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Empire Offshore Wind, Empire Wind Projects (EW 1 and EW 2) Draft Environmental Impact Statement

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Author:

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LIST OF APPENDICES

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Appendix A. Required Environmental Permits and Consultations

A.1. Required Environmental Permits

Table A-1 identifies the environmental permits and approvals that are required for implementation of the EW 1 and EW 2 Projects and the status of each permit or approval. Potential permits and approvals for SBMT are identified in Section 1.4 of the appended Environmental Assessment Form (Appendix O).

Table A-1 Required Environmental Permits and Approvals for the Proposed Projects

Agency/Regulatory Authority	Permit/Approval	Status
Federal (Portions of the Projects within Federal Jurisdiction)		
BOEM	COP Approval	COP filed with BOEM on January 10, 2020. Updates to the COP were submitted on April 14, 2021, and May 20, 2022.
BSEE	Oil Spill Response Plan	Planned
NMFS	MMPA Section 101(a)(5) Incidental Harassment Authorization or Letter of Authorization	Application submitted August 12, 2022; Notice of Receipt published in *Federal Register* on September 9, 2022.
USACE	CWA Section 404, RHA Section 10 Individual Permit, and Section 408 Permission	Pre-construction Notification Application submitted October 3, 2022
USCG	Private Aids to Navigation authorization	Planned for Q3 2023
USCG	Local Notice to Mariners per Ports and Waterways Safety Act	Planned for Q3 2023
USEPA	CAA OCS Air Permit	Complete OCS Air Permit Application submitted November 10, 2022
State (Portions of the Projects within State Jurisdiction)		
New York State, Public Service Commission	Certificate of Environmental Compatibility and Public Need	Planned
New York Office of General Services, Bureau of Land Management	Application for Use of State Submerged Land	Planned
NYSDEC	State Pollutant Discharge Elimination System Construction Stormwater Permit and CWA Section 401 Certification	Planned
NYSDOT	Highway Work Permit (*if applicable*) and Exemption to Accommodation Plan for Longitudinal Use of Freeway Right-of-Way by Utilities	Planned
New York Coastal Management Program	Coastal Zone Management Act consistency certification	Planned

Agency/Regulatory Authority	Permit/Approval	Status
New York State Legislature	Parkland alienation legislation for cable emplacement within municipal parkland	

Q = quarter

A.2. Consultation and Coordination

A.2.1 Introduction

This section discusses public and agency involvement leading up to the preparation and publication of the Draft EIS, including formal consultations, cooperating agency exchanges, the public scoping comment period, and correspondence. This section discusses public involvement in the preparation of this EIS, including BOEM's consideration of public scoping comments, formal consultations, and cooperating agency exchanges. Interagency consultation, coordination, and correspondence throughout the development of this Draft EIS occurred primarily through virtual meetings, teleconferences, and written communications (including email). BOEM coordinated with numerous agencies throughout the development of this document, as listed in Section A.2.3.2, *Cooperating Agencies*.

A.2.2 Consultations

A.2.2.1. Coastal Zone Management Act

The Coastal Zone Management Act requires that federal actions within the coastal zone or within the geographic location descriptions (i.e., areas outside the coastal zone in which an activity would have reasonably foreseeable coastal effects) affecting any land or water use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. Because the Lease Area is geographically nearest the coast of New York and certain Project elements would occur within New York State waters, a consistency certification with the New York Coastal Management Program was submitted to the New York State Department of State on June 24, 2021. Empire also filed a voluntary consistency certification with the State of New Jersey on June 24, 2021, due to the geographic proximity of the Lease Area. The consistency certifications for New York and New Jersey are included in Appendix A to Empire's COP (Empire 2022) pursuant to 30 CFR 585.627(9) to assist BOEM with NEPA compliance. Empire's COP provided the necessary data and information under 15 CFR 930.58. The state's concurrence is required before BOEM may approve or approve with conditions the COP per 30 CFR 585.628(f) and 15 CFR 930.130(1).

A.2.2.2. Endangered Species Act

Section 7(a)(2) of the ESA of 1973, as amended (16 USC 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either NMFS or the U.S. Fish and Wildlife Service (USFWS), depending upon the jurisdiction. Pursuant to 50 CFR 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM is consulting on the proposed activities considered in this Draft EIS with both NMFS and USFWS and has prepared BAs for listed species under their respective jurisdictions.

A.2.2.3. Government-to-Government Tribal Consultation

Executive Order 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications, and Secretarial Order No. 3317 requires U.S. Department of the Interior agencies to develop and participate in meaningful consultation with federally recognized tribes where a tribal implication may arise. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy (BOEM 2018). This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed federal decision-making" and is in keeping with the spirit and intent of the NHPA and NEPA, Executive and Secretarial Orders, and U.S. Department of the Interior Policy (BOEM 2018). BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

On April 29, 2021, BOEM initiated formal consultation with tribal nations under the NHPA and invited them to be NHPA Section 106 consulting parties to the Projects through individual letters mailed and emailed to tribal leaders with the Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Mashantucket Pequot Tribal Nation, Mohegan Tribe of Indians of Connecticut, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation.

On June 24, 2021, BOEM sent another set of letters and emails to tribal leaders notifying them that the Notice of Intent (NOI) to prepare an EIS for the Projects was issued that day and noted that the scoping comment period was open until July 26, 2021. BOEM then sent an email to tribal leaders on July 12, 2021, offering a government-to-government consultation meeting to discuss the public scoping information for the Projects. BOEM held a government-to-government meeting with the following tribal nations on August 3, 2021: Delaware Tribe of Indians, the Delaware Nation, Mashantucket Pequot Tribal Nation, the Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). In a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Projects.

A.2.2.4. National Historic Preservation Act

Section 106 of the NHPA (54 USC 306108) and its implementing regulations (36 CFR 800) require federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. BOEM has determined that the proposed Projects is an undertaking subject to Section 106 review. The construction of WTGs and OSS, installation of interarray cables, and development of staging areas are ground- or seabed-disturbing activities that may adversely affect archaeological resources. The presence of WTGs may also introduce visual elements out of character with the historic setting of historic structures or landscapes; in cases where historic setting is a contributing element of historic properties' eligibility for the NRHP, the Projects may adversely affect those historic properties.

The Section 106 regulations at 36 CFR 800.8 provide for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. This process is commonly known as "NEPA substitution for Section 106" and BOEM is using this process and documentation required for the preparation of this EIS and the ROD to comply with Section 106. Appendix N of this Draft EIS contains BOEM's Finding of Adverse Effect, which includes a description and summary of BOEM's consultation to date. BOEM will continue consulting with the New York SHPO, New Jersey SHPO, ACHP, federally recognized tribes, and the consulting parties regarding the Finding of Adverse Effect and the resolution of adverse effects. BOEM has and will be conducting Section 106 consultation meeting(s) on the Finding of Adverse Effect and the resolution of adverse effects, and the agency will be requesting that the consulting parties review and comment on the Finding of Adverse Effect and proposed resolution measures. BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR 800.2(d)(3). The Scoping Summary Report (BOEM 2021), available on BOEM's Project-specific website, summarizes comments on historic preservation issues.

On April 29, 2021, BOEM initiated consultation with federally recognized tribes: Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Mashantucket Pequot Tribal Nation, Mohegan Tribe of Indians of Connecticut, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation. (Section A.2.2.3). BOEM requested information on sites of religious and cultural significance to the tribes that the proposed Projects could affect and BOEM offered its assistance in providing additional details and information on the proposed Projects to the tribes. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Projects.

On April 29, 2021, BOEM contacted representatives of local governments, state and local historical societies, and other federal agencies to solicit information on historic properties and determine their interest in participating as consulting parties. Participants that have accepted consulting party status for the NHPA Section 106 Consultation are listed in Table A-2.

Table A-2 Participating Consulting Parties for NHPA Section 106 Consultation

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and state agencies	New Jersey Office of Planning Advocacy NJDEP, Historic Preservation Office New York SHPO New York State Parks, Recreation, and Historic Preservation New York State Parks, Recreation and Historic Preservation, Long Island State Parks Region 9 New York State Parks, Recreation and Historic Preservation, Region 9, Gilgo State Park New York State Parks, Recreation and Historic Preservation, Region 9, Jones Beach State Park New York State Parks, Recreation and Historic Preservation, Region 9, Robert Moses State Park
Federal agencies	ACHP BSEE U.S. Maritime Administration National Park Service USACE USEPA
Federally recognized tribes	The Delaware Nation Delaware Tribe of Indians Shinnecock Indian Nation Wampanoag Tribe of Gay Head (Aquinnah)
Local governments	Atlantic Highlands Borough City of Long Beach Highlands Borough

Participants in the Section 106 Process	Participating Consulting Parties
	Lake Como Borough Long Branch Nassau County New York City Landmarks Commission Ocean County Sea Grit Borough Suffolk County Town of Babylon Town of Hempstead Town of Islip Village of Amityville Village of Bellport
Nongovernmental organizations or groups	Bay Shore Historical Society Equinor Wind US LLC Historical Society of Highlands Point O'Woods Association Romer Shoal Light The League of Historical Societies of New Jersey

A.2.2.5. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the MSA, federal agencies are required to consult with NMFS on any action that may result in adverse effects on EFH. NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR 600. As provided for in 50 CFR 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain OCS activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM developed an EFH Assessment concurrent with the Draft EIS and transmitted the EFH Assessment to NMFS on August 12, 2022. NMFS anticipates receipt of the complete EFH Assessment from BOEM and initiation of the EFH consultation on March 13, 2023.

A.2.2.6. Marine Mammal Protection Act

Section 101(a) of the MMPA (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a)(l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS the authority to authorize the incidental but not intentional take of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Incidental Take Authorizations may be issued as either (1) regulations and associated Letters of Authorization, or (2) an Incidental Harassment Authorization. Letters of Authorizations may be issued for up to a maximum period of 5 years, and Incidental Harassment Authorizations may be issued for a maximum period of 1 year. NMFS has also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 CFR 216) and has published application instructions that prescribe the procedures necessary to apply for an Incidental Take Authorization. Applicants seeking to obtain authorization for the incidental take of marine mammals under NMFS' jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA.

Once NMFS determines an application is adequate and complete, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in the application. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an immitigable impact on their availability for taking for subsistence uses. NMFS must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements.

Empire submitted a Letter of Authorization application to NMFS on August 12, 2022. The application was reviewed and considered complete, and NMFS published a Notice of Receipt in the *Federal Register* on September 9, 2022.

A.2.3 Development of Draft Environmental Impact Statement

This section provides an overview of the development of the Draft EIS, including public scoping, cooperating agency involvement, and distribution of the Draft EIS for public review and comment.

A.2.3.1. Scoping

On June 24, 2021, BOEM issued an NOI to prepare an EIS consistent with NEPA regulations (42 USC 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (83 *Federal Register* 13777). The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the EIS. The formal scoping period was from June 24 through July 26, 2021. BOEM held three virtual public scoping meetings to solicit feedback and to identify issues and potential alternatives for consideration in the EIS. Throughout this timeframe, federal agencies, state and local governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, IPFs, reasonable alternatives (e.g., geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to analyze in the EIS, as well as provide additional information. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), which requires federal agencies to assess the effects of projects on historic properties. Additionally, BOEM informed its Section 106 consultation by seeking public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the COP. The NOI requested comments from the public in written form, delivered by hand or by mail, or through the regulations.gov web portal.

BOEM held three virtual scoping meetings on June 30, July 8, and July 13, 2021. BOEM reviewed and considered all scoping comments in the development of the Draft EIS and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2021) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/renewable-energy/state-activities/empire-wind. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2021-0038" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include commercial fisheries and for-hire recreational fishing; mitigation and monitoring; alternatives; birds; NEPA/Public Involvement Process; cumulative effects; climate change; marine mammals; and others.

A.2.3.2. Cooperating Agencies

BOEM invited other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Draft EIS. According to CEQ guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings on November 18, 2020, and on May 13, May 21, June 7, August 19, and November 3, 2021, to discuss the environmental review process, schedule, responsibilities, consultation, and potential EIS alternatives.

The following federal agencies and state, tribal, and local governments have supported preparation of the Draft EIS as cooperating or participating agencies, or cooperating tribal nations:

Federal Cooperating Agencies

- BSEE
- NMFS
- National Park Service
- USACE
- USCG
- USEPA
- U.S. Maritime Administration

State Cooperating Agencies

- NYSDEC
- New York State Department of State
- NYSERDA

Local Cooperating Agencies

- New York City Mayor's Office of Environmental Coordination

Federal Participating Agencies

- ACHP
- Department of Navy
- DOD
- USFWS

Cooperating Tribal Nations

- The Shinnecock Indian Nation

NMFS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involve activities that have the potential to affect marine resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to the MMPA, as amended (16 USC 1361 et seq.); the regulations governing the taking and importing of marine mammals (50 CFR 216); the ESA (16 USC 1531 et seq.); and the regulations governing the taking, importing, and exporting of threatened and endangered species (50 CFR 222–226). In accordance with 50 CFR 402, NMFS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing action that may affect marine resources listed as threatened or endangered. NMFS has additional responsibilities to conserve and manage fishery resources of the United States, which includes the authority to engage in consultations with other federal agencies pursuant to the MSA and 50 CFR 600 when proposed actions may adversely affect EFH. The MMPA is the only authorization for NMFS that requires NEPA compliance, which, after independent review, may be via adoption of BOEM's EIS and issuance of the ROD.

USACE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to Sections 10 and 14 of the RHA and Section 404 of the CWA. Issuance of Section 10 or Section 404 permits requires NEPA compliance, which will be met via adoption of BOEM's EIS and issuance of the ROD.

BSEE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect marine resources under its jurisdiction by law and special expertise.

USEPA is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise, including air quality and water quality.

USCG is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect navigation and safety issues that fall under its jurisdiction by law and special expertise.

The National Park Service is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect National Park Service resources under its jurisdiction by law and special expertise. The National Park Service, as a bureau within the Department of the Interior and cooperating agency for the preparation of this EIS, has special expertise regarding the regulation of uses on National Park Service units and management of park system resources that includes compliance with the Park System Resource Protection Act (Public Law 113–287, December 2014). The National Park Service also is participating in the consultation under Section 106 of the NHPA.

ACHP is serving as a participating agency because the scope of the Proposed Action and alternatives involves activities that could affect historic properties under its jurisdiction by law and special expertise. ACHP also is participating in the consultation under Section 106 of the NHPA.

USFWS is serving as a participating agency because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. USFWS also serves as the consulting agency under Section 7 of the ESA for federal agencies proposing actions that may affect terrestrial resources listed as threatened or endangered.

DOD and Department of the Navy are serving as participating agencies because they have special expertise with respect to potential impacts that may occur as a result of the Proposed Action, including regarding potential impacts on special use airspace and radar used for air defense.

New York State Department of State is serving as cooperating agencies pursuant to 40 CFR 1501.8 because it has special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

NYSDEC is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action, connected actions, and alternatives involve activities that could affect resources under its jurisdiction by law and special expertise. NYSDEC intends to rely upon BOEM's EIS for its compliance with the New York State Quality Review Act. NYSDEC's interest in the connected SBMT Project is related to NYSDEC regulatory authority, including, but not limited to, 401 water quality certification, and Environmental Conservation Law Article 15 (Water Resources).

The U.S. Maritime Administration and NYSERDA are serving as cooperating agencies pursuant to 40 CFR 1501.8 because the connected action at SBMT would involve federal and state funding that is subject to environmental review under NEPA and the New York State Quality Review Act, respectively. NYSERDA has signed a conditional grant agreement with SBMT Asset LLC (an Equinor/BP joint venture), under which NYSERDA would, if the conditions set forth in the grant agreement are satisfied, provide grant funding for upgrades to the SBMT to make it suitable for WTG staging and assembly and to serve as an O&M hub for the Empire Wind and other offshore wind projects. The conditions in the grant agreement include satisfactory completion of environmental impact review for the SBMT Project. The U.S. Maritime Administration is reviewing the SBMT Project related to a 2021 Port Infrastructure Development Grant application.

BOEM is coordinating with The Shinnecock Indian Nation as a cooperating Tribal Nation under 40 CFR 1501.8. Cooperating Tribal Nations are asked to provide information to BOEM for portions of the EIS for which they have special expertise, including identifying resources that are significant to The Shinnecock Indian Nation, impacts of the Projects on those resources, and potential mitigation of adverse effects.

A.2.3.3. Distribution of the Draft Environmental Impact Statement for Review and Comment

A list of agencies, organizations, and persons to whom copies of the Draft EIS were sent is provided in Appendix K. The Draft EIS is also available in electronic format for public viewing at https://www.boem.gov/renewable-energy/state-activities/empire-wind.

Hard copies and/or digital copies of the Draft EIS can be requested by contacting the Program Manager, Office of Renewable Energy, in Sterling, Virginia. Publication of this Draft EIS initiates a 60-day comment period where government agencies, members of the public, and interested stakeholders can provide comments and input. BOEM will accept comments in any of the following ways:

- In hard copy form, delivered by mail, enclosed in an envelope labeled "Empire Wind COP Draft EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.
- Through the regulations.gov web portal by navigating to https://www.regulations.gov/ and searching for docket number "BOEM-2022-0053." Click the "Comment Now!" button to the right of the document link. Enter your information and comment, then click "Submit."
- By attending one of the public hearings at the locations and dates listed in the notice of availability and providing written or verbal comments.

BOEM will use comments received during the public comment period to inform its preparation of the Final EIS, as appropriate.

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B.3. Chapter 3, Affected Environment and Environmental Consequences

B.3.1 Section 3.1, Impact-Producing Factors

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B.3.2 Section 3.2, Mitigation Identified for Analysis in the Environmental Impact Statement

None.

B.3.3 Section 3.3, Definition of Impact Levels

None.

B.3.4 Section 3.4, Air Quality

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Appendix C. List of Preparers and Reviewers, & Glossary

C.1. List of Preparers and Reviewers

Table C-1 Bureau of Ocean Energy Management Contributors

Name	Role/Resource Area
National Environmental Policy Act (NEPA) Coordinator	
Sangunett, Brandi	Environmental Protection Specialist
Resource Scientists and Contributors	
Baker, Arianna	Navigation and Vessel Traffic
Baker, Kyle	Marine Mammals; Sea Turtles; NMFS BA
Bigger, David	Birds; Bats; Coastal Habitat and Fauna; USFWS BA
Brune, Genevieve	Land Use and Coastal Infrastructure
Bucatari, Jennifer	Other Uses
Chaiken, Emma	Commercial Fisheries and For-Hire Recreational Fishing; Recreation and Tourism
Cornelison, Meghan	Environmental Justice
De Zeeuw, Maureen	Birds
Dobbs, Kerby	Other Uses
Draher, Jennifer	Water Quality
Feinberg, Lucas	Project Coordinator
Hesse, Jeffrey T.	Other Uses
Horrell, Christopher	Cultural Resources; FOE; Section 106 Consultation
Howson, Ursula	Benthic Resources; Coastal Habitat and Fauna; Commercial Fisheries and For-Hire Recreational Fishing; Finfish, Invertebrates, and Essential Fish Habitat; Other Uses; Recreation and Tourism; Wetlands, NMFS BA; EFH Assessment
Jensen, Mark	Demographics, Employment, and Economics; Recreation and Tourism
Klein, Kimberly	Marine Mammals, Planned Activities Scenario
McCarty, John	Visual Resources; Recreation and Tourism
McCoy, Angel	Meteorologist, Technical Design Elements
Miller, Jennifer	Other Uses
Moshier, Marissa	Cultural Resources; FOE; Section 106 Consultation
Richards, Renee	Other Uses
Schnitzer, Laura	Cultural Resources; FOE; Section 106 Consultation
Slayton, Ian	Air Quality, Planned Activities Scenario
Stokely, Sarah	Cultural Resources; FOE; Section 106 Consultation
Sullivan, Kim	Environmental Justice

FOE = Findings of Effect

Table C-2 BOEM and Cooperating Agency Reviewers

Name	Title	Agency
BOEM and DOI Reviewers		
Brown, William	Chief Environmental Officer	BOEM
Krevor, Brian	Lead Environmental Protection Specialist	BOEM
Melendez-Arreaga, Pedro	Lead Attorney-Advisor, Office of the Solicitor	DOI
Morin, Michelle	Chief, Environment Branch for Renewable Energy	BOEM
Ottman, Noel	Attorney-Advisor, Office of the Solicitor	DOI
Stromberg, Jessica	Deputy Branch Chief, Environment Branch for Renewable Energy	BOEM
Vorkoper, Stephen	Attorney-Advisor, Office of the Solicitor	DOI
Cooperating and Participating Agency Reviewers		
Crocker, Julie	Endangered Fish Branch Chief, GARFO Protected Resources Division	NMFS
Desautels, Michele	District 1	USCG
Heckman, Andrea	Lead Environmental Protection Specialist	BSEE
Hanson, Keith	Marine Habitat Resource Specialist, GARFO Habitat and Ecosystem Services Division	NMFS
Kallgren, Maureen	Marine Transportation Specialist	USCG
Krueger, Mary	Energy Specialist, Interior Region 1, North Atlantic - Appalachian	NPS
McLean, Laura	Ocean and Lakes Policy Analyst	NYSDOS
Minck, Chris	New York District, Regulatory, Project Manager	USACE
NYSDEC	Division of Air Resources Division of Environmental Permits Division of Fish and Wildlife Division of Marine Resources	NYSDEC
Petriman, Viorica	Environmental Engineer, Air & Radiation Division, Permitting Section, USEPA Region 2	USEPA
Tuxbury, Susan	Wind Program Coordinator, GARFO Habitat and Ecosystems Division	NMFS
USCG	Sector New York	USCG

DOI = U.S. Department of the Interior; GARFO = Greater Atlantic Regional Fisheries Office; HESD = Habitat and Ecosystem Services; NPS = National Park Service; NYSDOS = New York State Department of State

Table C-3 Consultants

Name	Company	Role/Resource Area
Aarts, Jan	ICF	QA/QC
Baer, Sarah	ICF	Environmental Justice
Byram, Saadia	ICF	Editor
Copeland, Tanya	ICF	Project Manager
Diller, Elizabeth	ICF	Project Director
Ernst, David	ICF	Air Quality
Johnson, Dave	ICF	Bats; Birds; Coastal Habitat and Fauna; Wetlands; Water Quality; USFWS BA

Name	Company	Role/Resource Area
Jost, Rebecca	ICF	Other Uses; Land Use and Coastal Infrastructure; Recreation and Tourism
Paulson, Merlyn	ICF	Scenic and Visual Resources
Tavel, January	ICF	Cultural Resources; FOE; CHRVEA
Valley, Nathalie	ICF	Navigation and Vessel Traffic
Baggett, Lesley	AKRF	Benthic
DeFalco, Lorianne	AKRF	Demographics, Employment and Economics
Krebs, Justin	AKRF	QA/QC; NMFS BA; EFH Assessment
Lozano, Carlos	AKRF	Finfish, Invertebrates, EFH
Manhard, Chris	AKRF	Commercial Fisheries and For-Hire Recreational Fisheries
Manhard, Rachael	AKRF	Marine Mammals; Sea Turtles; NMFS BA

CHRVEA = Cumulative Historic Resources Visual Effects Analysis; QA/QC = quality assurance/quality control

C.2. Glossary

Term	Definition
affected environment	Environment as it exists today that could be potentially affected by the proposed Projects
algal blooms	Rapid growth of the population of algae, also known as algae bloom
allision	A moving (drift or powered) vessel hitting a stationary object
anthropogenic	Generated by human activity
Applicant-proposed measures	Applicant-proposed measures to avoid, minimize, or mitigate potential impacts
attenuation	The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium
below grade	Below ground level
benthic	Related to the bottom of a body of water
benthic resources	The seafloor surface, the substrate itself, and the communities of bottom-dwelling organisms that live within these habitats
Cetacea	Order of aquatic mammals made up of whales, dolphins, porpoises, and related lifeforms
coastal habitat	Coastal areas where flora and fauna live, including salt marshes and aquatic habitats
coastal waters	Waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters)
coastal zone	The lands and waters starting at 3 nm from the land and ending at the first major land transportation route
collision	Two or more moving vessels hitting each other
commercial fisheries	Areas or entities raising and catching fish for commercial profit
commercial-scale wind energy facility	Wind energy facility usually greater than 1 MW that sells the produced electricity
criteria pollutant	One of six common air pollutants for which USEPA sets National Ambient Air Quality Standards: CO, lead, nitrogen dioxide, ozone, particulate matter, or SO_2

