited density estimates for sea turtles in the Study Area. The Study Area is in the Mid-Atlantic North region defined in NEFSC and SEFSC (2011) for sea turtle distribution. Sea turtles are expected to be present in the Study Area during summer and fall due to seasonal habitat use, with sea turtles moving to warmer water habitats in winter (Hawkes et al. 2007, Dodge et al. 2014, DoN, 2017). Sea turtles were most commonly observed in summer and fall, absent in winter, and nearly absent in spring during the Kraus et al. (2016) aerial surveys of the Massachusetts Wind Energy Area and Rhode Island/Massachusetts Wind Energy Area. Kraus et al. (2016) reported that leatherback and loggerhead sea turtles were the most commonly observed turtle species with an additional six Kemp's ridley sea turtles identified over five years. Similarly, aerial surveys conducted for the NYSDEC in the New York Offshore Planning Area monthly over a period of three years recorded sea turtles to be most frequently seen in summer, followed by fall, absent in winter, and rare in spring (Tetra Tech and LGL 2020). Leatherback, loggerhead, and Kemp's ridley sea turtles were reported.

Also in the New York Bight, a multi-year series of seasonal aerial surveys was conducted by Normandeau associates for NYSERDA (Normandeau Associates and APEM 2018a, 2019a, 2019b, 2019c, 2020). The purpose of the aerial surveys was to gather high resolution data on marine resources within the Offshore Planning Area off Long Island, New York. High-resolution digital aerial photographs were collected along specific line transects each season for three consecutive years. Four sea turtle species were reported as being present in the area during the NYSERDA surveys: loggerhead, leatherback, Kemp's ridley, and green.

To obtain the densities used in the current study, Empire extracted the maximum seasonal abundance for each species from the NYSERDA data. The abundance was corrected to represent the abundance in the entire Offshore Planning Area and then scaled by the full Offshore Planning Area to obtain a density in units of animals per square kilometer. Two categories listed in the reports included more than one species: one combined loggerhead and Kemp's ridley turtles, and the other included turtles that were observed but not identified to the species level. The counts within the two categories that included more than one species were distributed amongst the relevant species with a weighting that reflected the recorded counts for each species. For example, loggerhead turtles were identified far more frequently than any other species; therefore, more of the unidentified counts were assigned to them. The underlying assumption is that a given sample of unidentified turtles would have a distribution of species that was similar to the observed distribution within a given season.

The NYSERDA study (Normandeau Associates and APEM 2018b, 2019a, 2019b, 2019c, 2020) reported that in the survey area, most of the sea turtles recorded were loggerhead sea turtles, by an order of magnitude. Seasonal sea turtle densities used in animal movement modeling are listed in **Table 5.7-14**.

Table 5.7-14 Sea Turtle Density Estimates Derived from NYSERDA Annual Reports

Species	Density (animals/100 km^2) a/			
	Spring	Summer	Fall	Winter
Kemp's ridley turtle b/	0.001	0.010	0.002	0.000
Leatherback turtle b/	0.000	0.003	0.008	0.000
Loggerhead turtle	0.003	0.268	0.002	0.000
Green turtle	0.000	0.000	0.000	0.000

Notes:
a/ Densities calculated from NYSERDA aerial survey reports (Normandeau Associates and APEM 2018a, 2019a, 2019b, 2019c, 2020)
b/ Listed as Endangered under the ESA.

Exposure estimates were calculated for sea turtles based on proposed construction schedules. To account for possible delays of pile driving from 2025 resulting in additional piles needing to be driven in 2026, Empire anticipates 96 monopile foundations and 24 pin piles will be installed in 2025 and 51 monopile foundations (zero pin piles) will be installed in 2026, although some monopile foundations from 2025 may be delayed into 2026. It is possible but not anticipated that monopile foundations and pin piles could be installed outside of the years described above due to schedule delays. As it is possible that either one or two monopile foundations may be installed per day, and either two or three pin piles may be installed per day, exposure estimates for all possible scenarios were modeled (i.e., one or two monopile foundations installed per day, and two or three pin piles installed per day). Empire estimates that no more than 24 monopiles may be installed in any month, and that no more than 96 monopiles would be installed per year. Therefore, take estimates were generated for up to 24 monopiles per month (maximum 96 monopiles per year) in all possible months of construction (i.e., May through December). Expoure estimates are provided in **Appendix M-2.** A maximum of 147 total monopile foundations may be driven over the course of the Project.

Additional information on sound attenuation devices can be found in **Section 4.4.2**.