Term	Definition
critical habitat	Geographic area containing features essential to the conservation of threatened or endangered species
cultural resource	Precontact or contact districts, objects, places, sites, buildings, structures, shipwrecks, and archaeological sites and collections on the American landscape, as well as sites of traditional, religious, or cultural significance to cultural groups, including Native American tribes
cumulative impacts	Impacts that could result from the incremental impact of a specific action, such as the proposed Projects, when combined with other past, present, or reasonably foreseeable future actions or other projects; can occur from individually minor, but collectively significant actions that take place over time
demersal	Living close to the ocean floor
design envelope	The range of proposed Project characteristics defined by the applicant and used by BOEM for purposes of environmental review and permitting
dredging	Removal of sediments and debris from the bottom of lakes, rivers, harbors, and other waterbodies
duct bank	Underground structure that houses the onshore export cables, which consists of polyvinyl chloride pipes encased in concrete
Earth curvature	Mathematical calculation of the Earth curvature over the ocean's surface defines the physical structure height(s) at which the Projects' WTGs and OSS are visible from offshore and onshore view receptors
ecosystem	Community of interacting living organisms and nonliving components (such as air, water, soil)
electromagnetic field	A field of force produced by electrically charged objects and containing both electric and magnetic components
embayment	Recessed part of a shoreline
endangered species	A species that is in danger of extinction in all or a significant portion of its range
Endangered Species Act-listed species	Species listed under the ESA of 1973 (as amended)
ensonification	The process of filling with sound
environmental consequences	The potential direct, indirect, and cumulative impacts that the construction, O&M, and decommissioning of the proposed Projects would have on the environment
environmental justice communities	Minority and low-income populations affected by the proposed Projects
epifauna	Fauna that lives on the surface of a seabed (or riverbed), or is attached to underwater objects or aquatic plants or animals
essential fish habitat	"Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 CFR 600)
export cables	Cables connecting the wind facility to the onshore electrical grid power
export cable corridor	Area identified for routing the entire length of the onshore and offshore export cables
federal aids to navigation	Visual references operated and maintained by USCG, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation
field of view	The horizontal or vertical extent of the observable landscape seen at any given moment, usually measured in degrees

Term	Definition
finfish	Vertebrate and cartilaginous fishery species, not including crustaceans, cephalopods, or other mollusks
for-hire commercial fishing	Commercial fishing on a for-hire vessel (i.e., a vessel on which the passengers make a contribution to a person having an interest in the vessel in exchange for carriage)
for-hire recreational fishing	Fishing from a vessel carrying a passenger for hire who is engaged in recreational fishing
foundation	The bases to which the WTGs and OSS are installed on the seabed; for example, piled jacket or monopile
geomagnetic	Relating to the magnetism of the Earth
hard-bottom habitat	Benthic habitats composed of hard-bottom (e.g., cobble, rock, and ledge) substrates
historic property	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
historical resource	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
horizontal directional drilling	Trenchless technique for installing underground cables, pipes, and conduits using a surface-launched drilling rig
hull	Watertight frame or body of a ship or buoy
impact-producing factors	Resulting from the construction and installation, operations and maintenance, and decommissioning of the Projects
impulsive sound	Sound that is typically brief and intermittent with rapid rise time and decay back to ambient levels (for example, impact pile driving)
infauna	Fauna living in the sediments of the ocean floor (or river or lake beds)
interarray cables	Cables connecting the WTGs to each other and to the OSS
invertebrate	Animal with no backbone
jacket foundation	Latticed steel frame with three or four supporting piles driven into the seabed
jack-up vessel	Mobile and self-elevating platform with buoyant hull
jet excavation	Process of moving or removing soil with a jet
jet plowing	Plowing in which the jet plow, with an adjustable blade, or plow rests on the seafloor and is towed by a surface vessel; the jet plow creates a narrow trench at the designated depth, while water jets fluidize the sediment within the trench; in the case of the proposed Projects, the cables would then be feed through the plow and laid into the trench as it moves forward; the fluidized sediments then settle back down into the trench and bury the cable
knot	Unit of speed equaling 1 nm per hour
landfall site	The shoreline landing site at which the offshore cable transitions to onshore
marine mammal	Aquatic vertebrate distinguished by the presence of mammary glands, hair, three middle ear bones, and a neocortex (a region of the brain)

Term	Definition
marine waters	Waters in offshore areas where bottom depth is more than 98.4 feet (30 meters)
mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor
mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow's share cuts into the soil, opening a temporary trench, which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
monopile or monopile foundation	A long steel tube driven into the seabed that supports a tower
nautical mile	A unit used to measure sea distances and equivalent to approximately 1.15 miles (1.85 kilometers)
offshore substation	The interconnection point between the WTGs and the export cable; the necessary electrical equipment needed to connect the inter-array cables to the offshore export cables
onshore substation	Substation connecting the proposed Projects to the existing bulk power grid system
operations and maintenance facilities	Would include offices, control rooms, warehouses, shop space, and pier space
Outer Continental Shelf	All submerged land, subsoil, and seabed belonging to the United States but outside of states' jurisdiction
permanent threshold shift	A permanent loss of hearing sensitivity caused by excessive noise exposure (considered an auditory injury)
pile	A type a foundation akin to a pole
pile driving	Installing foundation piles by driving them into the seafloor
pinnipeds	Carnivorous, semiaquatic marine mammals with fins, also known as seals
pin pile	Small-diameter pipe driven into the ground as foundation support
plume	Column of fluid moving through another fluid
point of interconnection	Location where the power generated by the Projects is connected to the existing electric power grid.
private aids to navigation	Visual references on structures positioned in or near navigable waters of the United States, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation; permits for the aids are administered by USCG
Project area	The combined onshore and offshore area where proposed Project components would be located
protected species	Endangered or threatened species that receive federal protection under the ESA of 1973 (as amended)
scour protection	Protection consisting of rock and stone that would be placed around all foundations to stabilize the seabed near the foundations as well as the foundations themselves
scrublands	Plant community dominated by shrubs and often also including grasses and herbs

Term	Definition
seascape and landscape impact assessment	Seascape and landscape impact assessment methodologies analyze impacts on both the physical elements and features that make up a landscape, seascape, or open ocean; and the aesthetic, perceptual, and experiential aspects of the landscape, seascape, or open ocean that make it distinctive
sessile	Attached directly by the base
silt substrate	Substrate made of a granular material originating from quartz and feldspar, and whose size is between sand and clay
soft-bottom habitat	Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, ledge) substrates, as well as biogenic habitat (e.g., eelgrass, mussel beds, worm tubes) created by structure-forming species
substrate	Earthy material at the bottom of a marine habitat; the natural environment that an organism lives in
suspended sediments	Very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom; such material remains in suspension due to the upward components of turbulence and currents, or by suspension
temporary threshold shift	Temporary loss of hearing sensitivity caused by excessive noise exposure
threatened species	A species that is likely to become endangered within the foreseeable future
tidal energy project	Project related to the conversion of the energy of tides into usable energy, usually electricity
tidal flushing	Replacement of water in an estuary or bay because of tidal flow
transition bay	A clean, dry environment for jointing the offshore and onshore cable and providing protection to the cable joint during operation
trawl	A large fishing net dragged by a vessel at the bottom or in the middle of sea or lake water
turbidity	A measure of water clarity
utility right-of-way	Registered easement on private land that allows utility companies to access the utilities or services located there
viewshed	Area visible from a specific location
visual impact assessment	Visual impact assessment analyzes and evaluates the impacts on people of adding the proposed development to views from selected viewpoints
visual resource	The visible physical features on a landscape, including natural elements such as topography, landforms, water, vegetation, and manmade structures
Waters of the United States	"Waters of the United States" applies to the jurisdictional limits of the authority of USACE under the CWA. Waters of the United States include those waters listed in § 328.3(a). The lateral limits of jurisdiction in those waters may be divided into three categories. The categories include the territorial seas, tidal waters, and non-tidal waters (see 33 CFR 328.4(a), (b), and (c), respectively).
wetland	Land saturated with water; marshes; swamps
wind energy	Electricity from naturally occurring wind
wind energy area	Areas with significant wind energy potential and defined by BOEM

Term	Definition
wind turbine generator	Component that puts out electricity in a structure that converts kinetic energy from wind into electricity

Appendix D. Analysis of Incomplete or Unavailable Information

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and when information is incomplete or unavailable, the agency shall make clear that such information is lacking. When incomplete or unavailable information was identified, BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information and if the cost of obtaining it was exorbitant. If it could not be obtained, or if the cost of obtaining it was exorbitant, BOEM considered the best available scientific information and applied generally accepted scientific methodologies to inform the analysis.

D.1. Incomplete or Unavailable Information Analysis for Resource Areas

D.1.1 Air Quality

Although a quantitative emissions inventory analysis of the region, or regional modeling of pollutant concentrations, over the next 35 years would more accurately assess the overall impacts of the changes in emissions from the Projects, any action alternative would lead to reduced emissions regionally and can only lead to a net improvement in regional air quality. The differences among action alternatives with respect to direct emissions due to construction, O&M, and decommissioning of the Projects are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the use of the offshore portions of the Wind Farm Development Area and offshore export cable route corridor. Therefore, BOEM does not believe that there is incomplete or unavailable information on air quality that is essential to a reasoned choice among alternatives.

D.1.2 Bats

There will always be some level of incomplete information on the distribution and habitat use of bats in the offshore portions of the Wind Farm Development Area, as habitat use and distribution varies among seasons and species. Additionally, because U.S. offshore wind development is in its infancy, with only two offshore wind projects having been constructed at the time of this analysis, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the Wind Farm Development Area. However, sufficient information on collision risk to bats observed at land-based U.S. wind projects exists and was used to analyze and corroborate the potential for this impact as a result of the proposed Projects. In addition, as described in Section 3.5, the likelihood of a bat encountering an operating WTG during migration is very low and, therefore, the differences among action alternatives with respect to bats for the Projects are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related distribution and use of the offshore portions of the Wind Farm Development Area as well as to the potential for collision risk of bats. Therefore, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

D.1.3 Benthic Resources

Although there is uncertainty regarding the spatial and temporal distribution of benthic (faunal) resources and periods during which they might be especially vulnerable to disturbance, Empire’s surveys of benthic resources and other broad-scale studies (Battista et al. 2019; NYSERDA 2017; Guida et al. 2017; NEFMC 2017; MAFMC 2016, 2017) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources within the geographic analysis area. Uncertainty also exists regarding the impact of some IPFs on benthic resources. For example, specific stimulus-response related to acoustics and EMF is not well studied, although there is some emerging information from benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States that has begun to provide some new information to support a better understanding of the impacts. Further studies on the effects of underwater noise and EMF and the species-specific responses to these factors are needed, however, before a well-informed understanding can be achieved. Similarly, specific secondary impacts, such as changes in diets throughout the food web resulting from habitat modification and synergistic behavioral impacts from multiple IPFs, are not fully known. Again, results of benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States provide general knowledge of the overall impacts of these IPFs combined, if not individually. Therefore, the analysis provided in this EIS, which is based on those results, is supported by the best available science, despite the fact that additional study would provide greater understanding to more fully support sound scientific judgments and informed decision-making related to the overall impacts of these factors on benthic resources. For these reasons, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

D.1.4 Birds

Habitat use and distribution of marine birds varies between seasons, species, and years and, as a result, there will always be some level of incomplete information on the distribution and habitat use of marine birds in the offshore portions of the geographic analysis area. In addition, because U.S. offshore wind development is in its infancy, there will always be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the geographic analysis area. For this EIS, publicly available avian survey data and Project-specific avian sighting data that cover the Projects (see COP Volume 2b, Section 5.3, Appendix P, and Appendix Q; Empire 2022) were used to inform the predictive models and analysis of potential adverse impacts on bird resources.

Bird mortality data are available for onshore wind facilities and, based on a number of assumptions regarding their applicability to offshore environments, were used to inform the analysis of bird mortality associated with the offshore WTGs analyzed in the EIS. However, uncertainties exist regarding the use of the onshore bird mortality rate to estimate the offshore bird mortality rate due to differences in species groups present and life history and behavior of species as well as differences in the offshore marine environment compared to onshore habitats.

Modeling is commonly used to predict the potential mortality rates for marine bird species in Europe and the United States (BOEM 2015, 2021b). Due to inherent data limitations, these models often represent only a subset of species potentially present. However, the datasets used by both Empire and BOEM to assess the potential for exposure of marine birds to the Wind Farm Development Area represent the best available data and provide context at both local and regional scales. Furthermore, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Projects (e.g., Petersen et al. 2006; Skov et al. 2018). As such, the analysis provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to distribution and use of the offshore portions of the geographic analysis area as well as to the potential for collision risk and avoidance behaviors in bird resources. Furthermore, the similarity between the layouts analyzed for the different action alternatives does not render any of this incomplete and unavailable information essential to a reasoned choice among alternatives. Therefore, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

D.1.5 Coastal Habitat and Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, specific data on abundances and distributions within the geographic analysis area of various fauna within these habitats are likely to remain unknown without site-specific surveys. However, the species inventories and other general information about the area provide an adequate basis for evaluating the fauna likely to inhabit the onshore geographic analysis area. The geographic analysis area is within urbanized landscapes in the New York metropolitan area, and vegetation in the terrestrial onshore environment where onshore Project components would be sited almost entirely consists of landscape plants, including trees, shrubs, other ornamental plants, and maintained grass. Wildlife would be limited to those species adapted to living in urban environments. Additionally, the onshore activities proposed involve only common, industry-standard activities for which impacts are generally understood. Therefore, BOEM believes that the analysis provided in this EIS is sufficient to make a reasoned choice among the alternatives.

D.1.6 Commercial Fisheries and For-Hire Recreational Fishing

Fisheries are managed in the context of an incomplete understanding of fish stock dynamics and effects of environmental factors on fish populations. The commercial fisheries information used in this assessment has limitations. For example, vessel trip report data are only an approximation because this information is self-reported and may not account for all trips. Available historical data lack consistency, making comparisons challenging. However, these data represent the best available data, and sufficient information exists to support the findings presented in this EIS.

A second limitation is that recent annual revenue exposed for for-hire recreational fishing in the Lease Area is not available. The economic analysis conducted by BOEM of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall New York WEA, including the Lease Area, was conducted for 2007–2012 (Kirkpatrick et al. 2017). Although these data are presented in Section 3.9 and used for findings, updated data for the period of 2013 to the present are not available. BOEM supplemented the data from the economic analysis with data compiled by NMFS (2021a) regarding the annual revenue (2008–2018) for for-hire recreational fishing in the Lease Area and the percentage of each permit holder’s total trips coming from within the Lease Area during 2008–2018 to analyze differences in the importance of fishing grounds in the Lease Area for the for-hire recreational fishery. Using both sets of data, BOEM does not believe that there is incomplete or unavailable information on commercial fisheries and for-hire recreational fishing resources that is essential to a reasoned choice among alternatives.

D.1.7 Cultural Resources

Undiscovered terrestrial archaeological resources, submerged archaeological resources (shipwrecks and other anthropogenic features), ancient submerged landforms, and as-yet undocumented TCPs represent incomplete or unavailable information. However, the differences among alternatives with respect to cultural, historic, and archaeological resources are not expected to be significant. BOEM will use the ROD as an agreement document to establish commitments for an inadvertent submerged archaeological resources discovery plan, inadvertent terrestrial archaeological resources discovery plan, cultural resources treatment plans, and archaeological monitoring during construction within the APE in accordance with BOEM’s existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585*, ensuring potential historic properties are identified, effects assessed, and adverse effects resolved. Therefore, BOEM does not believe this incomplete or unavailable information on historic properties is essential to a reasoned choice among alternatives.

D.1.8 Demographics, Employment, and Economics

Empire's economic analysis estimated the employment and outputs for the Proposed Action. This provided sufficient information for the evaluation of demographics, employment, and economics to support a reasoned choice among alternatives. There is some inherent uncertainty in forecasting how economic variables in various areas will evolve over time. However, the differences among action alternatives with respect to demographics, employment, and economics are not expected to be significant. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

D.1.9 Environmental Justice

The analysis of disproportionately high and adverse effects on minority and low-income populations is tiered to the assessment of impacts on other resources analyzed in this EIS. As a result, incomplete or unavailable information related to other resources, as described in this appendix, also affect the completeness of the analysis of impacts for environmental justice. As discussed in other sections, BOEM has determined that incomplete and unavailable information for other resources on which the analysis of environmental justice impacts rely was either not relevant to the assessment of reasonably foreseeable high and adverse effects; was not essential to a reasoned choice among alternatives; alternative data or methods could be used to predict potential impacts and provided the best available information; or the overall costs of obtaining the information was exorbitant or the means to do so were unknown. Therefore, BOEM does not believe that there is incomplete or unavailable information for environmental justice that is essential to a reasoned choice among alternatives.

D.1.10 Finfish, Invertebrates, and Essential Fish Habitat

Although there is some uncertainty regarding the spatial and temporal distribution of finfish and invertebrate resources and periods during which they might be especially vulnerable to disturbance, Empire's aquatic resource surveys and other broad-scale studies (e.g., Guida et al. 2017) provided a suitable basis for general predictions of finfish and invertebrate resources with respect to species, densities, and distributions within the geographic analysis area. Additional information related to ESA-listed species and EFH will be addressed in the forthcoming BA and EFH Assessment. While impacts on these specific finfish and invertebrate species are not anticipated to vary from the general impacts provided in the EIS, specific impact discussion for ESA-listed species and EFH will be provided in the BA and EFH Assessment.

Uncertainty also exists regarding the impact of some IPFs on invertebrate resources, such as the effects of EMFs and underwater noise (e.g., generated from pile driving). The available information on invertebrate sensitivity to EMF is equivocal (Hutchinson et al. 2020), and sensitivity to sound pressure and particle motion effects is not well understood for many species, nor are synergistic or antagonistic impacts from multiple IPFs. Similarly, specific secondary impacts such as changes in diets throughout the food chain resulting from habitat modification are not well known for finfish and invertebrates. Where applicable, the assessment drew upon information in the available literature and an increasing number of monitoring and research studies related to wind development, other undersea development, or artificial reefs in Europe and the United States, several of which were recently drafted or published. These monitoring studies help provide a broad understanding of the overall impacts of these IPFs combined, if not individually.

For these reasons, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. Therefore, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrate, and EFH resources that is essential to a reasoned choice among alternatives.

D.1.11 Land Use and Coastal Infrastructure

There is no incomplete or unavailable information related to the analysis of impacts on land use and coastal infrastructure.

D.1.12 Marine Mammals

NMFS has summarized the most current information about marine mammal population status, occurrence, and use of the region in its draft 2021 stock status report for the Atlantic OCS and Gulf of Mexico (NMFS 2021b). These studies provided a suitable basis for predicting the species, abundances, and distributions of marine mammals in the geographic analysis area. However, population trend data from NMFS are unavailable for six of the 10 species likely to occur in the Project area. As a result, there is uncertainty regarding how Project activities and cumulative effects may affect these populations. In addition to species distribution information, effects of some IPFs on marine mammals are also uncertain or ambiguous, as described below.

Potential effects of EMF have not been scaled to consider impacts on marine mammal populations or their prey in the geographic analysis area (Taormina et al. 2018). The widespread ranges of marine mammals and difficulty obtaining permits make experimental studies challenging. As a result, no scientific studies have been conducted that examine the effects of altered EMF on marine mammals. Although scientific studies summarized by Normandeau et al. (2011) demonstrate that marine mammals are sensitive to, and can detect, small changes in magnetic fields (Section 3.15), potential impacts would likely only occur within a few feet of cable segments. The current literature does not support a conclusion that EMF could lead to changes in behavior that would cause significant adverse effects on marine mammal populations.

The behavioral effects of anthropogenic noises on marine mammals are increasingly being studied; however, behavioral responses vary depending on a variety of factors such as life stage, previous experience, and current behavior (e.g., feeding, nursing) and are therefore difficult to predict. In addition, the current NMFS disturbance criteria apply a single threshold for all marine mammals for impulsive noise sources and do not consider the overall duration, exposure, or frequency distribution of the sound to account for species-dependent hearing acuity. While elevated underwater sound could startle or displace animals, behavioral responses are not necessarily predictable from source levels alone (Southall et al. 2007).

In addition, research regarding the potential behavioral effects of pile-driving noise has generally focused on harbor porpoises and seals; studies that examine the behavioral responses of baleen whales to pile driving are absent from the literature. Of the available research, most studies conclude that, although pile-driving activities could cause avoidance behaviors or disruption of feeding activities, individuals would likely return to normal behaviors once the activity had stopped. However, uncertainty remains regarding the long-term cumulative acoustic impacts associated with multiple pile-driving projects that may occur over a number of years. This also applies to other Project activities such as vessel movements, HRG surveys, geotechnical drilling, and dredging activities that may elicit behavioral reactions in marine mammals. As a result, it is not possible to predict with certainty the potential long-term behavioral effects on marine mammals from Project-related pile driving or other activities, as well as ongoing concurrent and cumulative pile driving and other activities.

To address this uncertainty, the assessment used the best available information when considering behavioral effects related to underwater noise. To better characterize these impacts, graded probability of response frequency-weighted metrics developed by Wood et al. (2012) were used in addition to the NMFS disturbance threshold, as described in Section 3.15, *Marine Mammals*. Monitoring studies would provide insight into species-specific behavioral reactions to Project-generated underwater noise. Long-term monitoring of concurrent and multiple projects could inform the understanding of long-term effects and subsequent consequences from cumulative underwater noise activities on marine mammal populations.

There is a lack of research regarding the responses of large whale species to extensive networks of new structures due to the novelty of this type of development on the Atlantic OCS. Although new structures are anticipated from multiple offshore wind projects under the planned activities scenario, it is expected that spacing will allow large whales to access areas within and between wind facilities. No physical obstruction of marine mammal migration routes or habitat areas are anticipated, but whether avoidance of offshore wind lease areas will occur due to new structures is unknown. Additionally, while there is some uncertainty regarding how hydrodynamic changes around foundations may affect prey availability, these changes are expected to have limited impacts on the local conditions around WTG foundations. The potential consequences of these impacts on marine mammals of the Atlantic OCS are unknown. Monitoring studies would provide insight into species-specific avoidance behaviors and other potential behavioral reactions to Project structures.

At present, this EIS has no basis to conclude that these IPFs would result in significant adverse impacts on marine mammal populations.

BOEM determined that the overall costs of obtaining the missing information for or addressing these uncertainties are exorbitant, or the means to obtain it are not known. Therefore, to address these gaps, BOEM extrapolated or drew assumptions from known information for similar species and studies using generally accepted scientific methodologies, as presented in Section 3.15 and in the BA submitted to NMFS (BOEM 2022). The information and methods used to predict potential impacts on marine mammals represent the best available information, and the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making. Therefore, BOEM does not believe that there is incomplete or unavailable information on marine mammal resources that is essential to a reasoned choice among alternatives.

D.1.13 Navigation and Vessel Traffic

Vessel traffic in the NSRA Study Area was characterized using AIS data recorded via satellite and coastal receivers between August 2017 and July 2018. These data were compared to and supplemented with data collected (through visual observations and radar) from project survey vessels working in the Lease Area (COP Volume 2e, page 8-80; Empire 2022). The project survey vessel observations (collected from March to December 2018) have the added advantage of collecting additional data for vessels that may turn off their AIS tracking system or are not required to install and transmit AIS (such as vessels under 65 feet [20 meters]). The NSRA analysis also drew upon NOAA VMS fishing-specific data (2015 to 2016) from the Northeast Ocean Data Portal (Northeast Regional Ocean Data Portal 2018). Fishing vessels at least 65 feet long were not required to carry AIS until March 2015 (80 *Federal Register* 5282); therefore, AIS data prior to March 2015 are more limited than data available after March 2015. The combination of AIS and VMS data described above with informed assumptions about smaller vessel numbers represents the best available vessel traffic data and is sufficient to enable BOEM to make a reasoned choice among alternatives.

As stated in Section 3.16, WTG and OSS structures could potentially interfere with marine radars. Marine radars have varied capabilities and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency; however, trained radar operators, properly installed and adjusted vessel equipment, marked WTGs, and the use of AIS all would enable safe navigation with minimal loss of radar detection (USCG 2020). Based on the foregoing, BOEM does not believe that there is incomplete or unavailable information on navigation and vessel traffic that is essential to a reasoned choice among alternatives.

D.1.14 Other Uses

There is no incomplete or unavailable information related to the analysis of impacts on other uses.

D.1.15 Recreation and Tourism

Evaluations of impacts on recreation and tourism rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, as described in this document, also affects the completeness of the analysis of impacts on recreation and tourism. BOEM has determined that incomplete and unavailable resource information for recreation and tourism or for other resources on which the analysis of recreation and tourism impacts rely was either not relevant to the assessment of adverse impacts; was not essential to a reasoned choice among alternatives; alternative data or methods could be used to predict potential impacts and provided the best available information; or the overall costs of obtaining the information was exorbitant or the means to do so were unknown. Therefore, the information provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to the alternatives.

D.1.16 Sea Turtles

There is incomplete information on the distribution and abundance of sea turtle species that occur in the Atlantic OCS and the Lease Area. The NMFS BA (BOEM 2022) provides a thorough overview of the available information about potential species occurrence and exposure to Project-related IPFs. The studies summarized therein provide a suitable basis for predicting potential species occurrence, relative abundance, and probable distribution of sea turtles in the geographic analysis area.

Some uncertainty exists about the effects of certain IPFs on sea turtles and their habitats. The effects of EMF on sea turtles are not completely understood. However, the available relevant information is summarized in the BOEM-sponsored report by Normandeau et al. (2011). Although the thresholds for EMF disturbing various sea turtle behaviors are not known, the evidence suggests that impacts may only occur on hatchlings over short distances, and no adverse effects on sea turtles have been documented to occur from the numerous submarine power cables around the world. In addition, no nesting beaches, critical habitat, or other biologically important habitats were identified in the offshore export cable corridor.

There is also uncertainty about sea turtle responses to proposed Project construction activities, and data are not available to evaluate potential changes to movements of juvenile and adult sea turtles due to elevated suspended sediments. However, although some exposure may occur, total suspended solid impacts would be limited in magnitude and duration and would occur within the range of exposures periodically experienced by these species. On this basis, any resulting impact on sea turtle behavior due to sediment plumes would likely be too small to be biologically meaningful, and no adverse impacts would be expected (NOAA 2020). Some potential exists for sea turtle displacement, but it is unclear if this would result in adverse impacts (e.g., because of lost foraging opportunities or increased exposure to potentially fatal vessel interactions). Additionally, it is currently unclear whether concurrent construction of multiple projects, increasing the extent and intensity of impacts over a shorter duration, or spreading out project construction with lower-intensity impacts over multiple years would result in the least potential harm to sea turtles. There is also uncertainty regarding the cumulative acoustic impacts associated with pile-driving activities. It is unknown whether sea turtles affected by construction activities would resume normal feeding, migrating, or breeding behaviors once daily pile-driving activities cease, or if secondary impacts would continue. Under the planned activities scenario, individual sea turtles may be exposed to acoustic impacts from multiple projects in a single day or from one or more projects over the course of multiple days. Although the consequences of these exposure scenarios have been analyzed with the best available information, some level of uncertainty remains due to the lack of observational data on species' responses to pile driving.

Some uncertainty exists regarding the potential for sea turtle responses to FAA hazard lights and navigation lighting associated with offshore wind development. Empire would limit lighting on WTGs and OSS to minimum levels required by regulation for worker safety, navigation, and aviation. Although sea turtles' sensitivity to these minimal light levels is unknown, sea turtles do not appear to be adversely affected by oil and gas platform operations, which produce far more artificial light than offshore wind structures. The placement of new structures would be far from nesting beaches, so no impacts on nesting female or hatchling sea turtles are anticipated.

Considerable uncertainty exists about how sea turtles would interact with the long-term changes in biological productivity and community structure resulting from the reef effect of offshore wind farms across the geographic analysis area. Artificial reef and hydrodynamic impacts could influence predator-prey interactions and foraging opportunities in ways that influence sea turtle behavior and distribution. Also, the extent of sea turtle entanglement on artificial reefs and shipwrecks is not captured in sea turtle stranding records and the significance and potential scale of sea turtle entanglement in lost fishing gear are not quantified. These impacts are expected to interact with the ongoing influence of climate change on sea turtle distribution and behavior over broad spatial scales, but the nature and significance of these interactions are not predictable. BOEM anticipates that ongoing monitoring of offshore energy structures will provide some useful insights into these synergistic effects.

BOEM considered the level of effort required to address the uncertainties described above for sea turtles and determined that the methods necessary to do so are lacking or the associated costs would be exorbitant. Therefore, where appropriate, BOEM inferred conclusions about the likelihood of potential biologically significant impacts from available information for similar species and situations. These methods are described in greater detail in Section 3.19, *Sea Turtles*, and in the BA submitted to NMFS (BOEM 2022). Therefore, the analysis provided is sufficient to support sound scientific judgments and informed decision-making about the proposed Projects with respect to impacts on sea turtles. For these reasons, BOEM does not believe that there is incomplete or unavailable information on turtles that is essential to a reasoned choice among alternatives.

D.1.17 Scenic and Visual Resources

No incomplete or unavailable information related to the analysis of impacts on scenic and visual resources was identified.

D.1.18 Water Quality

No incomplete or unavailable information related to the analysis of impacts on water quality was identified.

D.1.19 Wetlands

No incomplete or unavailable information related to the analysis of impacts on wetlands was identified.

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Appendix E. Project Design Envelope and Maximum-Case Scenario

Empire proposes the Project using a PDE concept. This concept allows Empire to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, export cables, and OSS.[1]

BOEM provides Empire and other lessees with the option to submit COPs using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Empire and analyzed in this Draft EIS could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews as design changes occur.

This Draft EIS assesses the impacts of the reasonable range of Project designs that are described in the COP by using the maximum-case scenario process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS considers the interrelationship among aspects of the PDE rather than simply viewing each design parameter independently. This Draft EIS also analyzes the planned action impacts of the maximum-case scenario together with other past, present, and reasonably foreseeable future actions.

A summary of Empire's PDE parameters is provided in Table E-1 and Table E-2. Table E-3 details the full range of maximum-case design parameters for the proposed Project and which parameters are relevant to the analysis for each EIS section in Chapter 3, *Affected Environment and Environmental Consequences*.

Table E-1 Summary of PDE Parameters

Parameter	EW 1	EW 2	Total
Type of foundation (WTGs)	Monopile	Monopile	Monopile
Type of foundations (OSS)	Piled jacket	Piled jacket	Piled jacket
Number of foundations	58	91	149
Number of OSS	1	1	2
Number of WTGs	57	90	147
Rotor diameter	853 feet (260 meters)	853 feet (260 meters)	853 feet (260 meters)
Hub height	525 feet (160 meters)	525 feet (160 meters)	525 feet (160 meters)
Upper blade tip height	951 feet (290 meters)	951 feet (290 meters)	951 feet (290 meters)
Voltage of interarray cables	66 kV	66 kV	66 kV

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance.

Parameter	EW 1	EW 2	Total
Total length of interarray cables	116 nm (214 kilometers)	144 nm (267 kilometers)	260 nm (481 kilometers)
Voltage of submarine export cables	230 kV	230 kV	230 kV
Total length of submarine export cables	40 nm (74 kilometers)	26 nm (48 kilometers)	66 nm (122 kilometers)

Table E-2 Summary of Project Siting Options in the PDE

Project Element	EW 1	EW 2
POI	Gowanus	Oceanside
Submarine export cable route	EW 1 Route B	EW 2 Route C
Onshore substation	EW 1	EW 2 Onshore Substation A and EW 2 Onshore Substation C
Submarine export cable landfall	EW 1	EW 2 Landfall A: Riverside Boulevard and East Broadway EW 2 Landfall B: Shore Road and Monroe Boulevard EW 2 Landfall C: Lido Beach West Town Park EW 2 Landfall E: Laurelton Boulevard and West Broadway
Onshore cable route	EW 1	LB-A through LB-H, LB Variant, and IP-A through IP-H

Table E-3 Maximum-Case Design Parameters for the Empire Wind Project (an "X" indicates that the parameter is relevant to an EIS resource analysis)

Design Parameter	Empire Wind 1	Empire Wind 2	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual	3.21 Water Quality	3.22 Wetlands
Wind Farm																					
Wind farm capacity	816 MW	1,260 MW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wind Turbines																					
Approximate total number[1]	57	90	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
Hub height above HAT	525 feet (160 meters)			X		X		X	X	X	X		X		X	X	X		X		
Upper blade tip above HAT	951 feet (290 meters)			X		X		X	X	X	X		X		X	X	X		X		
Lower blade tip above HAT[2]	85 feet (26 meters)			X		X		X	X	X	X		X		X	X	X		X		
Rotor diameter	853 feet (260 meters)			X		X		X	X	X	X		X		X	X	X		X		
Wind Turbine Oil/Grease/Fuel																					
Transformer oil	2,378 gallons (9,000 liters)		X		X	X				X		X			X			X		X	
Main bearing grease	95 gallons (360 liters)		X		X	X				X		X			X			X		X	
Yaw grease	32 gallons (120 liters)		X		X	X				X		X			X			X		X	
Yaw gear oil	95 gallons (360 liters)		X		X	X				X		X			X			X		X	
Main bearing grease	95 gallons (360 liters)		X		X	X				X		X			X			X		X	
Hydraulic oil	317 gallons (1000 liters)		X		X	X				X		X			X			X		X	
Cooling (water/glycerol)	872 gallons (3300 liters)		X		X	X				X		X			X			X		X	
Pitch lubrication (grease)	53 gallons (200 liters)		X		X	X				X		X			X			X		X	
Pitch system hydraulic accumulators (nitrogen)	17,171 gallons (65,000 liters)		X		X	X				X		X			X			X		X	
Pitch gearbox oil	18 gallons (70 liters)		X		X	X				X		X			X			X		X	
Gearbox oil (gear oil)	1,057 gallons (4,000 liters)		X		X	X				X		X			X			X		X	
Sulfur hexafluoride (SF_6 gas)	287 pounds (130 kilograms)		X		X					X		X			X			X			
Monopile Foundation																					
Base diameter	36 feet (11 meters)				X	X		X	X			X		X	X		X	X			
Seabed penetration	180 feet (55 meters)				X			X	X			X		X	X		X	X			
Seabed footprint (without scour protection)[3]	1,023 square feet (95 m^2)				X	X		X	X			X		X	X		X	X		X	
Seabed footprint (with scour protection)[4]	39,902 square feet (3,707 m^2)				X	X		X	X			X		X	X		X	X		X	
Diameter at MSL	33 feet (10 meters)							X				X			X		X		X		
Monopile Foundation Scour Protection																					
Depth of scour protection	16.4 feet (5 meters)				X			X	X			X					X			X	
Diameter for monopile (including foundation)	207 feet (63 meters)				X	X		X				X		X	X		X	X	X	X	

Design Parameter	Empire Wind 1	Empire Wind 2	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual	3.21 Water Quality	3.22 Wetlands
Volume for monopile[5]	13,080 cubic yards (10,000 cubic meters)				X			X				X		X	X		X	X			
Monopile Foundation Parameters																					
Seafloor footprint of installation vessel[6]	0.5 acre (0.2 hectare)				X			X	X			X		X	X		X	X		X	
Seafloor penetration of installation vessel[6]	82 feet (25 meters)				X			X	X			X					X			X	
Pile hammer size	5,500 kilojoules			X	X	X		X				X		X			X	X			
Maximum blows per minute per pile at maximum energy setting	40			X	X	X		X				X		X			X	X			
Average piling time per pile	3 hours																				
Wind Turbine Installation Parameters																					
Seafloor footprint of wind turbine installation vessels[6]	0.5 acre (0.2 hectare)				X			X	X	X		X		X	X		X	X		X	
Estimated time per component (hours/wind turbine)	48 hours/wind turbine			X		X					X				X		X			X	
Offshore Substation																					
Piled Jacket Foundation[7]																					
Leg spacing at seabed	197 feet x 197 feet (60 meters x 60 meters)														X		X				
Pile diameter	8 feet (2.5 meters)				X							X		X	X		X	X			
Seabed penetration	197 feet (60 meters)				X				X			X					X				
Seabed footprint (without scour protection)[3]	38,750 square feet (3,600 m^2)				X	X			X			X		X	X		X	X		X	
Seabed footprint (with scour protection)[8]	93,560 square feet (8,692 m^2)				X	X			X			X		X	X		X	X		X	
Leg spacing at MSL	164 feet x 164 feet (50 meters x 50 meters)														X				X		
Piled Jacket Foundation Scour Protection[9]																					
Depth for piled jacket	6.6 feet (2 meters)								X												
Area (including foundation)	93,560 (8,692 m^2)								X						X						
Total Volume[5]	30,698 cubic yards (23,470 cubic meters)					X									X						
Piled Jacket Foundation Parameters																					
Seafloor footprint of piled jacket installation vessel (per jacket)[10]	0.5 acre (0.2 hectare)				X			X	X		X			X	X		X	X		X	
Seafloor penetration of installation vessel[10,11]	82 feet (25 meters)				X			X	X		X						X			X	
Pile hammer size	4,000 kilojoules			X	X	X		X			X			X				X			
Maximum blows per minute per pile at maximum energy setting	40			X		X											X				
Average piling time per pile[12]	4.2 hours																				
Offshore Substation Topside Maximum Parameters																					
Voltage	230 kV																				
Width	230 feet (70 meters)			X		X		X	X						X				X		
Length	230 feet (70 meters)			X		X		X	X						X				X		

Design Parameter	Empire Wind 1	Empire Wind 2	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual	3.21 Water Quality	3.22 Wetlands
Height[13]	92 feet (28 meters)			X		X		X	X						X	X			X		
Base height AMSL (air gap)[2]	72 feet (22 meters)			X		X			X						X				X		
Offshore Substation Oil/Grease/Fuel Maximum Parameters[14]																					
Transformer/reactor oil	158,503 gallons (600,000 liters)		X		X	X						X		X	X			X		X	
Sulfur hexafluoride (SF_6 gas)	11,023 pounds (5,000 kilograms)		X									X		X	X			X			
Diesel fuel	7,925 gallons (30,000 liters)		X		X	X						X		X	X			X		X	
UPS batteries	66,139 pounds (30,000 kilograms)				X							X		X	X			X			
Submarine Export Cables																					
Number of routes	1	1			X	X		X	X	X		X	X	X	X	X	X	X		X	
Number of cables per route	2	3			X	X		X	X	X		X	X	X	X	X	X	X		X	
Total length[15]	40 nm (74 kilometers)	26 nm (48 kilometers)			X	X		X	X	X		X	X	X	X	X	X	X		X	
Voltage	230 kV														X						
Diameter (3 core cable)	1 foot (300 millimeters)								X	X					X	X					
Minimum target burial depth[16]	6 feet (1.8 meters) 15 feet (4.5 meters)[17]				X	X		X	X	X		X	X	X	X	X	X	X		X	
Trench depth[16]	8 feet (2.4 meters) 18 feet (5.5 meters)[17]				X	X		X	X	X		X	X	X	X	X	X	X		X	
Seafloor disturbance width[18]	33 feet (10 meters)				X	X		X	X	X		X	X	X	X	X	X	X		X	
Separation distance	33 to 300 feet (10 to 91 meters)				X	X		X	X	X		X	X	X	X	X	X	X		X	
Trench width[19]	5 feet (1.5 meters)				X	X		X	X	X		X	X	X	X	X	X	X		X	
Anchor corridor width[20]	1,250 feet (381 meters)[21]				X			X	X	X		X	X	X	X		X	X		X	
Siting corridor width[22]	500 feet (152 meters)	900 feet (274 meters)			X	X		X	X	X			X		X		X			X	
Permanent easement width[23]	200 feet (60 meters)								X	X			X		X		X			X	
Submarine Export Cable Protection Maximum Parameters (Provided per cable within each siting corridor)																					
Width at base	36 feet (11 meters)				X	X		X	X			X			X	X	X			X	
Width at top	5 feet (1.5 meters)				X	X		X	X			X			X	X	X			X	
Depth	5 feet (1.5 meters)				X	X		X	X			X		X	X	X	X	X		X	
Interarray Cable																					
Total length	116 nm (214 kilometers)	144 nm (267 kilometers)	X		X	X		X	X	X		X		X	X	X	X	X		X	
Voltage	66 kV														X						
Diameter	0.6 foot (170 millimeters)								X	X					X	X	X				
Target burial depth[16]	6 feet (1.8 meters)				X	X		X	X	X		X		X	X	X	X	X		X	

Design Parameter	Empire Wind 1	Empire Wind 2	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual	3.21 Water Quality	3.22 Wetlands
Trench width[24]	5 feet (1.5 meters)				X	X		X	X	X		X		X	X	X	X	X		X	
Seafloor disturbance width[18]	33 feet (10 meters)				X	X		X	X	X		X		X	X	X	X	X		X	
Interarray Cable Protection Maximum Parameters (Provided per cable within each siting corridor)																					
Width at base	16 feet (5 meters)				X	X		X	X	X		X			X	X	X			X	
Width at top	3 feet (1 meters)				X	X		X	X	X		X			X	X	X			X	
Depth	3 feet (1 meters)				X			X	X	X		X		X	X	X	X	X		X	
Cable and Pipeline Crossings (Provided per cable within each siting corridor)																					
Width at base	53 feet (16 meters)				X	X		X	X	X		X	X		X	X	X			X	
Width at top	6.6 feet (2 meters)				X	X		X	X	X		X	X		X	X	X			X	
Depth	6.6 feet (2 meters)				X			X	X	X		X	X	X	X	X	X	X		X	
Onshore Export Cable Maximum Parameters																					
Number of cables	N/A	9+3 fiber optic cables		X		X	X		X	X	X		X						X	X	X
Route length[25]	N/A	5.6 miles (9.1 kilometers)	X	X		X	X		X	X	X		X						X	X	X
Number of routes	N/A	2	X	X		X	X		X	X	X		X						X	X	X
Voltage	N/A	230 kV									X										
Diameter	N/A	0.4 foot (133 millimeters)							X	X	X										
Construction corridor width (open cut)	N/A	150 feet (46 meters)[26]		X		X	X		X	X	X		X						X	X	X
Operational corridor width[27]	N/A	25 feet (8 meters)		X		X	X		X		X		X						X	X	X
Interconnection Cable Maximum Parameters																					
Number of cables per route	6+2 fiber optic cables	18+3 fiber optic cables		X		X	X		X	X	X		X							X	X
Total route length	0.2 mile (0.4 kilometer)	2.8 miles (4.5 kilometer)	X	X		X	X		X	X	X		X						X	X	X
Voltage	345 kV	138 to 345 kV									X										
Diameter	0.5 foot (150 millimeters)								X	X	X										
Construction corridor width (open cut)	50 feet (15 meters)	100 feet (30 meters)[26]		X		X	X		X	X	X		X		X				X	X	X
Operational corridor width[28]	25 feet (8 meters)			X		X	X		X		X		X		X				X	X	X
Export Cable and Interconnection Cable Installation Methods																					
Export Cable Landfall/Inland Waterway Crossings																					
Trenchless (HDD, direct pipe, jack and bore, or similar)	X	X				X	X	X	X			X	X	X	X			X		X	X
Open cut trench/jetting (with or without dredging)	X	X				X	X	X	X			X	X	X	X			X		X	X
Open cut/jetting (cofferdam)	X	X				X	X	X	X			X	X	X	X			X		X	X
Open cut/jetting (conduit through bulkhead with or without cofferdam)	X	X				X	X	X	X			X	X	X	X			X		X	X
Open cut/jetting (conduit over bulkhead with or without cofferdam)	X	X				X	X	X	X			X	X	X	X			X		X	X

Design Parameter	Empire Wind 1	Empire Wind 2	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual	3.21 Water Quality	3.22 Wetlands
Above-water crossing (cable bridge)	-	X																			
Onshore Export Cable/Interconnection Cable Routes (Upland)																					
Open cut trench	X	X		X		X	X		X				X						X	X	X
HDD	X	X		X		X	X		X				X						X	X	X
Other trenchless (jack and bore)	X	X		X		X	X		X				X							X	X
Summary of Onshore Open Cut Trench Parameters																					
Depth of trench	10 feet (3 meters)								X				X								
Width of trench	10 feet (3 meters)	30 feet (9 meters)							X				X						X		
Construction corridor width	50 feet (15 meters)	150 feet (46 meters)[29]		X		X	X		X				X						X	X	X
Operational corridor width[30]	25 feet (8 meters)			X		X	X		X				X						X	X	X
Summary of HDD Parameters																					
Submarine Export Cable Landfall HDD																					
Onshore (entry) work area footprint	200 feet x 200 feet (61 meters x 61 meters)	246 feet x 246 feet (75 meters x 75 meters)		X		X	X		X				X							X	X
Offshore (exit) work area footprint	100 feet x 100 feet (30 meters x 30 meters)			X	X	X	X	X	X			X	X	X			X	X		X	X
Onshore Export Cable/Interconnection Cable Crossing HDD																					
Onshore work area footprint	200 feet x 200 feet (61 meters x 61 meters) x 2 (entry/exit)	246 feet x 246 feet (75 meters x 75 meters) x 2 (entry/exit)		X		X	X		X				X							X	X
Summary of Other Trenchless Crossing (non-HDD) Parameters																					
Work area footprint	60 feet x 60 feet (18 meters x 18 meters)			X		X	X		X				X						X	X	X
Bore pit footprint	60 feet x 60 feet (18 meters x 18 meters)			X		X	X		X				X							X	X
Receiving pit footprint	40 feet x 40 feet (12 meters x 12 meters)			X		X	X		X				X							X	X
Summary of Direct Pipe Workspace Parameters																					
Submarine Export Cable Landfall Direct Pipe Option																					
Onshore (entry) work area footprint	-	260 feet x 680 feet (79 meters x 207 meters)		X		X	X		X				X							X	X
Offshore (exit) work area footprint	-	100 feet x 100 feet (30 meters x 30 meters)		X	X	X	X	X	X			X	X	X			X	X		X	X

[1] The number of WTGs proposed allows for overplanting. Up to 147 WTG will be installed at any of 176 locations. The remaining two locations will be used for OSS.
[2] For this parameter, the minimum value represents the maximum PDE value to be used for assessing impacts.
[3] Per foundation.
[4] Per foundation if scour protection is required.
[5] Per foundation if scour protection is required. Includes protection for J-tubes where interarray cables meet the OSS.

[6] Accounts for jack-up installation vessels. Seafloor footprint will be the short-term impacts associated with construction and installation activities; operational footprint is the long-term impacts.
[7] Up to 12 piles per foundation. For piled jackets designed with up to four legs, three piles per leg. For piled jackets designed with six legs, up to two piles per leg or three piles per corner.
[8] Per foundation if scour protection is required. This footprint will also cover scour protection of the submarine cable protection for J-tubes entering the ISS.
[9] This scour protection will also cover scour protection of the submarine cable protection for J-tubes entering the OSS.
[10] Accounts for jack-up installation vessels. Seafloor footprint will be short term.
[11] Range is dependent on soil type.
[12] Only one foundation is proposed to be installed via pile driving at a given time for the Projects (i.e., there would be no overlap in pile-driving activities between EW 1 and EW 2).
[13] Height from lowest deck on topside or foundation to highest deck on topside.
[14] Values listed are per OSS. Listed fluids and values are representative; approximate actual values will be incorporated into the Projects' emergency response plan.
[15] The approximate distance along the centerline of the surveyed submarine export cable siting corridor from the edge of the Lease Area to the export cable landfall. Actual length of cables may increase as a result of micrositing and final location of OSS. Final installation would be within the surveyed corridor assessed.
[16] Burial depths to be based on CBRA and site-specific conditions, and may be greater than values listed here.
[17] In locations where the submarine export cable would cross federally maintained areas, in accordance with engagement with USACE and other stakeholders. This depth will be determined based upon the current or future authorized depth or the existing water depths, whichever is greater; therefore, minimum burial could be greater.
[18] Direct seabed disturbance, including tracks from the trenching tool.
[19] The width of the trench is defined here as the widest point of the bottom of the trench established by the clearing of the seabed by the trenching tool and will vary based upon the final installation method selected and soil conditions; the seabed surface trench width could be up to 10 feet (3 meters) in select locations, based upon the final installation method selected. Typical installation width is anticipated to be 1.5 feet (0.5 meter).
[20] The area in which a submarine export cable installation vessel may anchor in support of installation activities; distance measured from the edge of the siting corridor. Corridor width may increase or decrease where site constraints exist. Impacts from Project-related vessel anchoring are expected to be in up to 269 square feet (25 m^2) area, with a maximum penetration depth of 49 feet (15 meters) in up to 1,400 locations.
[21] For EW 1, the anchor corridor would be in New York and New Jersey state waters only.
[22] The area in which the submarine export cables could be installed. Assumes cables to be laid in parallel. Corridor width may increase or decrease where site constraints exist
[23] Distance from centerline for each cable. If a field joint is required, a wider easement may be required at the location of the joint.
[24] The widest point of the bottom of the trench established by the clearing of the seabed by the trenching tool. The seabed surface trench width could be up to 10 feet (3 meters) in select locations, based upon the final installation method selected and soil conditions.
[25] Represents maximum route length for a single onshore export cable route. For EW 2, up to two routes may be used.
[26] Where constrained by existing development, the onshore export cable construction corridor width may be less than 100 feet; the maximum width is included herein, as part of the PDE.
[27] Based on onshore cable conduits being installed side by side in a single corridor; however, conduits may also be split or stacked depending on site conditions.
[28] Based on onshore cable conduits being installed side by side in a single corridor; however, conduits may also be split or stacked depending on site conditions. As such, this width may vary in certain locations.
[29] Where constrained by existing development, the onshore export cable construction corridor width may be less than 150 feet (46 meters); the maximum width is included herein, as part of the PDE.
[30] Per cable circuit.
HAT = highest astronomical tide; MSL = mean sea level; N/A = not applicable; SF_6 = sulfur hexafluoride; UPS = uninterrupted power supply

Appendix F. Planned Activities Scenario

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LIST OF ATTACHMENTS

LIST OF TABLES

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F.1. Planned Activities Scenario

This appendix describes the other ongoing or planned activities that could occur within the geographic analysis area for each resource and contribute to baseline conditions and trends for resources considered in this EIS. The *Projects* here are the construction, O&M, and conceptual decommissioning of the EW 1 and EW 2 wind energy projects within BOEM's Renewable Energy Lease Area OCS-A 0512, located on the OCS approximately 14 miles south of Long Island, New York and 19.5 miles east of Long Branch, New Jersey.