An estimated maximum of 17 foundations may be difficult-to-drive (including as many as 7 difficult-to-drive foundations for EW 1 and as many as 10 difficult-to-drive foundations for EW 2). This number represents a conservative estimate; the actual number will be informed by analysis of geotechnical data that will occur prior to construction. It is expected that difficult-to-drive foundation locations will be known in advance, and efforts will be made to avoid pile installation at those locations where possible. However, to be conservative, exposure estimates were calculated based on an assumption that pile driving would occur at the maximum 17 potential difficult-to-drive foundation locations. Empire expects that all difficult-to-drive foundations would be installed in 2025. It is possible but not anticipated that some difficult to drive foundations could be installed in 2026; however, to be conservative it was assumed all difficult to drive foundations would occur in 2025 as this scenario results in the most conservative exposure estimates for any single year of construction. To be conservative it was assumed that driving of difficult-to-drive foundations would occur in the months of highest density for each species, spread evenly among those months (i.e., of the 24 monopiles driven in the four months of highest density for each species, it was assumed four of those 24 would be considered difficult-to-drive in three months and five of those 24 would be difficult-to-drive in the remaining one month).

Underwater sound propagation modeling for vibratory installation and removal of potential cofferdams was completed using dBSea, a powerful software developed by Marshall Day Acoustics for the prediction of underwater noise in a variety of environments. The model is built by importing bathymetry data and placing noise sources in the environment. Each source can consist of equipment chosen from either the standard or user defined databases. Noise mitigation methods may also be included. The user has control over the seabed and water properties including sound speed profile, temperature, salinity, and current.

Noise levels are calculated throughout the entire Project Area. For estimating source levels and frequency spectra, the vibratory pile driver was estimated assuming an 1,800 kilonewton vibratory force. Modeling was accomplished using adjusted one-third-octave band vibratory pile driving source levels cited for similar vibratory pile driving activities conducted during cofferdam installation for the Block Island Wind Farm (Tetra Tech 2012). The assumed sound source level for vibratory pile driving corresponded to 195 dB SEL. For additional details see **Appendix M-1**. Modeling was conducted for the scenarios listed in **Table 5.7-15**.

Table 5.7-15 Underwater Acoustic Modeling Scenarios

Scenario	Description	Location (UTM Coordinates)	Apparent Source Level dB re: dB re 1 μPa^2·s
Scenario 1: Cofferdam Installation	Vibratory Pile Driving	EW 1: 583452 m, 4501772 m EW 2-1: 613965 m,4492769 m EW 2-2: 617063 m, 4493259 m EW 2-3: 616467 m, 4492268 m EW 2-4: 615730 m, 4492964 m	195 $L_{E,\ 1sec}$
Scenario 2: Goal Post Installation	Impact Pile Driving	Representative Location	200 $L_{p,pk}$ a/ 174 $L_{E,\ 1sec}$ a/ 184 L_p a/

Table 5.7-15 Underwater Acoustic Modeling Scenarios (continued)

Scenario	Description	Location (UTM Coordinates)	Apparent Source Level dB re: dB re 1 μPa²·s
Scenario 3: EW 2 Onshore Substation C Marina Bulkhead Work (Sheetpile installation)	Vibratory Pile Driving	Representative Location	160 $L_{E,\ 1sec}$
Scenario 4: EW 2 Onshore Substation C Marina Berthing Pile Removal	Vibratory Pile Driving	Representative Location	165 $L_{E,\ 1sec}$

Notes:
a/ Source levels based on the GARFO Acoustics Tool pile type information (NOAA Fisheries 2019e)

The results of the modeling for vibratory pile driving for cofferdam installation, goal post pile driving, and marina work are presented in **Table 5.7-16**, **Table 5.7-17**, and **Table 5.7-18.**

Table 5.7-16 Sea Turtles Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Cofferdam Vibratory Pile Driving (as per NOAA Fisheries 2019e)

	Threshold Distance (meters)			
	Sea Turtle Behavioral	Sea Turtle TTS	Sea Turtle PTS	Sea Turtle Behavioral
Location	175 L_P	189 SEL	204 SEL	210 SEL
EW 1	53	207	94	56
EW 2-1	15	93	18	18
EW 2-2	13	101	13	0
EW 2-3	10	96	10	0
EW 2-4	10	14	0	0

Source: NOAA Fisheries 2019e; Popper et al. 2014

Table 5.7-17 Sea Turtles Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Goal Post Impact Pile Driving (as per NOAA Fisheries 2019e)

Type Pile	Mitigation (dB)	Hammer Type	Sea Turtle TTS 189 $L_{E,\ TUW,\ 24hr}$	Distance (m) to Sea Turtle TTS (Peak SPL) 226 dB_{Peak}	Sea Turtle PTS 204 $L_{E,\ TUW,\ 24hr}$	Distance (m) to Sea Turtle PTS (Peak SPL) 232 dB_{Peak}	Sea Turtle Behavioral 175 L_P
12-inch Steel Pile	0	Impact	183.0	0.0	18.3	0.0	39.8
	6	Impact	73.0	0.0	7.3	0.0	15.8
	10	Impact	39.0	0.0	3.9	0.0	8.6