The geographic analysis area varies for each resource as described in the individual resource sections of Chapter 3. BOEM anticipates that impacts could occur during Project construction starting in 2023 and throughout a 35-year operational term for EW 1 and EW 2.[1] The geographic analysis area is defined by the anticipated geographic extent of impacts for each resource. For the mobile resources—bats, birds, finfish, and invertebrates; marine mammals; and sea turtles—the species potentially affected are those that occur within the area of impact of the Proposed Action. The geographic analysis area for these mobile resources is the general range of the species. The purpose is to capture the cumulative impacts on each of those resources that would be affected by the Proposed Action as well as the impacts that would still occur under the No Action Alternative.

In this appendix, distances in miles are in statute miles (miles used in the traditional sense) or nm (miles used specifically for marine navigation). This appendix uses statute miles more commonly and refers to them simply as *miles*, whereas nm is referred to by name.

F.2. Ongoing and Planned Activities

This section includes a list and description of ongoing and planned activities that could contribute baseline conditions and trends within the geographic analysis area for each resource topic analyzed in this EIS. Projects or actions that are considered speculative per the definition provided in 43 CFR 46.30[2] are noted in subsequent tables but excluded from the cumulative impact analysis in Chapter 3.

Ongoing and planned activities described in this section consist of 10 types of actions: (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation; (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; and (10) onshore development activities.

BOEM analyzed the possible extent of future other offshore wind energy development activities on the Atlantic OCS to determine reasonably foreseeable cumulative effects measured by installed power capacity. Table F2-1 in Attachment 2 presents the current status of projects. The methodology for

[1] Empire's lease with BOEM (Lease OCS-A 0512) will have an operations term of 25 years that commences on the date of COP approval. Empire would need to request an extension of its operations term from BOEM in order to operate the proposed Projects for 35 years. For the purposes of maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, the Draft EIS analyzes a 35-year operations term.

[2] 43 CFR 46.30 – Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. The federal and non-federal activities that BOEM must take into account in the analysis of cumulative impacts include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by BOEM. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite.

developing the scenario is the same as for the Vineyard Wind 1 project and details of the scenario development are described in the Vineyard Wind 1 Final EIS (BOEM 2021a).

F.2.1 Offshore Wind Energy Development Activities

F.2.1.1. Site Characterization Studies

A lessee is required to provide the results of site characterization activities with its site assessment plan (SAP) or COP. For the purposes of the cumulative impact analysis, BOEM makes the following assumptions for survey and sampling activities to characterize a maximum-case scenario:

- Site characterization would occur on all existing leases and potential export cable routes.
- Site characterization would likely take place in the first 3 years following execution of a lease, based on the fact that a lessee would likely want to generate data for its COP at the earliest possible opportunity.
- Lessees would likely survey most or all of the proposed Lease Area during the 5-year site assessment term to collect required geophysical information for siting of a meteorological tower, two buoys, and commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological tower and buoy areas likely to be surveyed first.
- Lessee would not use air guns, which are typically used for deep-penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016).

Table F-1 describes the typical site characterization surveys, the types of equipment and method used, and which resources the survey information would inform.

Table F-1 Site Characterization Survey Assumptions

Survey Type	Survey Equipment and Method	Resource Surveyed or Information Used to Inform
HRG surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi-beam echosounder, ultra-short baseline equipment	Shallow hazards, archaeological, bathymetric charting, benthic habitat
Geotechnical/sub-bottom sampling	Vibracores, deep borings, cone penetration tests	Geological, marine archaeology
Biological	Grab sampling, benthic sled, underwater imagery/sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Birds, marine mammals, sea turtles
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)
	Direct sampling of fish and invertebrates	Fish and invertebrates

Source: BOEM 2016.

F.2.1.2. Site Assessment Activities

After SAP approval, a lessee can evaluate the meteorological conditions, such as wind resources, with the approved installation of meteorological towers and buoys. Meteorological buoys have become the preferred meteorological and oceanographic (metocean) data collection platform for developers, and BOEM expects that most future site assessments will use buoys instead of towers (BOEM 2021d). The installation and operation of meteorological buoys involves substantially less activity and a much smaller footprint than the construction and operation of a meteorological tower. Site assessment activities have been approved or are in the process of being approved for multiple lease areas consisting of one to three meteorological buoys per SAP (Table F2-1 in Attachment 2). Site assessment would likely take place starting within 1 to 2 years of lease execution, because preparation of an SAP (and subsequent BOEM review) takes time. This cumulative analysis considers these site assessment activities.

F.2.1.3. Construction and Operation of Offshore Wind Facilities

Table F2-1 in Attachment 2 lists all offshore wind development activities that BOEM considers reasonably foreseeable by lease areas and projects.

F.2.2 Commercial Fisheries Cumulative Fishery Effects Analysis

Table F-2 depicts future construction of offshore wind projects from Maine to North Carolina that are currently in various stages of planning within BOEM's offshore leases. Projected construction dates for each offshore wind project are listed in Table F2-1 in Attachment 2, and each project will require a NEPA process with an EIS or environmental assessment prior to approval.

Table F-2 summarizes (1) the incremental number of construction locations that are projected to be active in each region during each year between 2021 and 2030; (2) the number of operational turbines in each region at the beginning of each year between 2021 and 2030; and (3) the total number of active construction locations and operational turbines across the Atlantic OCS by year.

BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Projects: wind turbines, offshore and onshore cable systems, OSS, onshore O&M facilities, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, O&M, and conceptual decommissioning activities as the proposed Projects. However, future offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For the analysis of ongoing and planned activities, all proposed projects included in Table F2-1 in Attachment 2 are analyzed in Chapter 3 of this EIS.

Table F-2 Future Offshore Wind Project Construction Schedule (dates shown as of October 24, 2022)

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Aqua venuis (state waters)	-	-	-	*2*	-	-	-	-	-	-	-
Total Other State Waters Projects	-	-	-	*2*	-	-	-	-	-	-	-
Estimated Other State Waters Construction	**-**	**-**	**-**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	0
Estimated O&M total	**-**		**--**	**0**	**2**	**2**	**2**	**2**	**2**	**2**	2
Existing and Ongoing Projects											
Block Island (state waters)	*5*	-	-	-	-	-	-	-	-	-	-
Vineyard Wind 1 part of OCS-A 0501	-	-	-	*63*	-	-	-	-	-	-	-
South Fork, OCS-A 0517	-	-	-	*13*	-	-	-	-	-	-	-
CVOW, OCS-A 0497	*2*	-	-	-	-	-	-	-	-	-	-
Estimated Existing and Ongoing Project Construction	**7**	**0**	**0**	**78**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**7**	**7**	**7**	**85**	**85**	**85**	**85**	**85**	**85**	**85**
Planned Projects											
Massachusetts/Rhode Island Region											
Sunrise, OCS-A 0487	-	-	-	-	95	-	-	-	-	-	-
Revolution, part of OCS-A 0486	-	-	-	102	-	-	-	-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	-	-	-	-	64			-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	-	-	-	-	82		-	-	-	-	-
Mayflower OCS-A 0521	-	-	-		-	149	-	-	-	-	-
Beacon Wind 1, part of OCS-A 0520	-	-	-		79	-	-	-	-	-	-
Beacon Wind 2, part of OCS-A 0520	-	-	-	-	-	78	-	-	-	-	-
Bay State Wind, part of OCS-A 0500	-	-	-	-	-	112					
OCS-A 0500 remainder	-	-	-	-	-	232					
OCS-A 0487 remainder	-	-	-	-	-						
Liberty Wind, part of OCS-A 0522	-	-	-	-	-						

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Estimated annual Massachusetts/Rhode Island construction	**0**	**0**	**0**	**102**	**320**	**571**	**0**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**102**	**320**	**891**	**891**	**891**	**891**	**891**
New York/New Jersey Region											
Ocean Wind 1, OCS-A 0498	-	-	-	-	101	-	-	-	-	-	-
Atlantic Shores South, OCS-A 0499	-	-	-	-	-	11	200		-	-	-
Ocean Wind 2, part of OCS-A 0532	-	-	-	-	-	-	113				
Empire Wind 1, part of OCS-A 0512	-	-	-	58				-	-	-	-
Empire Wind 2, part of OCS-A 0512	-	-	-	91					-	-	-
Atlantic Shores North, OCS-A 0549	-	-	-	-	-	-	160				
OW Ocean Winds East LLC, OCS-A 0537	-	-	-	-	-	-	102				
Attentive Energy LLC, OCS-A 0538	-	-	-	-	-	-	104				
Bight Wind Holdings, LLC, OCS-A 0539	-	-	-	-	-	-	148				
Atlantic Shores Offshore Wind Bight, LLC, OCS-A 0541	-	-	-	-	-	-	95				
Invenergy Wind Offshore LLC, OCS-A 0542	-	-	-	-	-	-	99				
Vineyard Mid-Atlantic LLC, OCS-A 0544	-	-	-	-	-	-	104				
Estimated annual New York/New Jersey construction	**0**	**0**	**0**	**149**	**101**	**11**	**1,125**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**149**	**250**	**261**	**1,386**	**1,386**	**1,386**	**1,386**
Delaware/Maryland Region											
Skipjack, OCS-A 0519	-	-	-	-	17	-	-	-	-	-	-
US Wind, OCS-A 0490	-	-	-	-	126	-	-	-	-	-	-
GSOE I, OCS-A 0482	-	-	-	93							
OCS-A 0519 remainder	-	-	-								
Estimated annual Delaware/Maryland construction	**0**	**0**	**0**	**93**	**143**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**93**	**236**	**236**	**236**	**236**	**236**	**236**
Virginia/North Carolina Region											
CVOW-C, OCS-A 0483	-	-	-	208					-	-	-

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Kitty Hawk North, OCS-A 0508	-	-	-	-	70						
Kitty Hawk South, OCS-A 0508	-	-	-	-	-	-	-	123			
Estimated annual Virginia/North Carolina construction:	**0**	**0**	**0**	**208**	**70**	**0**	**0**	**123**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**208**	**278**	**278**	**278**	**401**	**401**	**401**
Total											
Estimated annual total construction	**7**	**0**	**0**	**630**	**634**	**582**	**1,125**	**123**	**0**	**0**	**0**
Estimated O&M total	**7**	**7**	**7**	**7**	**637**	**1,271**	**1.853**	**2,978**	**3.101**	**3.101**	**3.101**

Projects in *italics* are projects that have already been constructed or that are ongoing projects. Completed and ongoing projects are not included in project totals.
CVOW = Coastal Virginia Offshore Wind

F.2.3 Incorporation by Reference of Cumulative Impacts Study and the Analyses Therein

BOEM has completed a study of IPFs on the North Atlantic OCS to consider in an offshore wind development cumulative impacts scenario (BOEM 2019). That study is incorporated in this document by reference. The study identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects. It further classifies those relationships into a manageable number of IPFs through which renewable energy projects could affect resources. It also identifies the types of actions and activities to be considered in a cumulative impact scenario. The study identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identifies the relationships between IPFs associated with specific ongoing and planned activities in the North Atlantic OCS to consider in a NEPA cumulative impacts scenario. These IPFs and their relationships were utilized in the EIS analysis of cumulative impacts, and the application of which IPF applied to which resource was decided by BOEM.

As discussed in the BOEM (2019) study, reasonably foreseeable activities other than offshore wind projects may also affect the same resources as the proposed Projects or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. This appendix lists reasonably foreseeable non-offshore wind activities that may contribute to the cumulative impacts of the proposed Projects.

F.2.4 Undersea Transmission Lines, Gas Pipelines, and Other Submarine Cables

There are numerous charted cables within the Lease Area and along the submarine export cable routes. The current status of many of these cables is poorly documented in the public domain, including on NOAA charts. There are currently six NOAA-charted submarine cables that cross through the Lease Area, with an additional three uncharted cables identified within the Lease Area during geophysical survey activities. Through coordination, it is understood that none of the charted cables within the Lease Area are currently in use. In-service cables along the offshore export cable corridor include one bundle of two 345-kV HVAC transmission lines, two 138-kV HVAC transmission cable bundles, Neptune Regional Transmission system, and FLAG Atlantic South telecommunications cable. At least six transmission cables are planned to be installed in the region. The New York Telephone Cable between Fort Hamilton and Fort Wadsworth was identified in the geographic analysis area during a USACE Freedom of Information Act request but was not found during survey campaigns (Empire 2022).

There are no charted pipelines in the Lease Area, and none were identified during geophysical survey activities. In-service pipelines along the submarine export cable route include the Transco Lower New York Bay Lateral gas pipeline, one gas pipeline buried in the northern New York Harbor utility corridor, two gas pipelines and one petroleum product pipeline buried in the southern New York Harbor utility corridor, and the deeply tunneled replacement Brooklyn-Staten Island water siphon. Two retired and partially dismantled Brooklyn-Staten Island water siphons are along the submarine export cable route as well as the planned Transco Raritan Bay Loop gas pipeline (Empire 2022).

The offshore wind projects listed in Table F2-1 in Attachment 2 that have a COP under review are presumed to include at least one cable route.

F.2.5 Tidal Energy Projects

The Roosevelt Island Tidal Energy Project is in the East Channel of the East River, a tidal strait connecting Long Island Sound with the Atlantic Ocean in New York Harbor. In 2005, Verdant Power petitioned the Federal Energy Regulatory Commission (FERC) for permission for the first U.S. commercial license for tidal power. In 2012, FERC issued a 10-year license to install up to 1 MW of power (30 turbines/10 TriFrames) at the Roosevelt Island Tidal Energy Project (FERC 2012; Verdant Power 2018). See the South Fork Wind Farm and South Fork Export Cable Project Final EIS (BOEM 2021b) for descriptions of other tidal projects that are more distant from the Projects in Maine and Massachusetts.

F.2.6 Dredging and Port Improvement Projects

The following dredging projects have been proposed or studied at or near ports that may be used by the Projects in New York and Texas, and are either in operation or are considered reasonably foreseeable:

- USACE has proposed maintenance dredging of the critical shoal areas immediately offshore of the . SBMT and the approach to the Gowanus Creek Federal Navigation Channel. Approximately 850,000 cubic yards of material would be removed. This project is anticipated to occur in the summer/fall of 2021 (USACE 2021a).
- Planned activities for Howland Hook include dredging and deepening of the Arthur Kill Channel near the old Goethals Bridge. This channel work is planned for 2022 or 2023 and is associated with two already completed channel maintenance projects in the Arthur Kill Channel (USACE 2021b).
- USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey Federal navigation channel, including the removal of material from the Port Elizabeth Channel. Maintenance dredging and associated upland placement activities are planned to occur between July 2021 and February 2022 (USACE 2021c).
- USACE is planning or currently conducting numerous navigation projects in and around the Port of Corpus Christi. These include jetty repairs along the Corpus Christi Ship Channel near Port Aransas on Mustang Island; new work dredging within the Corpus Christi Ship Channel along the Lower Bay Reach near Pelican Island and Port Aransas (11.5 million cubic yards); new work dredging within the Corpus Christi Ship Channel along the Upper Bay Reach in Corpus Christi Bay (18 million cubic yards); dike improvements at a spoils containment area adjacent to La Quinta Channel; new work dredging along the Corpus Christi Ship Channel within the Inner Harbor area of Corpus Christi Bay (7 million cubic yards); maintenance dredging within the La Quinta Channel (1 million cubic yards); and maintenance dredging within an approximately 10-mile segment of the Intercoastal Waterway in Corpus Christi Bay (USACE 2022a).
- The Port of Corpus Christi Authority is proposing to deepen portions of the Corpus Christi Ship Channel starting near the southeastern side of Harbor Island, traversing east through the Aransas Pass, and extending into the Gulf of Mexico for an approximate distance of 13.8 miles (USACE 2022b). The project would deepen the ship channel beyond the current authorized channel depths of -54 feet and -56 feet MLLW to maximum depths of -79 feet and -81 feet MLLW to accommodate transit of fully loaded Very Large Crude Carriers through the Corpus Christi Ship Channel. An estimated 42 million cubic yards of new work dredged material would be generated by the channel deepening. Additionally, the proposed project includes:
    - Extending the existing terminus of the authorized channel an additional 29,000 feet into the Gulf of Mexico to reach -80 MLLW;
    - Expanding the existing Inner Basin at Harbor Island as necessary to accommodate Very Large Crude Carrier turning, including construction of a flare transition from the Corpus Christi Ship Channel with Aransas to meet the turning basin expansion;

- Potential placement of the new work dredged material into waters of the United States for beneficial use sites in and around Corpus Christi and Redfish Bays;
- Potential placement of dredged material on San Jose Island for dune restoration;
- Potential placement of dredged material feeder berms for beach to provide restoration along San Jose and Mustang Islands; and
- Transport of new work dredged material to the Corpus Christi New Work Ocean Dredged Material Disposal Site.

F.2.7 Marine Minerals Use and Ocean Dredged Material Disposal

A sand resource area is off the coast of Lido Beach near Jones Inlet. The state sand resource area includes eight smaller sand borrow areas that were recently used for beach renourishment. Within federal waters, the geographic analysis area includes four federal sand resource areas; however, there are no active OCS lease areas for marine minerals within the geographic analysis area (BOEM 2018). The entire extent of the delineated sand borrow area is suitable for renourishment material (Empire 2022). USEPA, Region 2 is responsible for designating and managing ocean disposal sites for materials offshore in the region of the Projects. USACE issues permits for ocean disposal sites; all ocean sites are for the disposal of dredged material permitted or authorized under the Marine Protection, Research, and Sanctuaries Act (16 USC 1431 et seq. and 33 USC 1401 et seq.). Co-located with the sand resource area described above is an available dredge disposal site known as the Jones Inlet Dredged Material Disposal Site (Empire 2022 citing Marine Cadastre 2019).

F.2.8 Military Use

The Offshore Narragansett Bay Range Complex primarily consists of surface sea spaces and subsurface space off the coasts of Massachusetts, Rhode Island, and New York. As part of the range complex, the Narragansett Bay Operating Area extends from the shoreline seaward to approximately 180 nm (333 kilometers) from land at its farthest point. The complex is controlled by the Fleet Area Control and Surveillance Facility at Virginia Capes Naval Air Station Oceana. The Navy installations primarily operating in this complex are in New London, Connecticut, and Newport, Rhode Island.

The Narragansett Bay Warning Area is in the western portion of the Offshore Narragansett Bay Range Complex and is designated for operations where limitations may be imposed on aircraft not participating in operations. The Narragansett Bay Warning Area is actively used for U.S. Navy subsurface and surface training and testing activities and to prepare submarines and their crews for formal voyages. Additionally, this Warning Area is used to support special-use airspace, flight testing, surface-to-air gunnery exercises using conventional ordnance, Antisubmarine Warfare exercises, and air-intercept training (Empire 2022 citing Globalsecurity.org 2018).

Three danger zones/restricted areas as defined as a “water area (or areas) used for target practice, bombing, rocket firing or other especially hazardous operations, normally for the armed forces” are in the vicinity of the study area. The danger zones/restricted areas in the area are at the mouth of the New York Harbor, at the Naval Weapons Station Earle in Sandy Hook Bay, and around the Navy Homeport Pier on Staten Island (Empire 2022).

There are two Weapons Training Areas operated by USCG offshore New York and New Jersey within the geographic analysis area. These training areas are used for proficiency training in law enforcement operations (BOEM 2016) and for small caliber weapons training, generally from small vessels that transit during the day to the training area.

F.2.9 Marine Transportation

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, tankers (such as those used for liquid petroleum), cargo, cruise ships, smaller passenger vessels, and commercial fishing vessels. Recreational vessel traffic includes private motor boats and sailboats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. The Lease Area is between the Nantucket/Ambrose TSS along the northern boundary and the Hudson Canyon/Ambrose TSS along the southern boundary of the Lease Area. A third TSS, Barnegat/Ambrose, runs north-south off the coast of New Jersey. Empire's NSRA assumes a conservative growth potential in commercial shipping movements of 10 percent that is applied to the base-case scenario for traffic volumes in the geographic analysis area that includes the Nantucket/Ambrose, Hudson Canyon/Ambrose, and Barnegat/Ambrose TSS (COP Volume 3, Appendix DD, Section 7.5.1; Empire 2022).

USCG chartered a workgroup on May 11, 2011, to gather data, identify existing and future waterway usage, and conduct modeling and analysis of traffic patterns in light of the complex interactions of the various factors that would affect navigational safety along the Atlantic Coast of the United States including potential navigational conflicts with various planned wind energy areas. USCG published the workgroup's Interim Report (77 *Federal Register* 55781; September 11, 2012) and a notification (81 *Federal Register* 13307; March 14, 2016) that announced the availability of the final report issued by the Atlantic Coast PARS workgroup. USCG announced the final report to be complete as published on April 5, 2017 (82 *Federal Register* 16510). The Atlantic Coast PARS Final Report along with the other PARS referenced in Section 3.16 served to gauge and inform the navigational assessment of the Proposed Action and cumulative impacts.

F.2.10 National Marine Fisheries Service Activities

Research and enhancement permits may be issued for marine mammals protected by the MMPA and for threatened and endangered species protected under the ESA. NMFS is anticipated to continue issuing research permits under Section 10(a)(1)(A) of the ESA to allow take of certain ESA-listed species for scientific research. Scientific research permits issued by NMFS currently authorize studies on ESA-listed species in the Atlantic Ocean. Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with NEFSC could overlap with offshore wind lease areas in the New England region and south into the Mid-Atlantic region. Surveys include (1) the NEFSC Bottom Trawl Survey, a more than 50-year multispecies stock assessment tool using a bottom trawl; (2) the NEFSC Sea Scallop/Integrated Habitat Survey, a sea scallop stock assessment and habitat characterization tool, using a bottom dredge and camera tow; (3) the NEFSC Surfclam/Ocean Quahog Survey, a stock assessment tool for both species using a bottom dredge; and (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units. These surveys are anticipated to continue within the region, regardless of offshore wind development.

The regulatory process administered by NMFS, which includes stock assessments for all marine mammals and 5-year reviews for all ESA-listed species, assists in informing decisions on take authorizations and the assessment of project-specific and cumulative impacts that consider ongoing and planned activities in biological opinions. Stock assessments completed regularly under the MMPA include estimates of potential biological removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require that a proposed action have no more than a negligible impact on species or stocks, and that a proposed action impose the least practicable adverse impact on the species. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. These processes help to ensure that, through compliance with these regulatory requirements, a proposed action would not have a measurable impact on the conservation, recovery, and management of the resource.

F.2.10.1. Directed Take Permits for Scientific Research and Enhancement

NMFS issues permits for research on protected species for scientific purposes. These scientific research permits include the authorization of directed take for activities such as capturing animals and taking measurements and biological samples to study their health, tagging animals to study their distribution and migration, photographing and counting animals to get population estimates, taking animals in poor health to an animal hospital, and filming animals. NMFS also issues permits for enhancement purposes; these permits are issued to enhance the survival or recovery of a species or stock in the wild by taking actions that increase an individual's or population's ability to recover in the wild. Scientific research and enhancement permits have been issued previously for satellite, acoustic, and multi-sensor tagging studies on large and small cetaceans; research on reproduction, mortality, health, and conservation issues for NARWs; and research on population dynamics of harbor and gray seals. Reasonably foreseeable future impacts from scientific research and enhancement permits include physical and behavioral stressors (e.g., restraint and capture, marking, implantable and suction tagging, biological sampling).

F.2.10.2. Fisheries Use and Management

NMFS implements regulations to manage commercial and recreational fisheries in federal waters, including those within which the Projects would be located; the State of New Jersey and the State of New York regulate commercial fisheries in their state waters (within 3 nm of the coastline). The Projects overlap two of NMFS's eight regional councils to manage federal fisheries: MAFMC, which includes New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina; and NEFMC, which includes Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut (NEFMC 2016). The councils manage species with many FMPs that are frequently updated, revised, and amended and coordinate with each other to jointly manage species across jurisdictional boundaries (MAFMC 2019). Many of the fisheries managed by the councils are fished for in state waters or outside of the Mid-Atlantic region, so the council works with the Atlantic States Marine Fisheries Commission (ASMFC). ASMFC is composed of the 15 Atlantic coast states and coordinates the management of marine and anadromous resources found in the states' marine waters. In addition, the states and NMFS, under the framework of ASMFC's *Amendment 3 to the Interstate Fishery Management Plan for American Lobster*, cooperatively manage the American lobster resource and fishery (NOAA 1997).

The FMPs of the councils and ASMFC were established, in part, to manage fisheries to avoid overfishing. They accomplish this through an array of management measures, including annual catch quotas, minimum size limits, and closed areas. These various measures can further reduce (or increase) the size of landings of commercial fisheries in the Northeast and Mid-Atlantic regions.

NMFS also manages highly migratory species, such as tuna and sharks, that can travel long distances and cross domestic boundaries. Table F-3 summarizes other FMPs and actions in the region.

Table F-3 Other Fishery Management Plans

Area	Plan and Projects
ASFMC	ASMFC *Five-Year Strategic Plan 2019–2023* (ASMFC 2019) ASMFC 2022 Action Plan (ASMFC 2021) *Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change* (ASMFC 2018)
New York	*New York Ocean Action Plan 2017–2027*: adaptive management plan (NYSDEC 2017) New York State filed a petition with NOAA, NMFS, and MAFMC to demand that commercial fluke allocations be revised to provide fishers with equitable access to summer flounder. New York is also reviewing other species where there is an unfair allocation, including black sea bass and bluefish, and may pursue similar actions (*Federal Register* 31945 July 10, 2018).
Long Island Regional Development Council	East Hampton Shellfish Hatchery project to consolidate the hatchery's municipal hatchery and nursing facilities. Haskell's seafood facility in East Quogue is proposed become a fully functioning seafood processing plant.
New Jersey	NJDEP Division of Fish and Wildlife Marine Fisheries Management Rule Amendment Proposal with amendments to rules governing crab and lobster management, commercial Atlantic menhaden fishery, marine fisheries, and fishery management in New Jersey was published in the March 1, 2021, New Jersey Register (New Jersey Division of Fish and Wildlife 2021).

F.2.11 Global Climate Change

Section 7.6.1.4 of the *Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Activities on the Outer Continental Shelf* (Minerals Management Service 2007) describes global climate change with respect to assessing renewable energy development. Climate change is predicted to affect Northeast fishery species differently (Hare et al. 2016), and the NMFS biological opinion discusses in detail the potential impacts of global climate change on protected species that occur within the Proposed Action area (NMFS 2013).

The Intergovernmental Panel on Climate Change released a special report in October 2018 that compared risks associated with an increase of global warming of 1.5 °C and an increase of 2 °C. The report found that climate-related risks depend on the rate, peak, and duration of global warming, and that an increase of 2 °C was associated with greater risks associated with climatic changes such as extreme weather and drought; global sea level rise; impacts on terrestrial ecosystems; impacts on marine biodiversity, fisheries, and ecosystems and their functions and services to humans; and impacts on health, livelihoods, food security, water supply, and economic growth (IPCC 2018).

Table F-4 summarizes regional plans and policies that are in place to address climate change, and Table F-5 summarizes resiliency plans.

Table F-4 Climate Change Plans and Policies

Plans and Policies	Summary/Goal
New York	
Order Adopting a Clean Energy Standard (State of New York Public Service Commission 2016)	Requirement that 50% of New York's electricity come from renewable energy sources by 2030.

Plans and Policies	Summary/Goal
New York State Energy Plan 2015; 2017 Biennial Report to 2015 Plan (NYSERDA 2015, 2017a)	Requires 40% reduction in GHG from 1990 levels, 50% electricity to come from renewable energy resources, and a 600-trillion-British-thermal-unit increase in statewide energy efficiency.
Governor Cuomo State of State Address 2017, 2018, 2021	2017: Set offshore wind energy development goal of 2,400 MW by 2030 (Governor's Office 2017a). 2018: Procurement of at least 800 MW of offshore wind power between two solicitations in 2018 and 2019; new energy efficiency target for investor-owned utilities to more than double utility energy efficiency progress by 2025; energy storage initiative to achieve 1,500 MW of storage by 2025 and up to 3,000 MW by 2030 (Governor's Office 2018a, 2018b). 2021: The governor's 2021 agenda—Reimagine | Rebuild | Renew—establishes a goal of building out the renewable energy program. The agenda notes the development of two new offshore wind farms more than 20 miles offshore of Long Island, as well as the creation of dedicated offshore port facilities and additional transmission capacity development.
Governor Hochul State of the State Address (2022)	2022: Announced NYSERDA's third offshore wind procurement to be initiated in 2022; the procurement is expected to result in at least 2 GW of new offshore wind projects. 2022: Announced a $500 million infrastructure investment to develop offshore wind manufacturing and supply chain infrastructure. 2022: Announced a legislative proposal to ensure all new building construction reaches zero emissions by 2027, and to develop 2 million electrified or electrification-ready homes by 2030.
New York State Offshore Wind Master Plan (2017) (NYSERDA 2017b)	Grants NYSERDA ability to award 25-year long-term contracts for projects ranging from approximately 200 MW to approximately 800 MW, with an ability to award larger quantities if sufficiently attractive proposals are received. Each proposer is also required to submit at least one proposal of approximately 400 MW. Bids are due in February 2019; awards are expected in spring 2019; and contracts are expected to be executed thereafter.
2020 Offshore Wind Solicitation	As noted above, NYSERDA has provisionally awarded two offshore wind projects, totaling 2,490 MW. EW 2 (1,260 MW) and Beacon Wind (1,230 MW) of Equinor Wind US, LLC will generate enough clean energy to power 1.3 million homes and will be major economic drivers, supporting the following: • More than 5,200 direct jobs • Combined economic activity of $8.9 billion in labor, supplies, development, and manufacturing statewide • $47 million in workforce development and just access funding
The Climate Leadership and Community Protection Act, enacted on July 18, 2019, signed into law in July 2019, and effective January 1, 2020	The act establishes economy-wide targets to reduce GHG emissions by 40% of 1990 levels by 2030 and 85% of 1990 levels by 2050.

Plans and Policies	Summary/Goal
New Jersey	
New Jersey Energy Master Plan (New Jersey State 2019)	Updated in 2019, the plan sets the framework to implement Executive Order 28 by decarbonizing and modernizing New Jersey's energy system, expanding the clean energy innovation economy, and accelerating the deployment of renewable energy resources to meet the offshore wind energy generation goal established in Executive Order 92.
Executive Order 28: Measures to Advance New Jersey's Clean Energy Economy (2018)	Sets target of total conversion of the state's energy production profile to 100% clean energy sources on or before January 1, 2050.
Executive Order 92: Increase Offshore Wind Goal to 7,500 Megawatts by 2036 (2019)	Establishes a goal of 3,500 MW of offshore wind energy generation by 2030.
Executive Order 100: Protecting Against Climate Threats (PACT); Land Use Regulations and Permitting (2020)	Establishes a GHG monitoring and reporting program, establishes criteria to govern and reduce emissions, and integrates climate change considerations, such as sea level rise, into regulatory and permitting programs.

Table F-5 Resiliency Plans and Policies

Plans and Policies	Summary
New York	
Part 490 of Community Risk and Resiliency Act of 2014	Establishes statewide science-based sea-level rise projections for coastal regions of the state. As of 2019, NYSDEC is in the process of developing a State Flood Risk Management Guidance document for state agencies (NYSDEC n.d.).
NY Rising Community Reconstruction Program (2018)	$20.4 million in projects on Long Island to help flood-prone communities plan and prepare for extreme weather events as they continue projects to recover from Superstorm Sandy, Hurricane Irene, and Tropical Storm Lee. Three projects were announced for Suffolk County and five for Nassau County (Governor's Office 2018b).
New Jersey	
New Jersey Draft Climate Change Resilience Strategy (NJDEP 2021)	This is New Jersey's first statewide climate resiliency strategy and was released as a draft in April 2021. The *Draft Climate Change Resilience Strategy* develops a framework for policy, regulatory, and operational changes to support the resilience of New Jersey's communities, economy, and infrastructure. It includes 125 recommended actions across the following six priority areas: build resilient and healthy communities, strengthen the resilience of New Jersey's ecosystems, promote coordinated governance, invest in information, increase public understanding, promote climate-informed investments and innovative financing, and coastal resilience plan.

F.2.12 Oil and Gas Activities

The proposed Project area is in the North Atlantic Planning Area of the OCS Oil and Gas Leasing Program (National OCS Program). On September 8, 2020, the White House issued a presidential memorandum for the Secretary of the Interior on the withdrawal of certain areas of the United States OCS from leasing disposition for 10 years, including the areas currently designated by BOEM as the South Atlantic and Straits of Florida Planning Areas (The White House 2020a). The South Atlantic Planning Area includes the OCS off South Carolina, Georgia, and northern Florida. On September 25, 2020, the White House issued a similar memorandum for the Mid-Atlantic Planning Area that lies south of the northern administrative boundary of North Carolina (The White House 2020b). This withdrawal prevents consideration of these areas for any leasing for purposes of exploration, development, or production during the 10-year period beginning July 1, 2022, and ending June 30, 2032. However, currently, there has been no decision by the Secretary of the Interior regarding future oil and gas leasing in the North Atlantic or remainder of the Mid-Atlantic Planning Areas. Existing leases in the withdrawn areas are not affected.

BOEM issues geological and geophysical permits to obtain data for hydrocarbon exploration and production; locate and monitor marine mineral resources; aid in locating sites for alternative energy structures and pipelines; identify possible manmade, seafloor, or geological hazards; and locate potential archaeological and benthic resources. Geological and geophysical surveys are typically classified into categories by equipment type and survey technique. There are currently no such permits under review for areas offshore New York and New Jersey (BOEM 2021c).

Several liquefied natural gas ports are on the East Coast of the United States. Table F-6 lists existing, approved, and proposed liquified natural gas ports on the East Coast that provide (or may provide in the future) services such as natural gas export, natural gas supply to the interstate pipeline system or local distribution companies, storage of liquified natural gas for periods of peak demand, or production of liquified natural gas for fuel and industrial use. In addition, there are ten existing liquid natural gas export or import facilities and 18 liquid natural gas facilities that are approved but have not been constructed across the Gulf Coast states of Texas, Louisiana, and Mississippi (FERC 2022a, 2022b).

Table F-6 Liquid Natural Gas Terminals in the Eastern United States

Terminal Name	Type	Company	Jurisdiction	Status
Everett, MA	Import terminal	GDF SUEZ—DOMAC	FERC	Existing
Offshore Boston, MA	Import terminal	Neptune LNG	MARAD/USCG	Existing
Offshore Boston, MA	Import terminal, authorized to re-export delivered LNG	Excelerate Energy—Northeast Gateway	MARAD/USCG	Existing
Cove Point, MD (Chesapeake Bay)	Import terminal	Dominion—Cove Point LNG	FERC	Existing
Elba Island, GA (Savannah River)	Import terminal	El Paso—Southern LNG	FERC	Existing
Elba Island, GA (Savannah River)	Export terminal	Southern LNG Company	FERC	Existing
Jacksonville, FL	Export terminal	Eagle LNG Partners	FERC	Proposed

Source: FERC 2022a, 2022b.
DOMAC = Distrigas of Massachusetts; FL = Florida; GA = Georgia; LNG = liquified natural gas; MA = Massachusetts; MARAD = U.S. Department of Transportation Maritime Administration; MD = Maryland

F.2.13 Onshore Development Activities

Onshore development activities that may contribute to cumulative impacts include visible infrastructure such as onshore wind turbines and cell towers, port development, and other energy projects such as transmission and pipeline projects. Coastal development projects permitted through regional planning commissions, counties, and towns may also contribute to cumulative impacts. These may include residential, commercial, and industrial developments spurred by population growth in the region (Table F-7).

Table F-7 Existing, Approved, and Proposed Onshore Development Activities

Type	Description
Local planning documents	City of New York *2021–2025 Consolidated Plan* (NYC Planning 2021) *Nassau County Master Plan (*Nassau County Planning Department 2010) *Creating Resilience: A Planning Initiative, City of Long Beach Comprehensive Plan* (City of Long Beach 2018) *Staten Island Comprehensive Economic Development Strategy 2020* (Staten Island Economic Development Corporation 2020) *Plan CC Comprehensive Plan* (City of Corpus Christi 2016) *Aransas Pass 2018 Comprehensive Plan* (Aransas Pass 2018)
Onshore wind projects	According to the U.S. Geological Survey, there are two onshore wind projects within the 40-mile viewshed of the Projects. The Bayonne Wind Energy Project consists of one 1.5-MW turbine with a tip height of 103.6 meters and a rotor diameter of 77 meters (Hoen et al. 2021). Additionally, there is one unnamed onshore wind project in Sunset Park, Brooklyn that consists of one turbine. The specifications of that turbine are unknown.
Communications towers	There are numerous communication towers in communities within the viewshed of the Projects. For example, there are 17 towers within a 3-mile radius of Long Beach, New York; 38 communication towers within a 3-mile radius of Oceanside, New York; and 362 communication towers within a 3-mile radius of Gowanus (Brooklyn), New York (AntennaSearch.com 2021).
Development projects	As part of New York State's $100 billion infrastructure project, $5.6 billion will go to transform the Long Island Railroad to improve system connectivity. Within Suffolk County, the following stations will receive funds for upgrades: Brentwood, Deer Park, East Hampton, Northport, Ronkonkoma, Stony Brook, Port Jefferson, and Wyandanch. The East Hampton historic Long Island Railroad station will undergo upgrades and modernizations (Metropolitan Transit Authority 2017; Governor's Office 2017b). Additional plans for transit-oriented design and highway improvements are planned in Suffolk County in state and county planning documents. The Fire Island Inlet to Montauk Point Project is a $1.2 billion project by USACE, NYSDEC, and Long Island, New York municipalities to engage in inlet management; beach, dune, and berm construction; breach response plans; raising and retrofitting 4,400 homes; road-raising; groin modifications; and coastal process features. Within Suffolk County, portions of the Towns of Babylon, Islip, Brookhaven, Southampton, and East Hampton; 12 incorporated villages along Long Island's south shore (mainland); Fire Island National Seashore; and the Poospatuck and Shinnecock Indian Reservations will be involved in this project (USACE 2018).
Port studies/ upgrades	Ports in New York may require upgrades to support the offshore wind industry developing in the northeastern United States. Upgrades may include onshore developments or underwater improvements (such as dredging). In December 2017, NYSERDA issued an offshore wind master plan that assessed 54 distinct waterfront sites along the New York Harbor and Hudson River and 11 distinct areas with multiple small sites along the Long Island coast. Twelve waterfront areas and five distinct areas were singled out for "potential to be used or developed into facilities capable of supporting OSW projects" (Table 26, NYSERDA 2017b). Nearly all identified sites would require some level of infrastructure upgrade (from minimal to significant) depending on offshore wind activities intended for the site. Particular sites of interest include Red Hook-Brooklyn, SBMT, and the Port of

Type	Description
	Coeymans (NYSERDA 2017b). For additional information regarding specific proposed improvements to these ports, see DockNYC 2018, Capital Region Economic Development Council 2018, American Association of Port Authorities 2016, Rulison 2018, and NYCEDC 2018. New York State proposed port improvements include the governor's 2021 agenda "Reimagine | Rebuild | Renew," which includes upgrades to create five dedicated port facilities for offshore wind, including the following: • The nation's first offshore wind tower manufacturing facility, to be built at the Port of Albany • An offshore wind turbine staging facility and O&M hub to be established at SBMT • Increasing the use of the Port of Coeymans for cutting-edge turbine foundation manufacturing • Buttressing ongoing O&M out of Port Jefferson and Port of Montauk Harbor in Long Island Corpus Christi Polymers, LLC is planning to finish construction of a partially completed chemical manufacturing plant on Port of Corpus Christi property on the north side of the Inner Harbor area of Corpus Christi Bay. The $1.1 billion plant would produce between 1.1 million and 1.3 million metric tons of purified terephthalic acid and polyethylene terephthalate and would be the largest of its kind in the world. Completion of the project is expected to be in 2023 (Market Report Company 2022). Several new saltwater desalination plants are being proposed in the Corpus Christi area. The City of Corpus Christi is pursuing development of a saltwater desalination plant with a capacity of up to 30 mgd on property on the Inner Harbor Ship Channel and a 20- to 40-mgd saltwater desalination plant on a site near the La Quinta Ship Channel. The Port of Corpus Christi is pursuing development of a 30-mgd saltwater desalination plant on a site near the La Quinta Ship Channel and 50-mgd saltwater desalination plant on Harbor Island adjacent to the Corpus Christi Ship Channel (Virtual Builders Exchange 2022). The Port of Corpus Christi is partnering with Bluewater Texas Terminal to build two single-point mooring buoys 21 nm from the mouth of the Corpus Christi Ship Channel to serve as new offshore oil terminals. The offshore terminals will be used to load Very Large Crude Carriers at production rates of up to 80,000 barrels per hour with throughput capacities of 16 Very Large Crude Carriers per month. Crude oil from Permian and Eagle Ford shale plays will feed the export port via pipelines connected to the Harvest Midway Terminal, a planned multi-use crude oil storage terminal near Taft, Texas (Corpus Christi Business News 2020).

mgd = million gallons per day

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ATTACHMENT 1
ONGOING AND FUTURE NON-OFFSHORE WIND ACTIVITY ANALYSIS

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LIST OF TABLES

BOEM developed the following tables based on its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019), which evaluates potential impacts associated with ongoing and future non-offshore wind activities. The content of these tables has been vetted by cooperating agencies to the EIS and therefore has been included in whole for their use in impact and cumulative analyses, and for ease in reference by the reader.

Table F1-1 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Air Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of air toxics HAPs are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPs will be due to potential chemical spills. See Table F1-23 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts will be short-term and limited to the local area at and around the accidental release location.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 35 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil fuel power plants, onshore and offshore	The largest air quality impacts over the next 35 years will occur during the construction phase of any one project; however, projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources will be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As projects come online, power generation emissions overall will decline and the industry as a whole will have a net benefit on air quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Air emissions: O&M	activities involving renewable energy facilities, and various construction activities.	Activities associated with O&M of onshore wind projects will have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 35 years. Emissions will largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity will result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.
Climate change	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects will produce a small overall increase in GHG emissions over the next 35 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions from modifications of existing fossil fuel facilities to reduce power generation. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of onshore wind project activities.

HAP = hazardous air pollutant; hazmat = hazardous materials

Table F1-2 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Bats

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Direct impacts are not expected to occur as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Indirect impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would not be expected to result in direct impacts. Some indirect impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized, and no population-level effects would be expected.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population level impacts would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.
Presence of structures: Migration disturbances	There may be few structures scattered throughout the offshore bats geographic analysis area, such as navigation and weather buoys and light towers. Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population-level effects would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to cause disturbance to migrating tree bats in the marine environment.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Turbine strikes	There may be few structures in the offshore bats geographic analysis area, such as navigation and weather buoys, turbines, and light towers. Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.
Land disturbance: onshore construction	Onshore construction activities are expected to continue at current trends. Potential direct effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. While there is some potential for indirect impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss and could result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases will move northward. Extent and intensity of this impact is highly speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.

Table F1-3 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Benthic Resources

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a discussion of ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. See previous cell and Table F1-23 on water quality for details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for direct contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
EMFs	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. New cables generating EMFs are infrequently installed in the geographic analysis area. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet (15.2 meters) from the cable and the intensity of impacts on benthic resources is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.
New cable emplacement/ maintenance	Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities injure and kill benthic resources, and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPFs of Seabed profile alterations and Sediment deposition and burial.)	There are three planned submarine cables in the geographic analysis area including two transmission cables and one telecommunications cable. Impacts of planned cable emplacement would be the same as described for ongoing activities.
Noise: Onshore/ offshore construction	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: G&G	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: O&M	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 35 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Port utilization: Expansion	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).
Presence of structures: Hydrodynamic disturbance	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 35 years would likely require hard protection atop portions of the route (see the “new cable emplacement/maintenance” row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoy, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Cable infrastructure	The presence of cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the cumulative permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short-term because spoils are typically recolonized naturally. In addition, USEPA has established dredge spoil criteria and it regulates the disposal permits issued by USACE; these discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated.
Regulated fishing effort	Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	USACE and/or private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of benthic invertebrates that have calcareous shells, as well as reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of benthic species, and likely causing permanent changes of unknown intensity over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

Table F1-4 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Birds

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in feather oiling can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). These impacts rarely result in population-level impacts.	See Table F1-23 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter (Law et al. 2010). Birds may accidentally ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels. Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 35 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels. No population-level impacts would be expected.
Light: Structures	Buoys, towers, and onshore structures with lights can attract birds. Onshore structures like houses and ports emit a great deal more light than offshore buoys and towers. This attraction has the potential to result in an increased risk of collision with lighted structures (Hüppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Cable emplacement and maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. Suspended sediment could impair the vision of diving birds that are foraging in the water column (Cook and Burton 2010). However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and no biologically significant impacts on individuals or populations would be expected.	Future new cables, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in diving birds leaving the local area. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Sub-surface noise from vessels could disturb diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die annually from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various hard protections atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these objects. These impacts are local and can be short-term to permanent. These fish aggregations can provide localized, short-term to permanent, beneficial impacts on some bird species because it could increase prey species availability.	New cables, installed incrementally in the geographic analysis area for birds over the next 20 to 35 years, would likely require hard protection atop portions of the cables (see New cable emplacement/maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may be short-term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.
Presence of structures: Migration disturbances	A few structures may be scattered about the offshore geographic analysis area for birds, such as navigation and weather buoys and light towers. Migrating birds can easily fly around or over these sparsely distributed structures.	The infrequent installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in migration disturbances.
Presence of structures: Turbine strikes, displacement, and attraction	A few structures may be in the offshore geographic analysis area for birds, such as navigation and weather buoys, turbines, and light towers. Given the limited number of structures currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	The installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in an increase in collision risk or to result in displacement. Some potential for attraction and opportunistic roosting exists, but would be expected to be limited given the anticipated number of structures.
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Additionally, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft will continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for indirect impacts associated with habitat loss and fragmentation.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss but would not be expected to result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Ocean acidification	Increasing ocean acidification may affect prey species upon which some birds feed and could lead to shifts in prey distribution and abundance. Intensity of impacts on birds is speculative.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distribution of bird prey resources.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered migration patterns	Birds rely on cues from the weather to start migration. Wind direction and speed influence the amount of energy used during migration. For nocturnal migrants, wind assistance is projected to increase across eastern portions of the continent (0.32 m/s; 9.6%) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.17 m/s; 6.6%) during autumn migration (La Sorte et al. 2018).	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, seawalls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies and distributions of various diseases of birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

hazmat = hazardous materials

Table F1-5 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Terrestrial and Coastal Fauna

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Erosion and sedimentation	Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects terrestrial and coastal fauna, assuming that industry standard BMPs are implemented.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore construction	Periodic clearing of shrubs and tree saplings along existing utility ROWs causes disturbance and temporary displacement of mobile species and may cause direct injury or mortality of less-mobile species, resulting in short-term impacts that are less than noticeable. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, and cell tower projects also causes disturbance, displacement, and potential injury and/or mortality of fauna, resulting in small temporary impacts.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore, land use changes	Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, transportation infrastructure, sewer infrastructure, and cell tower projects could permanently convert various areas.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

ROW = right-of-way

Table F1-6 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Coastal Habitats

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a discussion of ongoing accidental releases. Accidental releases of fuel/fluids/hazmat have the potential to cause habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from releases and/or cleanup activities. Only a portion of the ongoing releases contact coastal habitats in the geographic analysis area. Impacts are small, localized, and temporary.	See Table F1-23 for a discussion of accidental releases.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occur from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. As population and vessel traffic increase, accidental releases of trash and debris may increase. Such materials may be obvious when they come to rest on shorelines; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
Anchoring	Vessel anchoring related to ongoing military, survey, commercial, and recreational activities will continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and potential for direct contact to cause physical damage to coastal habitats. All impacts are localized; turbidity is short-term and temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
EMF	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. New cables generating EMFs are infrequently installed in the analysis area. The extent of impacts is likely less than 50 feet from the cable, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Light: Vessels	Navigation lights and deck lights on vessels would be a source of ongoing light. The extent of impacts is limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	Light is expected to continue to increase gradually with increasing vessel traffic over the next 35 years. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.
Light: Structures	Ongoing lights from navigational aids and other structures onshore and nearshore. The extent of impacts is likely limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
New cable emplacement/ maintenance	Ongoing cable maintenance activities infrequently disturb bottom sediments; these disturbances are local and limited to the emplacement corridor (see the Sediment deposition and burial IPF).	There are three planned submarine cables in the geographic analysis area including two transmission cables and one telecommunications cable. Impacts of planned cable emplacement would be the same as described for ongoing activities.
Noise: Onshore/ offshore construction	Ongoing noise from construction occurs frequently near shores of populated areas in New England and the Mid-Atlantic, but infrequently offshore. Noise from construction near shore is expected to gradually increase over the next 35 years in line with human population growth along the coast of the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary.	No future activities were identified within the analysis area other than ongoing activities.
Noise: G&G	Site characterization surveys and scientific surveys are ongoing. The intensity and extent of the resulting impacts are difficult to generalize but are local and temporary.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can reach coastal habitats. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Cable laying/ trenching	Rare but ongoing trenching for pipeline and cable laying activities emits noise; cable burial via jet embedment also causes similar noise impacts. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines may occur in the geographic analysis area infrequently over the next 35 years. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.
Presence of structures: Habitat conversion	Various structures, including pilings, piers, towers, riprap, buoys, and various means of hard protection, are periodically added to the seascape, creating uncommon relief in a mostly flat seascape and converting previously existing habitat (whether hard-bottom or soft-bottom) to a type of hard habitat, although it differs from the typical hard-bottom habitat in the analysis area, namely, coarse substrates in a sand matrix. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019). Soft bottom is the dominant habitat type on the OCS, and structures do not meaningfully reduce the amount of soft-bottom habitat available (Guida et al. 2017; Greene et al. 2010). Structures can also create an artificial reef effect, attracting a different community of organisms.	Any new cable or pipeline installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Such protection is anticipated to increase incrementally over the next 35 years. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats.
Presence of structures: Transmission cable infrastructure	Various means of hard protection atop existing cables can create uncommon hard-bottom habitat. Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitats.	See above.
Land disturbance: Erosion and sedimentation	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term erosion and sedimentation of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Onshore construction	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term to permanent degradation of onshore coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized, short-term impacts on coastal habitats through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition within coastal habitats. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. No dredged material disposal sites were identified within the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. In submerged habitats, warming is altering ecological relationships and the distributions of ecosystem engineer species, likely causing permanent changes of unknown intensity gradually over the next 3 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

hazmat = hazardous materials

Table F1-7 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact on this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor.	Future new cables and cable maintenance would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.
Noise: Construction, trenching, operations and maintenance	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the Mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level. Noise is also created by O&M of marine minerals extraction, which has small, local impacts on fish, but likely no impacts at a fishery level.	Noise from construction near shore is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during their O&M over the next 35 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of the physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when ports or marinas, piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area, leading to temporary local impacts on commercial fisheries and for-hire recreational fishing. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Vessels	Vessel noise is anticipated to continue at levels similar to current levels. While vessel noise may have some impact on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 35 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include offshore wind turbines, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and may be long term.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The geographic analysis area would continue to have numerous ports and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.
Climate change	Impacts to commercial fisheries and for-hire recreational fishing are expected to result from climate change events such as increased magnitude or frequency of storms, shoreline changes, ocean acidification, and water temperature changes. Risks to fisheries associated with these events include habitat/distribution shifts, disease incidence, and risk of invasive species. If these risk factors result in a decrease in catch and/or an increase in fishing costs (e.g., transiting time), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. While climate change is predicted to have adverse impacts on the distribution and/or productivity of some stocks targeted by commercial fisheries and for-hire recreational fishing, other stocks may be beneficially affected. The economies of communities reliant on marine species that are vulnerable to the effects of climate change could be adversely affected. If the distribution of important stocks changes, it could affect where commercial and for-hire recreational fisheries are located. Furthermore, coastal communities with fishing businesses that have infrastructure near the shore could be adversely affected by sea level rise.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states, affect how the commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. For example, ongoing fishing restrictions designed to rebuild depleted stocks in the Northeast Multispecies (large-mesh) fishery will continue to reduce landings in that fishery.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a have a major adverse impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. As discussed in Karp et al. (2019), changing climate and ocean conditions and the resultant effects on species distributions and productivity can have significant effects on management decisions, such as allocation, spatiotemporal closures, stock status determinations, and catch limits. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-8 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Cultural Resources