Table 5.7-18 Sea Turtles Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Vibratory Pile Driving (as per NOAA Fisheries 2019e) – Marina Bulkhead Work

Type Pile	Mitigation (dB)	Hammer Type	Sea Turtle TTS 189 $L_{E,\ TUW,\ 24hr}$	Sea Turtle PTS 204 $L_{E,\ TUW,\ 24hr}$	Sea Turtle Behavioral 175 L_P
EW 2 Onshore Substation C Bulkhead Work Steel Sheet pile	0	Vibratory	20.0	2.0	1.0
	6	Vibratory	7.9	0.8	0.4
	10	Vibratory	4.3	0.4	0.2

Empire proposes to implement the following measures during construction to avoid, minimize, and mitigate potential impacts of underwater noise:

- Empire will apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds, enforced by Qualified NOAA Fisheries-approved PSOs;
- Real-time monitoring systems, as appropriate;
- Ramp up and shutdown procedures;
- Ramping up of noise generating activities for an agreed upon duration;
- Use of reduced visibility monitoring tools/technologies (e.g., night vision, infrared, and/or thermal cameras);
- Consideration of the potential use of commercially and technically available noise-reducing technologies as appropriate to assessments;
- Consideration of the use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances; and
- Provide reference materials on board Project vessels for identification of sea turtles.

Noise from vessel traffic may affect sea turtles but effects are expected to be minimal. Vessel noise is the dominant source of underwater noise at low frequencies ranging from 20 to 200 Hz and is increasing in the world's oceans (Rolland et al. 2012; Hildebrand 2009). Individual ships have different noise signatures; however, ship noise is typically in the range of 195 dB (re μPA²/ Hz at 1 m) for fast-moving (above 20 knots [37 km/h]) tankers to 140 dB for small fishing vessels (National Research Council 2003). Wind energy and high sea states also produce noise in this frequency range. The frequency ranges for vessel noise overlap with sea turtles' known hearing ranges (less than 1,000 Hz) and are expected to be audible, but would be within the typical conditions in sea turtles' ocean environments, especially within the Project Area, which is located between two TSS lanes. Impacts from vessel traffic noise may elicit behavioral changes in individuals near vessels, such as diving, changing swimming speed, or changing direction in order to avoid the noise. However, due to the existing noise from traffic in the TSS lanes, impacts are not anticipated to be greater than ambient conditions.

Short-term increased risk for ship strike due to the increase in vessel traffic. An increase in Project-related construction and support vessel traffic within the Lease Area, along the submarine export cable routes, and along the transit routes to and from the staging and construction areas is anticipated during construction, with an approximate short-term increase of vessel traffic in the area above baseline conditions. A summary of the anticipated types of vessels is provided in **Table 5.7-19** (see **Appendix K Air Quality Calculations and Emissions** for the number of transits and ports of origin). As part of the Navigation Safety Risk Assessment

(**Appendix DD**), the average number of unique vessels recorded per day with the Study Area were assessed for 12 months of AIS data. An average of 53 unique vessels were recorded per day within the Study Area, with a total of 102 vessels recorded on the busiest day. The busiest month was July 2018, when an average of 68 unique vessels were recorded per day. In comparison, Project-related vessel trips will represent a small increase to this existing traffic. Project vessel round trips will average less than 2 trips per day during construction. Empire has assumed that SBMT will be the local port and staging area for all purposes during construction and operations of the Project, with the following possible exceptions:

- Monopile foundations could be sourced from overseas and either staged in Canada or brought directly to their offshore installation locations;
- Port of Coeymans, on the Hudson River in upstate New York, is assumed to be the starting point for the transit of the scour protection for each foundation;
- Port of Albany, also on the Hudson River in upstate New York, is assumed to be the starting point for the transit of the transition pieces for each turbine foundation, as well as for the wind turbine towers;
- A submarine cable factory just north of Charleston, South Carolina is assumed to be the starting point for the transit of submarine cables;
- A yet-to-be-determined port in the Corpus Christi, Texas area is assumed to be the starting point for transporting the offshore substation topsides for EW 1 and EW 2, to the installation locations in the Lease Area. These will be brought directly to their offshore construction locations by a heavy transport vessel; and
- Halifax, Nova Scotia is assumed to be the starting point for the transit of scour protection rock and gravel. Rock and gravel will be brought directly to the offshore construction locations by a fall pipe vessel.