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for water quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and/or seafloor sediments can cause impacts on cultural resources because resources are affected during by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill, could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to or the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition and/or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release and ongoing local, state, and federal efforts to clean up trash on beaches and waterways would continue to mitigate the effects of small-scale accidental releases of trash.	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications). Accidental releases would continue at current rates along the northeast Atlantic coast.
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/ gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operations lighting would be limited to cultural resources on the shoreline for which a nighttime sky is a contributing element to historic integrity. This excludes resources that are closed at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic architectural properties or TCPs can result in impacts, particularly if the historic and/or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (commercial building, radio antenna, large satellite dishes, etc.) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, affecting their setting and historic significance.	Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures	The only existing offshore structures within the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur within the marine viewshed of the geographic analysis area.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and could cause impacts on submerged archaeological resources. These disturbances would be local and limited to emplacement corridors.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-contact Native American archaeological sites.
Land disturbance: Onshore construction	Onshore construction activities can impact archaeological resources by damaging and/or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.
Climate change: Warming and sea level rise, storm severity/frequency	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would also result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources, while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	Altered habitat/ecology related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to habitats/ecology would increase as a result of climate change.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	Altered migration patterns related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to migratory animal patterns would increase as a result of climate change.
Climate change: Warming and sea level rise, property/ infrastructure damage	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	The rate of property and infrastructure damage would increase as a result of climate change.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The installation of protective measures such as barriers and sea walls would impact archaeological resources during associated ground-disturbing activities. Construction of these modern protective structures would alter the viewsheds from historic properties and/or TCPs, resulting in impacts on the historic and/or cultural significance of resources.	The installation of coastal protective measures would increase as a result of climate change.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.

hazmat = hazardous materials; OECR = onshore export cable route

Table F1-9 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Energy generation/ security	In 2019, New Jersey energy production totaled 328 trillion Btu, of which 13.8 trillion Btu was from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2020).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as FADs. Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on FADs.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	No existing offshore structures are within the viewshed of the offshore wind lease areas except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	No known proposed structures not associated with offshore wind development are reasonably foreseeable.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing, and recreation are important to the region’s economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region’s substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Btu = British thermal unit; FAD = fish aggregating device

Table F1-10 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Environmental Justice

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Air emissions: Operations and maintenance	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Vessel noise is anticipated to continue at or near current levels.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Entanglement, gear loss/damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	There are no existing offshore structures within the viewshed of the offshore wind lease areas except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: cable infrastructure	Existing submarine cables cross cumulative lease areas.	Existing cable O&M activities would continue within the analysis area.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing and recreation are important to the region’s economy. No substantial changes are anticipated to existing vessel traffic volumes.	Vessel traffic is not expected to meaningfully increase over the next 35 years. Marine commerce and related industries would continue to be important to area employment.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and the economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources; increased disease frequency; and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on the fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-11 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table F1-23 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Anchoring	Vessel anchoring related to ongoing military use, and survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. These impacts would include increased turbidity levels and potential for direct contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long term.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting, and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	Vessels would continue to be a light source within the analysis area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.
Noise: Onshore/ offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the Mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (Thomsen et al. 2015), SPLs would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact. Noise is also created by O&M of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their O&M over the next 35 years. Impacts would likely be small and local.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure are not known (Weilgart 2018; Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this resource. These disturbances would be infrequent over the next 35 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Noise: Vessels	While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See cell to the left.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Hydrodynamic disturbance	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 35 years, would likely require hard protection atop portions of the route (see the New cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures In the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.
Presence of structures: Cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Regulated fishing effort	Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, municipalities, and/or NOAA, depending on jurisdiction, affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Ocean acidification	Continuous CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of invertebrates that have calcareous shells over the course of the next 35 years.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distributions of finfish, invertebrates, and EFH. This sub-IPF has been shown to affect the distribution of fish in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies of various diseases of finfish and invertebrates.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

AC = alternating current; DC = direct current; hazmat = hazardous materials

Table F1-12 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Viewshed	The only existing offshore structures within the offshore viewshed are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to met towers. Marine activity would also occur within the marine viewshed.
Presence of structures: Cable infrastructure	Onshore buried cables would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.

hazmat = hazardous materials; met = meteorological

Table F1-13 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Marine Mammals

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).	See Table F1-23 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide 62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to minor changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF; however, no effects from the numerous submarine cables have been observed. Furthermore, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is temporary and short term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled-out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary, short-term, and result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high intensity, high consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area (NOAA 2018). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018).	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), SPLs would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Noise: Cable laying/ trenching	Noise from cable laying could periodically occur in the analysis area.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to be limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, LFCs are at a greater risk of experiencing Level B Harassment produced by vessel traffic.	Any offshore projects that require the use of ocean vessels could potentially result in long term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but response would be expected to be temporary and short-term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary, short-term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long-term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef” effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near shore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This “reef effect” has the potential to result in long term, low-intensity benefits. Bridge foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and OSS foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef effect” (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of marine mammals makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves and pups.	No future activities were identified within the geographic analysis area for marine mammals other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammal habitat use and migratory patterns. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Record et al. 2019; MacLeod 2009; Nunny and Simmonds 2019).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of marine mammals, such as Phocine distemper. Climate change is clearly influencing infectious disease dynamics in the marine environment; however, no studies have shown a definitive causal relationship between any components of climate change and increases in infectious disease among marine mammals. This is due in large part to a lack of sufficient data and to the likely indirect nature of climate change's impact on these diseases. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals. There are a number of potential proposed mechanisms by which this might occur (see summary in Burge et al. 2014 Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Increased storm frequency could result in increased energetic costs for marine mammals, reduced fitness, particularly for juveniles, calves and pups. Erosion could impact seal haul outs reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

μT = microtesla; AC = alternating current; hazmat = hazardous materials

Table F1-14 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside of major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor in an emergency scenario (such as power loss) if they lose power to prevent them from drifting and creating navigational hazards for other vessels or drifting into structures.	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep draft visits to major port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 35 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 35 years.
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operational noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 35 years. Even with increased port visits by deep-draft vessels, this is still a relatively small adjustment when considering the whole of New England vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity.	Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 35 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.
Traffic: Aircraft	USCG SAR helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. Draft EIS Section 3.16 provides a discussion of navigation impacts on fishing vessel traffic.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

Table F1-15 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Military and National Security Uses

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Allisions	Existing stationary facilities that present allision risks include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.
Presence of structures: Fish aggregation	No existing stationary structures that would act as FADs were identified within the geographic analysis area.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Space use conflicts	Existing stationary facilities within the geographic analysis area that could present a space use conflict include onshore wind turbines, communication towers, and other onshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.
Traffic: Vessels	Current vessel traffic in the region is described in Draft EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Draft EIS Section 3.16.
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Draft EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Draft EIS Section 3.16.

FAD = fish aggregating device

Table F1-16 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Aviation and Air Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Towers	Existing aboveground stationary facilities within the geographic analysis area that present aviation hazards include onshore wind turbines, communication towers, dock facilities, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore development activities are anticipated to continue with additional proposed communications towers.
Presence of structures: Space use conflicts	Existing aboveground stationary facilities within the geographic analysis area that could cause space use conflicts for aircraft include onshore wind turbines, communication towers, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers.

Table F1-17 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Cables and Pipelines

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include buoys that are used to mark inlet approaches, channels, and shoals, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.
Presence of structures: Space use conflicts	Existing submarine cables cross cumulative lease areas and create potential space use conflicts with marine mineral and sand borrow areas.	Reasonably foreseeable non-offshore wind structures that could create space use conflicts with submarine cables have not been identified in the geographic analysis area.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.

Table F1-18 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Radar Systems

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Towers	Wind developments in the direct line of sight with, or extremely close to, radar systems can cause clutter and interference.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.

Table F1-19 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Scientific Research and Surveys

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Navigation hazards	Stationary structures are limited in the open ocean environment of the geographic analysis area, and include met buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two CVOW WTGs.	Reasonably foreseeable non-offshore wind activities would not implement stationary structures within the open ocean environment that would pose navigational hazards and raise the risk of allisions for survey vessels and collisions for survey aircraft.

CVOW = Coastal Virginia Offshore Wind; met = meteorological

Table F1-20 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently and would generate short-term disturbances.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Cable laying/ trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	Periodic maintenance is necessary for harbors within the analysis area.	Ongoing maintenance and dredging of harbors within the geographic analysis area will continue as needed. No specific projects are known.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	The only existing offshore structures within the viewshed of the Projects are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Projects would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.

Table F1-21 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Sea Turtles

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-23 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).	See Table F1-23 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct and indirect ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and up to potentially 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural conditions, and thus would be insignificant (Normandeau et al. 2011).	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM's 2007 Final Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Furthermore, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Light: Structures	Artificial lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles. Artificial lighting on the OCS does not appear to have the same potential for effects. Decades of oil and gas platform operation in the Gulf of Mexico, that can have considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2019).	Non-offshore wind activities would not be expected to appreciably contribute to this sub-IPF. As such, no impact on sea turtles would be expected.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles if a plume causes a barrier to normal behaviors, but no impacts would be expected due to swimming through the plume (NOAA 2020). Turbidity associated with increased sedimentation may result in short-term, temporary impacts on sea turtle prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is short-term and temporary. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table F1-11).
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for sea turtles. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from sea turtles. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future low-altitude aircraft activities such as survey activities and navy training operations could result in short-term responses of sea turtles to aircraft noise. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating sea turtles, if present within the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys utilizing air guns, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level.	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.
Noise: Turbines	Available evidence suggests that typical underwater noise levels from operating WTGs would be below current cumulative injury and behavioral effect thresholds for sea turtles. Operating turbines were determined to produce underwater noise on the order of 110 to 125 dB_{RMS}, occasionally reaching as high as 128 dB_{RMS}, in the 10-Hz to 8-kilohertz range (Tougaard et al. 2020). As measured at the Block Island Wind Facility, low frequency operational noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Operational noise impacts would be expected to be negligible.	This sub-IPF does not apply to future non-offshore wind development.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high intensity, low exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. Based on current literature, the following thresholds are used to assess impacts on turtles: Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014) Potential mortal injury: 204 dB_{SEL}, 232 dB_{PEAK} (PTS), 189 dB_{SEL}, 226 dB_{PEAK} (TTS) (Navy 2017) Behavioral harassment: 175 dB referenced to 1 μPa RMS (Navy 2017)	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Noise: Vessels	The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1994) and would therefore be audible. However, Hazel et al. (2007) suggests that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would be expected to be short-term and temporary (see the Vessels: Noise sub-IPF above). The impact on water quality from sediment suspension during port expansion activities is short-term, temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present where these structures are located. At the scale of the OCS geographic analysis area for sea turtles, there are very few areas that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations, Block Island Wind Facility WTGs, and two WTGs with the CVOW pilot project) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near-shore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility (5 WTGs) and the CVOW pilot project (2 WTGs) but given the limited number of WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coasts is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and evidence suggests that they cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of sea turtles makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could lead to long-term, high-consequence impacts on sea turtle onshore beach nesting habitat, including changes to nesting periods, changes in sex ratios of nestlings, drowned nests, as well as loss or degradation of nesting beaches. Offshore impacts, including sedimentation of near-shore hard bottom habitats have the potential to result in long-term, high consequence changes to foraging habitat availability for green turtles.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources. This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle breeding, foraging, and sheltering habitat use.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle habitat use and migratory patterns.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of sea turtles such as fibropapillomatosis.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition	Sediment erosion and/or deposition in coastal waters have the potential to result in long-term, high-consequence impacts on green sea turtle foraging habitat. Additionally, sediment erosion has the potential to result in the degradation or loss of potentially suitable nesting habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

μT = microtesla; AC = alternating current; CVOW = Coastal Virginia Offshore Wind; hazmat = hazardous materials

Table F1-22 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Scenic and Visual Resources

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat, suspended sediments, trash and debris	Ongoing offshore and onshore construction projects involve the use of vehicles, vessels, and equipment that contain fuel, fluids, and hazmat that have the potential for accidental release. Offshore and onshore construction can also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.	Future offshore and onshore construction projects have the potential to result in accidental releases from vehicles, vessels, and equipment that contain fuel, fluids, and hazmat. Future offshore and onshore construction could also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation, onshore construction, onshore land use changes	Onshore human-caused and naturally occurring erosion and sedimentation results from construction, maintenance, and weather events.	Ongoing onshore construction projects could generate noticeable disturbance in the landscape. Intensity and extent would vary depending on the location, type, and duration of activities.
Light: Offshore structures and vessels, onshore vehicles, roads, laydown, parking, facilities, equipment, and structures	Offshore vessels have an array of lights including navigational lights, deck lights, and interior lights. Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would require nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary depending on the location, type, direction, and duration of nighttime lighting.
Structures: Viewshed	Buoys are the only existing stationary structures within the offshore viewshed of the Projects. Typically, buoys are visible only in the immediate foreground (less than 1 mile). Stationary and moving barges, boats, and ships also are visible in the daytime and nighttime viewsheds.	Onshore wind-related structures that could be viewed in conjunction with the offshore project components would be limited to meteorological towers, substations, and electrical transmission towers and conductors.
Traffic: Helicopters, vessels, vehicles	Ongoing activities contribute air, marine, and onshore traffic and visible congestion.	Planned onshore and offshore construction projects involving vessel, vehicle, and helicopter traffic could generate noticeable changes in the characteristic seascape and landscape and viewer experience. Intensity and extent of the changes would vary depending on the location, type, direction, and duration of the traffic.

hazmat = hazardous materials

Table F1-23 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Water Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredge material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable lines, and pipeline laying activities. According to the DOE, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was < 70,000 barrels. Impacts on water quality from a small accidental release would be expected to brief and localized due to containment and cleanup requirements, and petroleum weathering processes (i.e., the chemical and physical changes in the aquatic environment) that break down petroleum. Catastrophic accidental releases (e.g., a tanker grounding), although less common than small localized releases, would be anticipated to have long-term impacts on water quality due to the large area of surface water affected and volumes of petroleum that make it more difficult to contain and clean up.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 35 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short term, and temporary.
New cable emplacement/ maintenance	Elevated suspended sediment concentrations can occur under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities, and new cable and pipeline laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short-term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 35 years due to survey activities, and submarine cable, lines, and pipeline-laying activities. Future new cables would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 35 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to interim and localized impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Non-Offshore Wind Activities Intensity/Extent
Discharges	Discharges impact water quality by introducing nutrients, chemicals, and sediments to the water. There are regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species.	Increased coastal development is causing increased nutrient pollution in communities. In addition, ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. Impacts of ocean disposal on water quality are minimized because USEPA has established dredge spoil criteria and regulate the disposal permits issued by USACE. The impact on water quality from sediment suspension during these future activities would be short-term and localized.
Land disturbance: erosion and sedimentation	Ground disturbance activities may lead to un-vegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to un-vegetated or unstable soils. Precipitation events could mobilize these soils leading to erosion and sedimentation effects and turbidity. The impacts for future offshore wind through this IPF would be staggered in time and localized. The impacts would be short term and localized with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to un-vegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

DOE = U.S. Department of Energy; hazmat = hazardous materials

Table F1-24 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Wetlands

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to unvegetated or unstable soils. Precipitation events could mobilize these soils, leading to erosion and sedimentation effects and turbidity. Impacts from future offshore wind activities through this IPF would be staggered in time and localized. The impacts would be short term and localized, with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to unvegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity and land development will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo-handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

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ATTACHMENT 2
MAXIMUM-CASE SCENARIO ESTIMATES FOR OFFSHORE WIND PROJECTS

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LIST OF TABLES

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The following tables provide maximum-case scenario estimates of potential offshore wind project impacts assuming maximum buildout within the Empire Wind EIS geographic analysis areas. BOEM developed these estimates based on offshore wind demand, as discussed in its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019). Estimates disclosed in this EIS's Chapter 3, No Action analyses were developed by summing acreage or number calculations across all lease areas noted as occurring within, or overlapping, a given geographic analysis area. This likely overestimates some impacts in cases where lease areas only partially overlap analysis areas. However, this approach was used to provide the most conservative estimate of future offshore wind development.

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Table F2-1 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 1, Turbine and Cable Design Parameters)

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
ME	*Aqua ventus (state waters)*	*State Project*					*X*		*2023*	*2*	*11*					*450*	*520*
	Total Other State Waters Projects									**2**	11					450	520
Existing and Ongoing Projects																	
MA/RI	*Block Island (state waters)*	*Built*					*X*		*Built*	*5*	*30*	*28*	*5*	*2*	*328*	*541*	*659*
MA/RI	*Vineyard Wind 1 part of OCS-A 0501*	*COP Approved (ROD issued 2021), PPA, SAP*					*X*		*2023*	*62*	*800*	*98*	*6.5*	*171*	*451*	*721*	*812*
MA/RI	*South Fork, OCS-A 0517*	*COP Approved (ROD issued 2021), PPA, SAP*					*X*		*2023*	*12*	*130*	*139*	*6.5*	*24*	*472*	*735*	*840*
VA/NC	*CVOW, OCS-A 0497*	RAP, FDR/FIR					X		Built	2	12	27	3	9	364	506	620
	Total Existing and Ongoing Projects									81	972	292		206			
Planned Projects																	
Massachusetts/Rhode Island Region																	
MA/RI	Sunrise, OCS-A 0487	COP, PPA, SAP					X		2024	94	1,034	105	6.5	180	459	656	787
MA/RI	Revolution, part of OCS-A 0486	COP, PPA, SAP					X		2023–2024	100	880	100	131	155	512	722	873
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	COP, PPA, SAP					X		2024–2026	62	804	125	10	139	630	837	1,047
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	COP, PPA, SAP							2024–2026	79	1,500	225	10	201	702	935	1,171
MA/RI	Mayflower OCS-A 0521	COP, PPA, SAP					X		2024–2028	147	2,400	1,179	6.5	497	605	919	1,066
MA/RI	Beacon Wind 1, part of OCS-A 0520	PPA, SAP							2024–2025	78	1,230	233	6.5	186	591	984	853
MA/RI	Beacon Wind 2, part of OCS-A 0520	SAP					X		2025–2026	77	1,200	233	6.5	186	591	984	853
MA/RI	Bay State Wind, part of OCS-A 0500	SAP, COP (unpublished); the MW is included in the description below in the 5,148 MW.					X		By 2030, spread over 2025–2030	110	4,200	120	6.5	172	492	722	853
MA/RI	Liberty Wind, part of OCS-A 0522	This group is exposed to 5,800 MW of demand—for MA (4,000 MW remaining), CT (900 MW remaining), and RI (900 MW expected). Collectively the remaining technical capacity is 5,148 MW.					X			227		120	6.5	398	492	722	853
MA/RI	OCS-A 0500 remainder						X					120			492	722	853
MA/RI	OCS-A 0487 remainder						X					120			492	722	853
MA/RI	Remaining MA/RI Lease Area Total[2]	73%								337	4,400	480	6.5	540	492	722	853

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
	Total MA/RI Leases[2]									**974**	**13,248**	**2,680**		**2,084**			
New York/New Jersey Region																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP					X		2023–2025	98	1,100	194[11]	98	190	512	788	906
NY/NJ	Atlantic Shores South (OCS-A 0499)	COP, PPA, SAP					X		2024–2027	200	1,510	441	58	547	576	919	1,049
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA					X		By 2030, spread over 2026–2030	111	1,554	120	5	173	512	788	906
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	2023–2026	57	816	46	5	133	525	853	951
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	2023–2027	90	1,260	30	5	166	525	853	951
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP					X		By 2030, spread over 2026–2030	157	2,198	99	58	249	576	919	1,049
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537				X		X	X	By 2030, spread over 2026–2030	100	1,200	120	5	157	492	722	853
NY/NJ	Attentive Energy LLC, OCS-A 0538						X	X	By 2030, spread over 2026–2030	102	1,224	120	5	160	492	722	853
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539						X	X	By 2030, spread over 2026–2030	145	1,740	120	5	231	492	722	853
NY/NJ	Atlantic Shores Offshore Wind Bight LLC, OCS-A 0541						X		By 2030, spread over 2026–2030	93	1,116	120	5	147	492	722	853
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542						X		By 2030, spread over 2026–2030	97	1,164	120	5	153	492	722	853
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544			X	X		X	X	By 2030, spread over 2026–2030	102	1,224	120	5	160	492	722	853
	Total NY/NJ Leases									**1,352**	**16,106**	**1,650**		**2,466**			
Maryland/Delaware Region																	
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA, SAP					X		2024	16	120	40	10	30	492	722	853
DE/MD	US Wind, part of OCS-A 0490	COP, PPA, SAP					X		2024–2027	121	2,000	146	7	152	528	820	938
DE/MD	GSOE I, OCS-A 0482	Collectively the technical capacity of this is group is 1,080 MW (90 turbines). The remaining capacity may be utilized by demand from NJ or MD.					X		By 2030, spread over 2023–2030	90	1,080	-	-	-	492	722	853
DE/MD	OCS-A 0519 remainder						X					-	-	-			
DE/MD	Remaining DE/MD Lease Area Total									90	1,080	240	5	139			
	Total DE/MD Leases									**227**	**3,200**	**426**		**321**			
Virginia/North Carolina Region																	
VA/NC	CVOW-C, OCS-A 0483	COP, SAP					X		2025–2027	205	3,000	417	5	301	489	761	869

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
VA/NC	Kitty Hawk North, OCS-A 0508	COP, SAP					X		2024–2030	69	1,242	100	30	149	574	935	1,042
VA/NC	Kitty Hawk South, OCS-A 0508	COP					X		2024–2027	121	1,242	353	30	200	574	935	1,042
	Total VA/NC Leases									**395**	**5,484**	**870**		**650**			
	OCS Total (Planned)[9,10]									**2,948**	**38,038**	**5,626**		**5,522**			

Projects in *italics* are projects that have already been constructed or that are ongoing projects. Completed and ongoing projects are not included in project totals.
[1] The spacing/layout for projects are as follows: NE State water projects include a single strand of WTGs and no OSS. For projects in the RI, MA, NY, NJ, DE, MD lease areas, a 1×1–nm grid spacing is assumed. For the CVOW-C Project, the spacing is 0.7 nm; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nm average spacing, which is less than the 1×1–nm spacing due to the need to attain the state's goals.
[2] Because development could occur anywhere within the RI and MA lease areas and assumes a continuous 1x1–nm grid, the actual development for these projects is expected to be approximately 73% of the collective technical capacity. Under the scenario described in this appendix, the total area in the RI and MA lease areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.
[3] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[4] The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP.
[5] The number of turbines for those lease areas without an announced number of turbines has been calculated based on lease size, a 1×1-nm grid spacing, and/or the generating capacity.
[6] BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size is assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 4 feet (1.8 meters) but not more than 10 feet (3.1 meters).
[7] If information for a future project could not be obtained from a COP, the length of interarray cabling is assumed to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one OSS, it is assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two OSS. Interarray cable is assumed to be buried between 4 and 6 feet.
[8] The hub height, rotor diameter, and turbine height for lease areas is based on worst-case scenario for the resource area. Presentation of heights vary by COP and may be presented relative to MLLW, mean sea level, or height above highest astronomical tide.
[9] BOEM recognizes that the estimates presented within this analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts. Totals by lease area and by OCS may not fully sum due to rounding errors.
[10] New York's demand is not double-counted; this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.
CT = Connecticut; CVOW = Coastal Virginia Offshore Wind; DE = Delaware; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; NE = New England; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement; RAP = research activities plan; RI = Rhode Island
[11] Includes cable length from offshore export cables and substation interconnector cables.

Table F2-2 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 2, Seabed/Anchoring Disturbance and Scour Protection)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[3]						Estimated Foundation Number[2]	WTG Foundation Footprint[3] (acres)	WTG Seabed Disturbance (Foundation + Scour Protection) (acres)[4]	Offshore Export Cable Seabed Disturbance (acres)[5]	Offshore Export Cable Operating Seabed Footprint (acres)[6]	Offshore Export Cable Hard Protection (acres)[7]	Anchoring Disturbance (acres)[8]	Interarray Construction Footprint/Seabed Disturbance (acres)[9]	Interarray Operating Footprint/ Seabed Disturbance (acres)[10]	Interarray Cable Hard Protection (acres)[11]
			Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism										
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP					X		101	4	84	1,935[12]	78	94	19	1,850[13]	144	77
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP					X		211	9	135	1,606	137	12	262	2,035	317	307
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA					X		113	5	96	727	48	43	12	271	162	0
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	58	1	52	368	37	33	9	534	82	26
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	91	2	82	360	24	32	9	633	129	32
NY/NJ	Atlantic Shores North, OCS-A 0549	SAP					X		160	7	135	600	40	35	10	382	239	0
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537				X		X	X	102	4	87	727	48	43	12	952	146	0
NY/NJ	Attentive Energy LLC, OCS-A 0538						X	X	104	4	88	727	48	43	12	970	149	0
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539						X	X	148	6	126	727	48	43	12	1,403	212	0
NY/NJ	Atlantic Shores Offshore Wind Bight LLC, OCS-A 0541						X		95	4	81	727	48	43	12	890	136	0
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542						X		99	4	84	727	48	43	12	925	142	0
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544			X			X		104	4	88	727	48	43	12	970	149	0
	Total NY/NJ Leases		X	X	X		X	X	**1,386**	**54**	**1,138**	**9,959**	**652**	**506**	**393**	**11,815**	**2,006**	**442**
	MA, RI, DE, MD, NC, VA Leases								**1,630**	**206**	**3,466**	**140,321**	**1,814**	**1,017**	**2,009**	**22,484**	**2,529**	**697**
	OCS Total								**3,016**	**260**	**4,604**	**150,280**	**2,465**	**1,523**	**2,402**	**34,299**	**4,534**	**1,139**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] The estimated number of foundations is the total number of turbines plus OSS. If information for a future project could not be obtained from a publicly available COP, it is assumed that for every 50 turbines there would be one OSS installed.
[3] If information for a future project could not be obtained from a publicly available COP, the foundation footprint is assumed to be 0.04 acre, which is based on the largest monopile reported (12 MW) for all lease areas.
[4] The seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. If information for a future project could not be obtained from a publicly available COP, it is assumed that for all lease areas that a 12-MW foundation with addition of scour protection would be 0.85 acre per foundation.
[5] Offshore export cable seabed bottom disturbance is assumed to be due to installation of the export cable, the use of jack-up vessels, and the need to perform dredging. If information for a future project could not be obtained from a publicly available COP, export cable seabed disturbance assumed to be 6.06 acres per mile.
[6] If information for a future project could not be obtained from a publicly available COP, the offshore export cable operating seabed footprint assumed to be 0.4 acre per mile.
[7] If information for a future project could not be obtained from a publicly available COP, the offshore export cable hard protection is assumed to be similar to Vineyard Wind 1 Project, which is 0.357 acre per mile of offshore export cable.
[8] If information for a future project could not be obtained from a publicly available COP, anchoring disturbance for other lease areas is assumed to be a rate equal to 0.10 acre per mile of offshore export cable.
[9] If information for a future project could not be obtained from a publicly available COP, interarray construction seabed disturbance is assumed to be 6.06 acres per mile.
[10] If information for a future project could not be obtained from a publicly available COP, the interarray operating footprint is assumed to be a rate equal to the average amount per foundation of 1.43 acres per foundation.
[11] If information for a future project could not be obtained from a publicly available COP, the interarray cable hard protection is assumed to be zero.
[12] Includes disturbance from offshore export cables and substation interconnector cables. Assumes an 82-foot-wide corridor would be disturbed per cable, based on the Ocean Wind 1 COP.
[13] Assumes an 82-foot-wide corridor would be disturbed, based on the Ocean Wind 1 COP.
nd = not defined; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-3 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 3, Gallons of Coolant, Oils, Lubricants, and Diesel Fuel)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						Total Coolant Fluids in WTGs (gallons)	Total Coolant Fluids in OSS or ESP (gallons)	Total Oils and Lubricants in WTGs (gallons)	Total Oils and Lubricants in OSS or ESP (gallons)	Total Diesel Fuel in WTGs (gallons)	Total Diesel Fuel in OSS or ESP (gallons)
			Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism						
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP					X		39,690	-	187,964	238,707	77,714	158,502
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP					X		820,000	10,300	606,200	370,050	80,000	75,000
NY/NJ	Ocean Wind 2, part of OCS-A 0532[2]	PPA					X		44,953	-	212,888	160,732	88,019	105,673
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	49,704	-	285,684	158,503	-	7,925
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP	X	X	X	X	X	X	78,480	-	451,080	158,503	-	7,925
NY/NJ	Atlantic Shores North, OCS-A 0549[3]	SAP					X		643,700	8,240	475,867	296,040	62,800	60,000
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537[2]				X		X		40,500	-	191,800	243,579	79,300	161,737
NY/NJ	Attentive Energy LLC, OCS-A 0538[2]						X	X	35,235	-	195,363	248,450	80,886	164,971
NY/NJ	Bight Wind Holdings LLC, OCS-A 0539[2]						X	X	53,460	-	278,110	353,189	114,985	234,518
NY/NJ	Atlantic Shores Offshore Wind Bight LLC, OCS-A 0541[2]						X		36,045	-	178,374	226,528	73,749	150,415
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542[2]						X		39,690	-	186,046	236,271	76,921	156,885
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544[2]		X	X	X		X	X	41,310	-	195,636	248,450	80,886	164,971
	Total NY/NJ Leases								**1,935,322**	**18,540**	**3,445,285**	**2,939,003**	**815,260**	**1,448,523**
	MA, RI, DE, MD, NC, VA Leases								**2,068,080**	**21,537**	**5,193,820**	**5,662,633**	**1,355,996**	**1,062,241**
	OCS Total								**4,003,402**	**40,077**	**8,639,105**	**8,601,636**	**2,171,556**	**2,510,764**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Ocean Wind 1 based on number turbines and OSS.
[3] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Atlantic Shores South based on number turbines and OSS.
ESP = electrical service platform; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-4 Offshore Wind Leasing Activities on the U.S. East Coast: Projects and Assumptions (Part 4, OCS Construction and Operation Emissions)

Region	Lease/Project/Lease Remainder[1]	Status	Air Quality Geographic Analysis Area	2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
Nitrogen oxides (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	1	779	3,330	3,597	2,422	479	479	479	479
NY/NJ	OW Ocean Wind East LLC, OCS-A 0537		X	--	--	--	2,280	2,280	2,280	2,280	2,280	162
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	2,326	2,326	2,326	2,326	2,326	165
	Total Air Quality Analysis Area			1	779	3,330	8,203	7,028	5,085	5,085	5,085	806
Volatile organic compounds (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	0	31	168	150	103	21	21	21	21
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	60	60	60	60	60	4
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	61	61	61	61	61	4
	Total Air Quality Analysis Area			1	31	168	271	224	142	142	142	29
Carbon monoxide (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	0	185	816	920	721	228	228	228	228
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	440	440	440	440	440	41
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	449	449	449	449	449	42
	Total Air Quality Analysis Area			0	185	816	1,809	1,610	1,117	1,117	1,117	311
Particulate matter, 10 microns or less (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	0	19	91	108	75	13	13	13	13
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	75	75	75	75	75	6
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	76	76	76	76	76	6
	Total Air Quality Analysis Area			1	19	91	259	226	164	164	164	25
Particulate matter, 2.5 microns or less (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	0	19	89	105	73	12	12	12	12
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	71	71	71	71	71	6
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	73	73	73	73	73	6
	Total Air Quality Analysis Area			1	19	89	249	217	156	156	156	24
Sulfur dioxide (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	0	16	75	68	43	7	7	7	7
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	24	24	24	24	24	1
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	24	24	24	24	24	1
	Total Air Quality Analysis Area			1	16	75	116	91	55	55	55	9
Carbon dioxide (tons)												
NY/NJ	Empire Wind (EW 1 & EW 2), OCS-A 0512	COP, PPA, SAP	X	280	48,380	202,661	215,973	160,035	45,918	45,918	45,918	45,918
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537		X	--	--	--	133,941	133,941	133,941	133,941	133,941	11,992
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544		X	--	--	--	136,620	136,620	136,620	136,620	136,620	12,232
	Total Air Quality Analysis Area			280	48,380	202,661	486,534	430,596	316,479	316,479	316,479	70,142

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas shown in Attachment 1 of this appendix.
Note: Emissions for OW Ocean Winds East LLC and Vineyard Mid-Atlantic LLC are scaled from Ocean Wind, based on number of turbines and estimated construction schedule.
NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

References Cited

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: December 2020.

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Appendix G. Assessment of Resources with Minor (or Lower) Adverse Impacts

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G.1. Introduction

To focus on the impacts of most concern in the main body of this Draft EIS, BOEM has included the analysis of resources with no greater than **minor** adverse impacts below. These include air quality; bats; birds; coastal habitat and fauna; demographics, employment, and economics; recreation and tourism; sea turtles; and wetlands. Those resources with potential impact ratings greater than **minor** are included in Draft EIS Chapter 3.

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3.4. Air Quality

This section discusses potential impacts on air quality from the proposed Projects, alternatives, and ongoing and planned activities in the air quality geographic analysis area. The air quality geographic analysis area, as shown on Figure 3.4-1, includes the airshed within 25 miles (40 kilometers) of the Wind Farm Development Area (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Projects.

3.4.1 Description of the Affected Environment for Air Quality

The overall geographic analysis area for air quality covers portions of northeastern New Jersey, New York City, and western Long Island; the area around the Port of Albany, New York; and over the ocean southeast of New York Harbor. This area includes the air above the Wind Farm Development Area and adjacent OCS area, the offshore and onshore export cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. In addition, some construction-related activity could occur in the Corpus Christi, Texas area. COP Section 4.3 (Empire 2022) provides further description of the air quality geographic analysis area. Appendix I provides information on climate and meteorological conditions in the Project region.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by USEPA pursuant to the CAA (42 USC 7409) for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are CO, lead, nitrogen dioxide (NO_2), ozone, PM_{10}, $PM_{2.5}$, and SO_2. New York, New Jersey, and Texas have established ambient air quality standards (AAQS) that are similar to the NAAQS. COP Table 4.3-1 (Empire 2022) shows the NAAQS. Emissions of lead from Project-associated sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, lead is not analyzed in this EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily NO_X and VOC, in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

USEPA designates all areas of the country as attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas are those where attainment status cannot be determined based on available information and are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was nonattainment at any point in the last 20 years but is currently attainment or is unclassified, then the area is designated a maintenance area. Nonattainment and maintenance areas are required to prepare a State Implementation Plan (SIP), which describes the region’s program to attain and maintain compliance with the NAAQS. The attainment status of an area can be found at 40 CFR 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2021a). Attainment status is determined through evaluation of air quality data from a network of monitors.

The nearest onshore areas to the offshore Wind Farm Development Area are the New York City boroughs of Brooklyn, Queens, and Staten Island; the southern portion of Nassau County and the southwestern portion of Suffolk County, New York; and the northeastern portion of Monmouth County, New Jersey. Project emissions potentially could occur during construction or operations in the following nonattainment and maintenance areas:

- New York-Northern New Jersey-Long Island Area, NY-NJ-CT Ozone Nonattainment Area (2008 and 2015 NAAQS)

- New York-Northern New Jersey-Long Island Area, NY-NJ-CT Carbon Monoxide Maintenance Area (1971 NAAQS)
- New York County, NY PM_{10} Nonattainment Area (1987 Annual NAAQS)
- New York-Northern New Jersey-Long Island Area, NY-NJ-CT $PM_{2.5}$ Maintenance Area (1997 Annual NAAQS)
- New York-Northern New Jersey-Long Island Area, NY-NJ-CT $PM_{2.5}$ Maintenance Area (2006 24-Hour NAAQS)

The nonattainment and maintenance areas include port facilities that the Projects could use for construction or operations including the SBMT, New York. More distant ports that may be used include the Port of Albany, New York, the Port of Coeymans, New York, and Corpus Christi, Texas, which are in areas designated attainment for all pollutants.[1] Figure 3.4-2 displays the nonattainment and maintenance areas that intersect the geographic analysis area.

The CAA prohibits federal agencies from approving any activity that does not conform to a SIP. This prohibition applies only with respect to nonattainment or maintenance areas (i.e., areas that were previously nonattainment and for which a maintenance plan is required). Conformity to a SIP means conformity to a SIP's purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area and therefore not subject to the requirement to show conformity. All other federal agencies responsible for approval, permitting, or financing of project components within any nonattainment or maintenance area associated with the Projects should complete their own analysis to determine if conformity applies to their decisions.

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that were in existence before August 1977. Projects subject to federal air quality permits are required to notify the federal land managers responsible for designated Class I areas within 62 miles (100 kilometers) of a project.[2] The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Projects on air quality–related values. The nearest Class I area to the Projects is the Brigantine Wilderness Area in New Jersey, about 67 miles (108 kilometers) southwest of the Projects.

The CAA amendments directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic Coasts and along the U.S. Gulf Coast off Florida, east of 87° 30′ west longitude. The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nm of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

[1] The Port of Albany and the Port of Coeymans are in the former Albany-Schenectady-Troy Area, New York Ozone Nonattainment Area for the 1979 and 1997 NAAQS. However, USEPA has revoked these standards.
[2] The 100-kilometer distance applies to notification and is not a threshold for use in evaluating impacts. Impacts at Class I areas at distances greater than 100 kilometers may need to be considered for larger emission sources if there is reason to believe that such sources could affect the air quality in the Class I area (USEPA 1992).

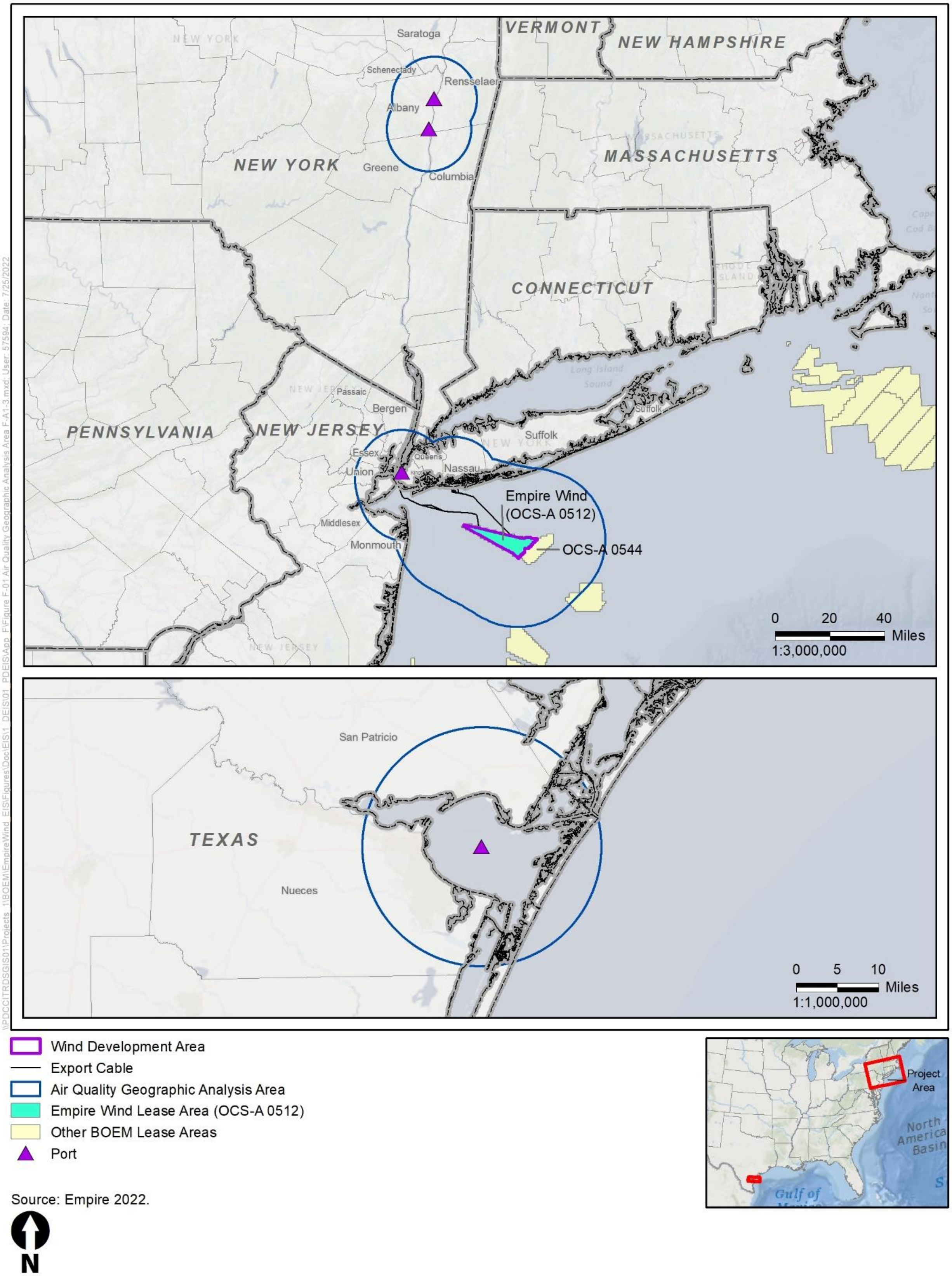
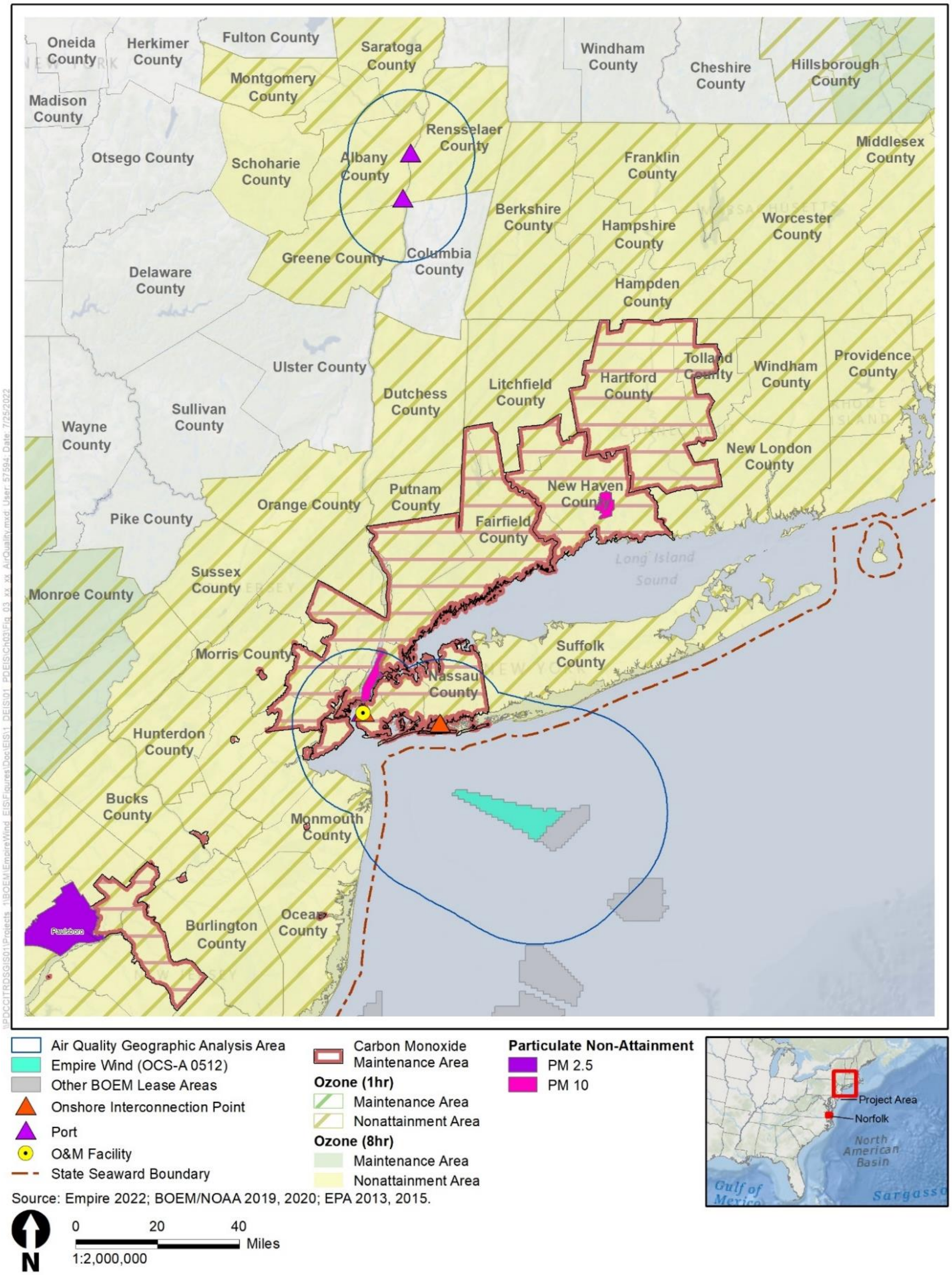


Figure 3.4-1 Air Quality Geographic Analysis Area



Note: Corpus Christi, Texas area is not shown.

Figure 3.4-2 Air Quality Status of the Geographic Analysis Area

3.4.2 Impact Level Definitions for Air Quality

Definitions of impact levels are provided in Table 3.4-1. Impact levels are intended to serve NEPA purposes only, and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4-1 Impact Level Definitions for Air Quality

Impact Level	Impact Type	Definition
Negligible	Adverse	Increases in ambient pollutant concentrations due to Project emissions would not be detectable.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would not be detectable.
Minor to Moderate	Adverse	Increases in ambient pollutant concentrations due to Project emissions would be detectable but would not lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be detectable.
Major	Adverse	Changes in ambient pollutant concentrations due to Project emissions could lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be larger than for minor to moderate impacts.

3.4.3 Impacts of the No Action Alternative on Air Quality

When analyzing the impacts of the No Action Alternative on air quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for air quality. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F, *Planned Activities Scenario*.

3.4.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1, *Description of the Affected Environment for Air Quality*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities as well as onshore construction activities. Other ongoing activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; and oil and gas activities. These activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through their emissions. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures. See Appendix F, Table F1-1 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for air quality. There are no ongoing offshore wind activities within the geographic analysis area for air quality.

State policies and plans to encourage and develop renewable energy sources in the region are summarized below.

New York

The New York State Climate Leadership and Community Protection Act set an expanded Clean Energy Standard, which requires that 70 percent of New York's electricity come from renewable sources by 2030. In 2014, Governor Andrew Cuomo launched an energy policy, Reforming the Energy Vision, to build an integrated energy network able to harness the combined benefits of the central grid with clean, locally generated power. The State Energy Plan sets a roadmap for the Reforming the Energy Vision policy, combining agency coordination, regulatory reform, and measures to encourage private capital investment. The initiatives outlined in the State Energy Plan, along with private sector innovation and investment fueled by Reforming the Energy Vision, are intended to put New York State on a path to achieving the following GHG emissions limits and clean energy goals:

- 40-percent reduction in GHG emissions from 1990 levels
- 50 percent of energy generation from renewable energy sources
- 600 trillion British thermal unit–increase in statewide energy efficiency (reduction in energy use through efficiency improvements)

NYSERDA led the development of the New York State Offshore Wind Master Plan and is leading the coordination of offshore wind opportunities in New York state and supporting the development of 9,000 MW of offshore wind energy by 2035.