Empire notes that the supply chain for the U.S. offshore wind industry is in its nascent stages but is quickly developing. Therefore, U.S. ports could be selected to supply major offshore wind components. Sea turtles near surface waters within these areas would be susceptible to vessel strikes or collisions, physical disturbances, and disturbance from vessel noise, all of which may inflict disturbance, injury, or result in mortality. Project vessels will follow existing shipping lanes to the extent feasible and practicable.

Sea turtles can detect approaching vessels, likely by sight rather than by sound, and seem to react more to slower-moving vessels (2.2 knots [4.1 km/h]) than to faster vessels (5.9 knots [10.9 km/h] or greater) (Hazel et al. 2009). Although sea turtles likely hear and see approaching vessels, they may not be able to avoid all collisions, and high-speed collisions with large objects can be fatal to sea turtles. Stranding data frequently documents mortality from vessel collision; however, these collisions tend to occur in shallow coastal and inshore waters with higher densities of vessels traveling at accelerated speeds (CH2M HILL 2018).

The most susceptible species to ship strike in the Project Area include leatherback and loggerhead sea turtles. In the summer season, leatherbacks are susceptible near coastal areas, in addition to offshore, if co-located with transiting vessels. Juvenile loggerheads found in coastal waters during foraging and resting are also susceptible, as their smaller size makes it more difficult to detect them in the water (Kenney and Vigness-Raposa 2010). Additionally, as sea surface temperatures drop in the fall and winter months, it is common for sea turtles, in particular loggerhead and Kemp's ridley turtles, to be affected by the drop in water temperature and become cold-stunned. The cold affects their diving capacities and constrains them to floating motionless at the surface, becoming more prone to ship strike (Meylan and Sadove 1986; Burke et al. 1991; Hochscheid et al. 2010). Empire proposes to implement measures to avoid, minimize, and mitigate the impacts of vessel collisions through measures in place for marine mammals, which will be indirectly beneficial to sea turtles. These mitigation measures are described in **Section 5.6**.

Table 5.7-19 Preliminary Summary of Offshore Vessels for Construction

Vessel	Description	Foundations		Wind Turbines	Offshore Substation Topside and Foundation	Submarine Export Cables	Interarray Cables	Scour Protection
		Monopile	Piled Jacket					
Heavy Lift Vessel	Vessel for installation of foundations (0-10 kts)	X	X		X			
Monopile Supply Vessel	Vessel for transport of monopile foundations (0-10 kts)	X						
Wind Turbine Installation Vessel	Vessel for installation of Wind Turbine components (0-10 kts)			X				
Wind Turbine Supply Vessel	Vessel for transport of Wind Turbine components (0-10 kts)			X				
Cable Lay Vessel/Barge	Vessel for installation of submarine cables (0-10 kts)					X	X	
Heavy Transport Vessel	Vessel for transport of offshore substation topside (0-10 kts)	X	X		X			
Cable Lay Support Vessel	Support vessel for cable lay operations (0-10 kts)					X	X	
Pre-Lay Grapnel Run Vessel	Vessel for seabed clearance along cable routes (0-10 kts)					X	X	
Fall Pipe Vessel	Vessel for installation of scour protection (0-10 kts)	X	X			X	X	X
Crew Transfer Vessel	Vessel for transporting workers to and from shore (0-10 kts)	X	X	X		X	X	
Construction Support Vessel	Vessel for general construction support (0-10 kts)	X	X			X	X	
Tugboat	Vessel for transporting and maneuvering barges (0-5 kts)	X	X	X	X	X		
Barge	Vessel for transport of construction materials (0-5 kts)	X	X	X	X			
Safety Vessel	Vessel for protection of construction areas (0-10 kts)	X	X			X	X	

Short-term potential for a change in water quality, including oil spills. Construction activities, including from foundation and submarine export cable installation, would result in short-term increases in turbidity and sedimentation in the Project Area. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2** and in **Appendix J**.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills and releases from, for example, grout used to seal the monopile to the transition piece. During jet plow and seabed preparation activities, there is also the potential to re-release constituents of concern due to resuspending sediment. However, Empire has sited the submarine export cable routes to avoid current and historic dumping grounds to the extent practicable. Empire has also completed initial chemical analysis of the sediment, which is expected to contain constituents of concern, and will take necessary precautions during installation activities at locations in which constituents of concern may be present in high concentrations with high likelihood of exposure to sensitive species.

In the event of an offshore oil spill releasing oil into the open ocean, currents and winds can carry oil across the various habitats that are utilized by various phases of life of sea turtles. Because sea turtles must break the surface regularly in order to breathe air, floating oil slicks can be encountered by the same turtle over and over again during their normal breathing cycles, causing ingestion of oil through the respiratory tract as well as through the digestive tract. The organs in both of these body systems can become coated with oil, to the point of becoming entirely mired and unable to swim. Similarly, sea turtles may swim through oil drifting in the water column as it sinks or disturb it in the sediments on the ocean bottom, once it has reached the benthic environment. Female sea turtles can pass oil compounds to developing young. Once laid, eggs are also able to absorb oil through their porous shell from oils found in the sands of the nest. These oils can potentially damage the baby turtle developing inside. Nesting turtles and their hatchlings are also likely to crawl into oil on contaminated beaches (NOAA Ocean Service 2016). While there are virtually no nesting beaches within the Project Area (with one exception), potential oil spills from any Project-related activities have the potential for dispersal into habitats in all directions.

Empire has also developed an OSRP (**Appendix F**) that details all of the measures proposed to avoid inadvertent releases and spills, and a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.12 Public Health and Safety**. Further, Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.

5.7.2.2 Operations and Maintenance

During operations and maintenance, the potential impact-producing factors to sea turtle may include:

- Presence of new permanent structures (i.e., foundations, wind turbines, and offshore substations); and
- Presence of new buried submarine export and interarray cables.

With the following potential consequential impact-producing factors:

- Modification of habitat;
- Project-related EMF;
- Project-related lighting;
- Project-related marine debris;
- Project-related underwater noise;
- Increased risk for ship strike due to the increase in vessel traffic; and
- Changes in water quality, including oil spills.

Modification of habitat. Installation of the foundations and scour protection will result in the conversion of some of the seafloor to hardbottom habitat. This has the potential to affect sea turtles by both reducing the available habitat for bottom-foraging individuals and by creating new hardbottom habitat. As seagrass and other submerged aquatic vegetation are not present in the Lease Area, long-term impacts to sea turtle habitat are not anticipated. Artificial hardbottom habitat created by the proposed foundation types at the wind turbine locations is likely to attract sea turtles, as it would provide beneficial conditions for foraging as well as options for sheltering, and potentially serve as a structure for cleaning flippers or carapaces (CH2M HILL 2018). Installation of semi-permanent and permanent structures for open ocean wind turbines have been known to create a 'reef effect', which increases the biodiversity of the area in which the artificial structure is placed. The small invertebrate life and fish species that aggregate on these foundation structures will draw in larger predators; this "reef effect" has the potential to attract sea turtles for feeding on alternate prey sources such as jellyfish and algae attached to the foundation and the turbine. This 'reef effect' is thought to have a positive impact on species, including sea turtles, as it increases foraging habitat. The introduction of artificial reef habitat attracts benthic and pelagic fish species, and provides substrate for sessile invertebrates, thus increasing prey availability for sea turtles. Therefore, introducing habitat has an overall long-term beneficial impact to sea turtles. The artificial reef habitat may also in turn result in increases in temporary residence times for sea turtles in the area; this phenomenon has been documented at oil and gas platforms in the Gulf of Mexico. These findings suggest similar effects may be anticipated around foundations for offshore wind in the Project Area. In addition, offshore wind turbines may attract recreational anglers due to the fish aggregating effect. However, increasing fishing in the localized area may have an adverse effect on sea turtles in the area due to the potential increase in lost fishing line, which in turn poses an entanglement and ingestion risk to sea turtles. The indirect effects of entanglement and ingestion have been shown to occur at artificial reefs, and is a possible adverse effect that may result from the Project. Entanglement in anthropogenic debris is also a known threat for sea turtles in every ocean basin (Duncan et al. 2017). Were a sea turtle to become entangled in fishing line or ingest fishing line, the effects would be expected to be adverse on that individual sea turtle (Barnette 2017).

Project-related EMF. The installation of submarine export and interarray cables in the Project Area may result in the introduction of EMF (see **Section 8.12** and **Appendix EE** for additional information). EMF results from alternating currents in the cables. This section also includes a discussion on the effects of magnetic fields on sea turtles. There is little to no data on EMF, so species sensitivity to field strength of either electric or magnetic fields is addressed as a proxy. While it is known that EMF sensitivities vary greatly by species, and that benthic species tend to be more affected by magnetic fields, it is not well understood how sea turtles react to either electric or magnetic fields. What research has been done suggests that sea turtles in all life stages orient to the Earth's magnetic field to position themselves in oceanic currents, which helps them locate seasonal feeding and breeding grounds and to return to their nesting sites. Sea turtles do not appear to be sensitive to EMF and appear to be less sensitive than marine mammals (Tethys 2010). Cable-related EMF is generally considered to be less intense than the Earth's geomagnetic field, and it is generally assumed that sea turtles will not be affected by this EMF (NJDEP 2010).

During operations, cables transmitting the produced electricity will emit magnetic and induced electric fields. This could affect the movements and navigation of sea turtles or some of the prey species that are sensitive to electric or magnetic fields, especially elasmobranchs or some teleost fish and decapod crustaceans. Changes in these geomagnetic fields could potentially impact a sea turtle's ability to navigate at sea, as well as affect their movement patterns (Taormina et al. 2018; Normandeau et al. 2011). Experiments show that sea turtles can detect changes in magnetic fields, which may cause them to deviate from their original direction (Lohmann and Lohmann 1996; Lohmann et al. 1999). Sea turtles also use nonmagnetic cues for navigation and migration, and these additional cues may compensate for variations in magnetic fields. There are indications that an overall geomagnetic sense is used and is critical for primary orientation necessary to travel towards areas that are important at various life stages (e.g., nesting beaches or feeding grounds), but detail and fine-scale navigation is accomplished via olfactory and visual cues (Normandeau et al. 2011). If located in the immediate area (within about 650 ft [200 m]) where electromagnetic devices are being used, sea turtles could deviate from their original movements, especially during feeding bouts. However, the extent of this disturbance is likely to be inconsequential. Potential impacts of exposure to electric and magnetic stressors are not expected to result in substantial changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts. As the magnetic and induced electric fields of the submarine export cables are expected to generate a relatively low intensity of EMF in the Project Area, impacts to sea turtle species are not anticipated to result in short-term behavioral disturbance. In addition, the heat generated by the transport of electricity through the submarine export cables are also not known to impact sea turtles (Taormina et al. 2018).

In a study, field measurements in the vicinity of two cables buried at 3.3 ft (1 m) below the benthic surface indicated an increase of approximately 2.5 °F (1.4 °C) at 7.9 in (20 cm) depth above the cable. While the study did stipulate that the applicability of the results to other projects is uncertain, due to the variation of relevant environmental and project factors, it concluded that impacts would not be significant based on the current data, in addition to the narrow cable corridors and weak thermal radiation (Taormina et al. 2018). Therefore, any potential impacts to prey species would likely be minimal and confined to a small area in the immediate vicinity of the submarine export cable. Given the highly mobile nature of sea turtles and the prevalence of other equal or greater value habitat in proximity to the Study Area, Empire does not anticipate any impacts to prey availability based on increases from heat. Similarly, any EMF-related effects on infaunal benthic invertebrates would be in a very narrow corridor surrounding the submarine export cable, and are also not expected to affect the availability of potential prey for any species. Empire has conducted engineering surveys to identify areas where sufficient submarine export cable burial is likely to be achievable, with target burial depths from a minimum of 6 ft (1.8 m). Burial will act as a buffer between EMF and the associated submarine export cable generated heat and the sea turtles, further reducing exposure levels. In areas where sufficient burial is not feasible, and where additional cable protection is deemed necessary, surface cable protection will provide an additional barrier to EMF and heat exposure.

Project-related lighting. Project-related operations and support vessels located within and transiting to and from the Lease Area will contain deck and safety lighting. Additionally, as discussed in **Section 3**, all wind turbines and offshore substations will contain safety lighting. As the Project-related lighting measures would not intentionally illuminate surrounding waters, operational lighting is not expected to have an effect on sea turtles. Empire will work with the appropriate regulatory agencies on lighting requirements.

Introduction of marine debris. Marine debris has the potential to be generated during operation activities, which could result in the sea turtles becoming entangled in or ingesting debris. This could result in injury or death. As all offshore personnel will be required to implement appropriate practices and protocols, the release of marine debris into Project Area waters is not anticipated.

Changes in water quality, including oil spills. During operations, routine maintenance activities have the potential to result in short-term increases in turbidity and sedimentation in the Project Area, which may directly or indirectly affect sea turtles. Potential impacts to water quality resulting from turbidity are further discussed in **Section 4.2** and **Appendix J**. As shown, the increase in turbidity and/or release of constituents of concern from re-suspended sediments is not expected to exceed background levels that occur during natural events, and will be both short-term and temporary in nature. As such, sea turtles are not expected to be exposed to conditions exceeding their current environment.

In addition to turbidity, water quality has the potential to be impacted through the introduction of constituents of concern, including oil and fuel spills. For reasons described earlier, such spills have impacts on sea turtles. Empire has developed an OSRP (**Appendix F**) that details all measures proposed to avoid inadvertent releases and spills, and a provides a protocol to be implemented should a spill event occur. Additional information can be found in **Section 8.12**. Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts on sea turtles from impacts to water quality and spills:

- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an OSRP.

Underwater noise. Operations activities will result in a slight increase in the ambient underwater noise in the Project Area (see **Appendix M-1 and M-2** for additional information on the anticipated increase in noise levels). As offshore wind areas typically produce low noise levels well below injurious thresholds established by NOAA Fisheries for sea turtle populations, no impacts to sea turtles are anticipated as a result of the Project. Furthermore, underwater noise measurements made at many existing wind farms have demonstrated that the operational noise produced was at such a low level that it was difficult to measure relative to the background noise (Cheesman 2016). McCauley et al. (2000) and Blackstock et al. (2017) noted that a minimum level of 166 dB to 175 dB re 1 μPa root mean square was required before any sea turtle behavioral reaction (e.g., increased swimming speed) was observed. The underwater noise will not approach this level to any appreciable distance, even during full wind turbine rotational operations. Therefore, the underwater noise from operational wind turbines is not expected to affect sea turtles.

Noise from Project-related operations and support vessel traffic is not anticipated to be greater than the ambient noise levels in the Project Area, as vessel traffic increases as a result of the operations and maintenance of the Project will be negligible. Vessel traffic will increase during operations mainly for the transportation of supplies and maintenance crews. Given the amount of existing vessel traffic in the area, and the proximity to the TSS lanes, the noise associated with Project-related supply vessels transiting to the offshore facilities will have a negligible contribution to the total ambient underwater sound levels. Similarly, nearshore vessel activity will be generally concentrated in established shipping channels, near industrial port areas, and will be consistent with the existing noise environment in those areas. Therefore, impacts from underwater sound due to Project operations and maintenance activities, including vessel activity, will be negligible and are unlikely to affect biological resources in the Project Area. As described, multiple sea turtle species are known to be co-located within the existing shipping channels in the New York area and the changes in vessel traffic proposed herein do not rise to the level of a scalable change for these species (i.e., it will not be meaningfully greater than existing vessel patterns and traffic).

Therefore, as discussed, impacts from vessel traffic noise may elicit behavioral changes in individuals near vessels such as diving, changing swimming speed, or changing direction in order to avoid the noise. However, due to the existing noise from traffic in the TSS lanes, impacts are not anticipated to be greater than ambient conditions.

Project-related vessel traffic. Using a CTV–only concept, the increase in Project-related operations and support vessel traffic within, and transiting to and from the Lease Area, is not anticipated to be noticeable above existing baseline conditions. The increase is negligible in comparison to the average traffic observed in the Project Area due to the presence of high traffic shipping lanes throughout the New York Bight (see **Section 8.7 Marine Transportation and Navigation** and **Appendix DD Navigation Safety Risk Assessment** for additional information). Sea turtles near surface waters within these areas would be susceptible to vessel strike, which may inflict injury or result in mortality, and disturbance that may alter individual behavior.

Empire's preferred O&M solution for EW 1 and EW 2 is a SOV concept, supported by a crew transfer vessel. The SOV is expected to remain offshore in the project site for a period of approximately two weeks, returning to the O&M base every two weeks for 24 hours for refueling, re-supplying, and crew changes. The SOV concept therefore significantly reduces the overall vessel transits from Project site to base, compared to the maximum design scenario of multiple crew transfer vessels making daily return trips. Therefore, under these conditions, there is a resulting reduction of vessel traffic that will reduce the risk of ship-strike and vessel noise. However, Empire still requires the ability to select alternatives described in the PDE, and to be assessed in the EIS, should an SOV concept not be technically and commercially suitable. Final construction and vessel traffic protocol will be outlined and assessed through NOAA Fisheries, and any associated mitigation measures will be outlined in the NOAA Fisheries IHA for the Project. Sea turtles are likely to benefit from mitigation in place to reduce the risk of Project-related vessel strikes on marine mammals, as described in **Section 5.6**.

Empire proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Project-related vessel speed restrictions, as appropriate, for sea turtles while transiting to and from the Lease Area;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (<18.5-km/h) speed restrictions in any DMA; and
- Vessel collision avoidance measures for Project-related vessels working in or in transit to and from the Lease Area, including a 164-ft (50-m) separation distance from all sea turtle species.

5.7.2.3 Decommissioning

Impacts during decommissioning are expected to be similar or less than those experienced during construction, as described in Section 5.7.2.1. It is important to note that advances in decommissioning methods/technologies are expected to occur throughout the operations phase of the Project. Additionally, sea turtle species abundance and distribution may also have changed, requiring updated analysis; further data on the spatial and temporal distribution of sea turtles will be collected during the operations phase and will be used to inform a decommissioning assessment. A full decommissioning plan will be submitted to BOEM for approval prior to any decommissioning activities, and potential impacts will be re-evaluated at that time, in addition to any documentation and approval by NOAA Fisheries. For additional information on the decommissioning activities that Empire anticipates will be needed for the Project, please see **Section 3**.

5.7.3 Summary of Avoidance, Minimization, and Mitigation Measures

In order to mitigate the potential impact-producing factors described, Empire has implemented the following embedded mitigation measures to avoid, minimize, and mitigate impacts through project siting and design. Note that Empire intends to continue discussions and engagement with regulatory agencies and ENGOs throughout the life of the Project to develop an adaptive mitigation approach that allows for flexibility, while providing the best and most protective mitigation measures.

5.7.3.1 Construction

During construction, Empire will commit to the following measures to avoid, minimize, and mitigate impacts described in Section 5.7.2.1. Additional activity-specific mitigation measures will be added to EW 1 and EW 2 protocols upon receipt of an IHA from NOAA Fisheries:

- Continued engagement with regulatory agencies, ENGOs, and other stakeholders on potential mitigation and best practices, as appropriate;
- Seasonal pile driving closures;
- Pre-clearance prior to the initiation of pile driving to ensure sea turtles are not located within relevant impact zones when pile driving begins;
- Shutdown of impact pile driving based on confirmed detection of sea turtles within relevant impact zones, when feasible;
- Establishment of clearance and shutdown zones enforced by:
    - Qualified NOAA Fisheries approved PSOs;
    - Real-time monitoring systems, as appropriate;
    - Use of PAM systems;
    - Use of reduced visibility monitoring tools/technologies (e.g., night vision, infrared and/or thermal cameras); and/or
- PSOs will be stationed at the pile driving platform/vessel as well as on a dedicated PSO vessel;
- Vessel collision avoidance measures for Project-related vessels working in or in transit to and from the Lease Area, including a 164-ft (50-m) separation distance from all sea turtle species;
- PSOs will be stationed at the pile driving platform/vessel as well as on a dedicated PSO vessel;
- Use of commercially available and technically feasible noise attenuation technologies to reduce pile driving noise;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMAs for North Atlantic right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10 knot (<18.5 km/h) speed restrictions in any visually triggered Slow Zone/DMA;
- Adherence to vessel strike avoidance measures as advised by NOAA Fisheries;
- Reference materials will be provided on board all Project vessels for identification of sea turtles; and
- Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste; and
- The development and enforcement of an OSRP (**Appendix F**).

In addition, during construction, Empire will consider the following avoidance, minimization, and mitigation measures to mitigate impacts described in Section 5.7.2.1:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances.

5.7.3.2 Operations and Maintenance

During operations, Empire will commit to implement the following measures to avoid, minimize, and mitigate impacts described in Section 5.7.2.2:

- Continued engagement with regulatory agencies, ENGOs, and other stakeholders on potential mitigation and best practices, as appropriate;

- Vessel collision avoidance measures for Project-related vessels working in or in transit to and from the Lease Area, including a 164-ft (50-m) separation distance from all sea turtle species;
- Project-related vessels will comply with NOAA Fisheries speed restrictions within the Mid-Atlantic U.S. SMA for North Atlantic right whales of 10 knots (18.5 km/h) or less for vessels 65 ft (20 m) or greater during the period of November 1 through April 30. Project-related vessels will also comply with the 10-knot (<18.5-km/h) speed restrictions in any DMA; and
- Vessel and structure lighting that minimizes illumination of the sea surface where feasible and subject to approval; and
- The development and enforcement of an OSRP (**Appendix F**).

In addition, during operations, Empire will consider the following avoidance, minimization, and mitigation measure to mitigate impacts described in Section 5.7.2.2:

- Use dedicated trained crew members (independent of PSOs) to help reduce the risk of collision under certain circumstances;
- Use of SOV concept, supported by a CTV, to reduce vessel traffic associated with Operations and Maintenance for the Project, if technically and commercially feasible; and
- Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.

As indicated in the list of measures above, Empire proposes to assist as feasible in monitoring efforts to clarify baseline conditions and to assess changes in distribution or abundance of sea turles. During the COP review process, Empire will work with regulatory agencies and stakeholders in development of appropriate program(s).

5.7.3.3 Decommissioning

Avoidance, minimization, and mitigation measures proposed to be implemented during decommissioning are expected to be similar to those implemented during construction and operations, as described in Section 5.7.3.1 and Section 5.7.3.2**.** A full decommissioning plan will be approved by BOEM prior to any decommissioning activities, and avoidance, minimization, and mitigation measures for decommissioning activities will be proposed at that time.

5.7.4 References

Table 5.7-20 Data Sources

Source	Includes	Available at	Metadata Link
BOEM	Lease Area	https://www.boem.gov/BOEM-Renewable-Energy-Geodatabase.zip	N/A
BOEM	State Territorial Waters Boundary	https://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/ATL_SLA(3).aspx	http://metadata.boem.gov/geospatial/OCS_SubmergedLandsActBoundary_Atlantic_NAD83.xml
OBIS SEAMAP	OBIS SEAMAP Sightings	http://seamap.env.duke.edu/species/	N/A
OBIS SEAMAP	Sea Turtle Density	http://seamap.env.duke.edu/species/	N/A

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