New Jersey

NJDEP has projected that under a scenario of continuation of current regulations and policies, emissions from electricity generation would decline slowly through 2050 due to improvements in efficiency and switching to cleaner fuels (NJDEP 2019). Under the No Action Alternative, without implementation of other future offshore wind projects, the electricity that would have been generated by offshore wind would likely be provided by fossil fuel-fired facilities.[3] As a result, the No Action Alternative could lead to less decline in emissions than would occur with offshore wind development. An overall mix of natural gas, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. New Jersey Executive Order 92 (November 19, 2019) sets a goal of developing 7,500 MW of offshore wind energy off the coast of New Jersey by 2035. The New Jersey Energy Master Plan (New Jersey Board of Public Utilities 2019) sets a goal of transitioning New Jersey to 100 percent renewable electricity by 2050.

3.4.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities as well as onshore construction activities. Other planned non-offshore wind activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; and oil and gas activities (Appendix F). These planned non-offshore wind activities have the potential to affect air quality through their emissions.

[3] In 2020, the generation mix of the PJM Interconnection, the regional grid that serves New Jersey, was approximately 40 percent natural gas, 34 percent nuclear, 19 percent coal, 3 percent wind, 2 percent hydroelectric, and 2 percent other sources, on an annual average basis (Monitoring Analytics 2021).

Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures.

Other planned offshore wind activities within the geographic analysis area that could contribute to impacts on air quality include:

- Construction of the Ocean Winds East project (100 WTGs), expected 2026–2030
- Construction of the Vineyard Mid-Atlantic LLC project (102 WTGs), expected 2026–2030

BOEM expects planned offshore wind activities to affect air quality through the following primary IPFs.

Air emissions: Most air pollutant emissions and air quality impacts from planned offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area. All projects would be required to comply with the CAA. Primary emission sources would include vessel traffic, increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive particle emissions from construction-generated dust. During operations, emissions from planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects within the air quality geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power generation emissions overall would decrease and the region as a whole would realize a net benefit to air quality.

The planned offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of lease areas OCS-A 0537 and OCS-A 0544. Wind energy projects currently proposed in these lease areas include Ocean Winds East and Vineyard Mid-Atlantic LLC, respectively. These projects would produce renewable power from the installation of 202 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F2-1, construction of Ocean Winds East (2026–2030), Vineyard Mid-Atlantic LLC (2026–2030), and the Proposed Action (2023–2027) would overlap in 2026 and 2027. Ocean Winds East and Vineyard Mid-Atlantic LLC would produce 2,424 MW of renewable power from the installation of 202 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F2-1, those projects within the geographic analysis area (Ocean Winds East and Vineyard Mid-Atlantic LLC) would have overlapping construction periods beginning in 2026 and continuing through 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Empire Wind (Ocean Winds East and Vineyard Mid-Atlantic LLC) proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 4,445 tons of CO, 23,030 tons of NO_X, 754 tons of PM_{10}, 721 tons of $PM_{2.5}$, 136 tons of SO_2, 604 tons of VOCs, and 1,352,808 tons of CO_2 (Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area.

During operations, emissions from planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects within the air quality geographic analysis area (Ocean Winds East and Vineyard Mid-Atlantic LLC) would vary by year as successive projects begin operation. Estimated operational emissions would be 83 tons per year of CO, 327 tons per year of NO_X, 12 tons per year of PM_{10}, 11 tons per year of $PM_{2.5}$, 2 tons per year of SO_2, 8 tons per year of VOCs, and 24,224 tons per year of CO_2 (Table F2-4). Cumulatively, operational emissions would be intermittent and dispersed throughout the offshore wind lease areas and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts.

Offshore wind energy development, by displacing fossil-fuel energy, would help offset emissions from fossil fuels, improving regional air quality and reducing GHG. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects.[4] An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.3–0.8 °C (0.5–1.4 °F) by 2100. Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emission contributions of the existing and projected mixes of power generation sources, and generally estimate the annual health benefits of an individual commercial scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocoure et al. 2016).

Construction and operation of offshore wind projects would produce GHG emissions that would contribute incrementally to climate change. CO_2 is relatively stable in the atmosphere and, for the most part, mixed uniformly throughout the troposphere and stratosphere. As such, the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects would likely reduce regional GHG emissions by displacing energy from fossil fuels. This reduction would more than offset the relatively small GHG emissions from offshore wind projects. This reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context.

Accidental releases: Planned offshore wind activities could release air toxics or hazardous air pollutants (HAP) because of accidental chemical spills within the air quality geographic analysis area. Section 3.21, *Water Quality*, includes a discussion of the nature of releases that would be anticipated. Based on Table F2-3, up to about 128,184 gallons (485,229 liters) of coolants and 736,764 gallons (2.8 million liters) of oils and lubricants would be contained within the 202 WTGs, and 317,006 gallons (1.2 million liters) of oils and lubricants and 15,580 gallons (60,000 liters) of diesel fuel would be contained in the 202 WTGs and four OSS for the wind energy projects within the air quality geographic analysis area. If accidental releases occur, they would be most likely during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short periods (hours to

[4] Katzenstein and Apt (2009) modeled a system of two types of natural gas generators, four wind farms, and one solar farm. The power output of wind and solar facilities can vary relatively rapidly, and the natural gas generators change their power output accordingly to meet electrical demand. When gas generators change their power output their emission rates may increase above their steady-state levels. As a result, the net emissions reductions realized from gas generators reducing their output in response to wind and solar power can be less than the reduction that would be expected based on the amount of wind and solar power. The study found that reductions in CO_2 emissions would be about 80 percent, and in NO_X emissions about 30–50 percent, of the emissions reductions expected if the power fluctuations caused no additional emissions.

days)[5] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air quality is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). Moreover, liquids associated with the Projects would be distributed among hundreds of independent marine-grade containers spread out over many different structures, thus making any kind of full release extremely unlikely. BOEM expects air quality impacts from accidental releases would be temporary and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 35-year period with a higher probability of spills during planned project construction, but they would not be expected to contribute appreciably to cumulative impacts on air quality.

3.4.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, air quality would continue to be affected by existing environmental trends and ongoing activities. Additional, higher-emitting, fossil-fuel energy facilities would be kept in service to meet power demand, fired by natural gas, oil, or coal. BOEM anticipates that ongoing non-offshore wind activities would result in **moderate** impacts on air quality because of air pollutant emissions and GHGs. Ongoing activities would result in moderate impacts on air quality because their emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a new violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. Although the proposed Projects would not be built under the No Action Alternative, BOEM expects ongoing non-offshore wind activities would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, air quality would continue to be affected by natural and human-caused IPFs. Planned non-offshore wind activities may also contribute to impacts on air quality because air pollutant and GHG emissions would increase through construction and operation of new energy generation facilities to meet future power demands (Table F1-1). Continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in New York and the neighboring states. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **moderate** impacts on air quality, primarily driven by recent market and permitting trends indicating future fossil-fueled electric generating units would most likely include natural-gas-fired facilities.

Offshore wind activities in the geographic analysis area would contribute to the emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. Pollutant emissions during operations would be generally lower and more transient. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2026 through 2030 (Table F2-4). Adverse air quality impacts from planned offshore wind projects are expected to be relatively small and transient. Planned offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequent minor to moderate beneficial impacts on regional air quality after offshore wind projects are operational.

[5] For example, small diesel fuel spills (500–5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

BOEM anticipates that the cumulative impacts of the No Action Alternative would result in **moderate** adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning, because these emissions would incrementally increase ambient pollutant concentrations (more than would activities without offshore wind or offshore wind alone), though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation.

BOEM expects **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational because these projects likely would lead to reduced emissions from fossil-fueled power generating facilities.

3.4.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on air quality:

- Emission ratings of construction equipment and vehicle engines;
- Location of construction laydown areas;
- Choice of cable-laying locations and pathways;
- Choice of marine traffic routes to and from the Wind Farm Development Area and offshore export cable routes;
- Soil characteristics at excavation areas, which may affect fugitive emissions; and
- Emission control strategy for fugitive emissions due to excavation and hauling operations.

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the Proposed Action and other action alternatives because the maximum-case scenario involved the maximum number of WTGs allowed in the PDE.

3.4.5 Impacts of the Proposed Action on Air Quality

The Projects may generate emissions and affect air quality in the New York City region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection. Offshore emissions would be within the OCS and state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Section 8.2 (Empire 2022) provides additional information on land use and proposed ports.

Air quality in the geographic analysis area may be affected by emissions of criteria pollutants from sources involved in the construction or maintenance of the proposed Projects and, potentially, during operations. These impacts, while generally localized to the areas near the emission sources, may occur at any location associated with the proposed Projects, be it offshore in the Wind Farm Development Area or at any of the onshore construction or support sites. Ozone levels in the region also could be affected.

The proposed Projects' WTGs, substations, and offshore and onshore cable corridors would not themselves generate air pollutant emissions during normal operations. However, air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the proposed Project area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Farm Development Area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substations, and at the construction staging areas. Additional emissions related to the proposed Projects could also occur at nearby ports used to transport material and personnel to and from the Project site. However, the proposed Projects would provide beneficial impacts on the air quality near the proposed Project location and the surrounding region to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants in the region.

The majority of air pollutant and GHG emissions from the Proposed Action would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permitting process that is underway by Empire.

Air emissions – construction: Fuel combustion and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Construction equipment would comply with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4-2.

Table 3.4-2 Empire Wind Total Construction Emissions (U.S. tons)

Year	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e[1]
2023	<1	1	<1	<1	<1	<1	280
2024	185	779	19	19	16	31	48,380
2025	816	3,330	91	89	75	168	202,661
2026	920	3,597	108	105	68	150	215,973
2027	721	2,422	75	73	43	103	160,035
Total	**2,642**	**10,130**	**295**	**286**	**202**	**453**	**627,329**

Source: Appendix F, Table F2-4
Sum of individual values may not equal total due to rounding.
[1] Calculation of CO_2e is based on 100-year global warming potentials published by USEPA in Table A-1 of 40 CFR Part 98, Subpart A. The global warming potentials are 1 for CO_2, 25 for methane, 298 for nitrous oxide, and 22,800 for sulfur hexafluoride.
< = less than; CO_2e = carbon dioxide equivalent

Offshore Construction

Emissions from construction activities would vary throughout the construction and installation of offshore components. Emissions from offshore activities would occur during pile and scour protection installation, offshore cable laying, turbine installation, and substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Projects may need emergency generators at times, potentially resulting in increased emissions for limited periods. Empire's APMs to reduce air quality impacts include compliance with applicable emissions standards (APM 28 and APM 31) and fuel sulfur content standards (APM 29 and APM 30), purchase of emission-reduction credits where required (APM 27), data and information sharing with BOEM and USEPA (APM 32 and APM 33), compliance with state regulations on engine idling (APM 34), and compliance with a Fugitive Dust Control Plan (see COP Section 4.3.2.1 and Table 9-1; Empire 2022).

The nearest Class I area, the Brigantine Wilderness Area in New Jersey, is more than 67 miles (108 kilometers) from the Projects. This distance is greater than the 100-kilometer distance within which USEPA recommends that the federal land manager of the Class I area be notified about a project that requires a federal air quality permit. Winds blow from the Project area toward the Brigantine Wilderness Area for only a small proportion of the year (see Appendix I, Figure I-1). Emissions from Project construction activities would not be concentrated at a single point but would occur throughout the geographic analysis area. As a result, Project emissions would be relatively well dispersed before being transported toward the Brigantine Wilderness Area. For these reasons, adverse air quality impacts are not expected at the Brigantine Wilderness area due to the Projects.

Air quality impacts due to offshore wind projects within the air quality geographic analysis area are anticipated to be small relative to those of combined impacts of larger emission sources in the region, such as fossil-fueled power plants. The largest air quality impacts of offshore wind projects are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. Construction of the proposed Projects would overlap with the early years of construction of Ocean Winds East and Vineyard Mid-Atlantic LLC (Table F2-4). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region and the westerly prevailing winds would result in most emission plumes remaining offshore for some distance. Although air quality offshore is subject to the NAAQS in federal waters and the OCS permit area, the amount of human exposure offshore is typically very low. However, ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

Onshore Construction

Onshore activities of the Proposed Action would consist primarily of HDD, duct bank construction, cable-pulling operations, and substation construction. Emissions would primarily be from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and heavy trucks, and fugitive particulate emissions from excavation and hauling of soil. Empire's APMs include complying with applicable emissions standards (APM 28 and APM 31) and fuel sulfur content standards (APM 29 and APM 30), purchase of emission-reduction credits where required (APM 27), data and information sharing with BOEM and USEPA (APM 32 and APM 33), compliance with state regulations on engine idling (APM 34), and compliance with a Fugitive Dust Control Plan (see COP Section 4.3.2.1 and Table 9-1; Empire 2022).

These onshore emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts, as they would be temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M: During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action would have no pollutant emissions. Emergency generators on the WTGs and the substations would operate only during emergencies or testing, so emissions from these sources would be small and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the Wind Farm Development Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Development Area for significant maintenance and repairs. The proposed Projects' contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the air quality geographic analysis area. COP Section 3.5 (Empire 2022) provides a more detailed description of offshore and onshore O&M activities, and COP Table 4.3-9 summarizes emissions during O&M. The annual estimated emissions for O&M are summarized in Table 3.4-3.

Table 3.4-3 Empire Wind Operations and Maintenance Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e[1]
Annual	228	479	13	12	7	21	45,918
Lifetime (35 years)	7,968	16,763	448	434	253	729	1,607,130

Source: Appendix F, Table F2-4
[1] Calculation of CO_2e is based on 100-year global warming potentials published by USEPA in Table A-1 of 40 CFR Part 98, Subpart A. The global warming potentials are 1 for CO_2, 25 for methane, 298 for nitrous oxide, and 22,800 for sulfur hexafluoride.
CO_2e = carbon dioxide equivalent

BOEM anticipates that air quality impacts from O&M of the Proposed Action would be minor, occurring for short periods of time several times per year during the proposed 35 years.

Emissions from onshore O&M activities would be limited to periodic use of construction vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Empire intends to construct and maintain an O&M facility to support O&M activities. A location for this facility at the SBMT is being considered (see COP Section 3.5; Empire 2022). BOEM anticipates that air quality impacts due to onshore O&M from the Proposed Action would be minor, intermittent, and occurring for short periods.

Increases in renewable energy could lead to reductions in emissions from fossil-fueled power plants. The USEPA Avoided Emissions and Generation Tool (USEPA 2021b) was used to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 953 tons of NO_X, 292 tons of $PM_{2.5}$, 232 tons of SO_2, and 3,573,860 tons of CO_2. This estimate is derived assuming the electricity generation mix of 2018 for generating units in New York and New Jersey that is included in the Avoided Emissions and Generation Tool. If renewable energy sources make up more of the electricity generation mix in the future, these potential benefits would be proportionally diminished as overall air emissions decrease and air quality improves. The avoided CO_2 emissions are equivalent to the emissions generated by about 705,000 passenger vehicles in a year (USEPA 2020a). Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its development and eventual decommissioning within different time periods of operation depending on the pollutant: $PM_{2.5}$ and SO_2 each would be offset in approximately 1 year of operation, and CO_2 in 3 months. NO_X emissions would be offset in approximately 34 years, or nearly the Projects' lifetime. If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Projects would be offsetting emissions that would otherwise be generated from another source.

The potential health benefits of avoided emissions can be evaluated using USEPA's CO-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020b). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action. Table 3.4-4 presents the estimated avoided health effects. The estimates in Table 3.4-4 are based on the reduction in electrical generation from fossil fuel combustion during Project operation. If emissions increases from Project O&M were included, the net avoided health effects and monetized benefits would be lower.

Table 3.4-4 COBRA Estimate of Annual Avoided Health Effects with Proposed Action

Discount Rate[1] (2023)	Avoided Mortality (cases per year)		Monetized Total Health Benefits (U.S. dollars per year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	7.613	17.223	$84,807,165	$191,089,005
7%	7.613	17.223	$75,691,313	$170,408,581

[1] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2020c).
[2] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2020c).

The overall impacts of GHG emissions can be assessed using "social costs." The "social cost of carbon," "social cost of nitrous oxide," and "social cost of methane"—together, the "social cost of greenhouse gases" (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

CEQ is currently updating its 2016 guidance document (CEQ 2016) on consideration of GHGs and climate change under NEPA. While CEQ works on updated guidance, it has instructed agencies to consider and use all tools and resources available to them in assessing GHG emissions and climate change effects including its 2016 GHG guidance document. The 2016 CEQ guidance noted that NEPA does not require monetizing costs and benefits but allows the use of the social cost of carbon, SC-GHG, or other monetized costs and benefits of GHGs in weighing the merits and drawbacks of alternative actions. SC-GHG estimates are presented below for purposes of information and disclosure.

For federal agencies, the best currently available estimates of SC-GHG are the interim estimates of the social costs of CO_2, methane, and nitrous oxide developed by the Interagency Working Group (IWG) on SC-GHG and published in its Technical Support Document (IWG 2021). IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. The discount rate accounts for the "time value of money," i.e., a general preference for receiving economic benefits now rather than later, by discounting benefits received later. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are less valuable or are a less significant factor in present-day decisions). IWG developed the current set of interim estimates of SC-GHG using three different annual discount rates: 2.5 percent, 3 percent, and 5 percent (IWG 2021).

There are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021). To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

To further address uncertainty, IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average damages from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95th percentile of damages estimated, applying a 3-percent annual discount rate for future economic effects. This is a low-probability but high-damage scenario and represents an upper bound of damages within the 3-percent discount rate model. The estimates below follow the IWG recommendations.

Table 3.4-5 presents the SC-GHG associated with estimated emissions from the Proposed Action. These estimates represent the present value of future market and nonmarket costs associated with CO_2, methane, and nitrous oxide emissions. In accordance with IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and Empire's estimates of emissions in each year. In Table 3.4-5, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG.

Table 3.4-5 Estimated Social Cost of GHGs associated with the Proposed Action

Description	Social Cost of GHGs (2020$)[1,2]			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Construction, Operation, and Decommissioning	$20,483,000	$81,201,000	$124,333,000	$246,235,000
Avoided Emissions	-$977,131,000	-$4,060,472,000	-$6,271,797,000	-$12,404,875,000
Net SC-GHG	-$956,647,000	-$3,979,271,000	-$6,147,464,000	-$12,158,640,000

Estimates are the sum of the social costs for CO_2, methane, and nitrous oxide over the Project lifetime.
Estimates are rounded to the nearest $1,000.
[1] NYSDEC calculates SC-GHG using discount rates of 1%, 2%, and 3% (NYSDEC 2022), which differ from the IWG recommended rates used in the table. If the estimated SC-GHG for the Proposed Action were calculated using the NYSDEC rates, the estimates would differ from those shown in the table.
[2] The following calendar years were used in calculating SC-GHG: construction 2023–2027, operation (30 years) 2028–2057, and decommissioning 2058–2059.

Air emissions – decommissioning: At the end of the operational lifetime of the Projects, Empire would decommission the Projects. Empire anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a "reverse installation" process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions where warranted. Emissions from Project decommissioning would be less than for construction, as shown in Table 3.4-6. The Projects anticipate pursuing a separate OCS Air Permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 35 years and in the future will have lower emissions than current vessels and equipment. BOEM anticipates minor and temporary air quality impacts from the Proposed Action due to decommissioning.

Table 3.4-6 Empire Wind Decommissioning Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e[1]
Total	422	1,698	50	48	35	78	101,050

Source: COP Appendix K, Table K-8 (Empire 2022)
[1] Calculation of CO_2e is based on 100-year global warming potentials published by USEPA in Table A-1 of 40 CFR Part 98, Subpart A. The global warming potentials are 1 for CO_2, 25 for methane, 298 for nitrous oxide, and 22,800 for sulfur hexafluoride.
CO_2e = carbon dioxide equivalent

The Proposed Action would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions displaced during operation of the Projects. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Consequently, the Proposed Action would have negligible impacts on climate change during construction and operation, and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

Accidental releases: The proposed Projects could release VOCs or HAPs because of accidental chemical spills. Based on Table F2-3, the Proposed Action would have up to about 128,184 gallons (485,228 liters) of coolants and damping liquid, 1,053,770 gallons (4.0 million liters) of oils and lubricants, and 15,850 gallons (59,999 liters) of diesel fuel in its 147 wind turbine and 2 substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be temporary and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.21.3.2, as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action.

3.4.5.1. Impact of the Connected Action

The connected action would affect air quality in the geographic analysis area through the following IPFs: accidental releases and air pollutant emissions. The connected action was evaluated in the Full Environment Assessment Form Supplemental Analysis for SBMT (NYCEDC 2022), which is included in this EIS as Appendix P.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at SBMT. NYCEDC would develop and implement a SWPPP or SPCC plan to manage accidental spills or releases of oil, fuel, or hazardous materials during construction and operation of improvements at the SBMT. The provisions of the SWPPP or SPCC plan would minimize emissions to the atmosphere that could occur due to accidental releases. Accordingly, accidental releases from the connected action alone would have localized, short-term, negligible to minor impacts on air quality.

Air emissions: The SBMT infrastructure improvement project would improve the terminal site that Empire would use for construction and staging of some Project components. Construction and operation of SBMT, and some Project construction and O&M activities, would occur in close proximity to each other on the site and would overlap in time.

Emission sources associated with SBMT would include land-based non-road equipment and on-road vehicles, and vessels accessing the site. SBMT performed air quality dispersion modeling to estimate pollutant concentrations for the highest-emissions periods for SBMT construction and operation. The results showed that all concentrations would be well within the NAAQS and New York AAQS (NYCEDC 2022, Table 3.20-6).

Construction and operation of the Proposed Action at SBMT would include land-based non-road equipment and on-road vehicles, vessels accessing the site, and emergency generators. These emissions potentially could increase pollutant concentrations above the levels that were modeled for SBMT. Comparison of the relative emissions for the Projects and SBMT indicates that the combined concentrations for the Projects and SBMT would be expected to be within the NAAQS and New York AAQS for each pollutant, for all years of the Projects' construction and operation.

3.4.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, and the connected action at SBMT.

Offshore construction. The contribution of the Proposed Action to the cumulative impacts on air quality from ongoing and planned activities would be minor during construction. During overlapping construction activities, there could be higher levels of impacts, but these effects would be temporary in nature, as the overlap in the air quality geographic analysis area would be limited in duration.

Onshore construction. The contribution of the Proposed Action to cumulative air quality impacts from ongoing and planned activities associated with onshore construction would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. As with the Proposed Action, fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M. The contribution of the Proposed Action O&M emissions to the combined impacts of ongoing and planned activities would be minor. O&M emissions associated with planned offshore wind activities would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in intermittent, and widely dispersed emissions. Planned offshore wind activities, including the Proposed Action, are estimated to emit 522 tons per year of CO, 743 tons per year of NO_X, 36 tons per year of PM_{10}, 34 tons per year of $PM_{2.5}$, 16 tons per year of SO_2, 49 tons per year of VOCs, and 111,383 tons per year of CO_2 when all projects are operating (Table F2-4). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized.

Additionally, some emissions associated with O&M activities could overlap with other projects' construction-related emissions. The largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the offshore wind projects within the air quality geographic analysis area. However, a net improvement in air quality is expected on a regional scale as the Projects begin operation and displaces emissions from fossil-fueled sources.

Air emissions – decommissioning. The contribution of decommissioning of the Proposed Action to the combined air quality impacts from ongoing and planned activities would be minor. The decommissioning process for all offshore wind projects is expected to be similar, and impacts would be similar in nature to impacts of construction but would be less in degree. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined GHG impacts on air quality from ongoing and planned activities would be beneficial from the net decrease in GHG emissions, to the extent that fossil-fueled generating facilities would reduce operations as a result of increased energy generation from offshore wind projects.

Accidental releases. Based on Table F2-3, there would be up to about 209,994 gallons (794,913 liters) of coolants, 1,933,235 gallons (7.3 million liters) of oils and lubricants, and 342,558 gallons (1.3 million liters) of diesel fuel contained in the 355 WTGs and OSS associated with the Proposed Action and other planned offshore wind projects in the air quality geographic analysis area. BOEM expects that in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined accidental release impacts on air quality from ongoing and planned activities would be negligible due to the temporary nature and localized potential effects. Accidental spills would occur infrequently over the 35-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to cumulative impacts on air quality, as the total storage capacity within the air quality geographic analysis area is considerably less than the existing volumes of hazardous liquids being transported by ongoing activities and is distributed among many different locations and containers.

3.4.5.3. Conclusions

Impacts of the Proposed Action. The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a conventional fossil-fueled power plant. Although there would be some air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4-4). **Minor** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Development Area and the surrounding region overall to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants. Empire has committed to APMs that would reduce potential impacts through complying with applicable emissions standards (APM 28 and APM 31) and fuel sulfur content standards (APM 29 and APM 30), purchase of emission-reduction credits where required (APM 27), data and information sharing with BOEM and USEPA (APM 32 and APM 33), compliance with state regulations on engine idling (APM 34), and compliance with a Fugitive Dust Control Plan. for onshore construction areas (see COP Section 4.3.2.1 and Table 9-1; Empire 2022). Because of the amounts of emissions, the fact that emissions are spread out in time (5 years for construction and then lesser emissions annually during operation), and the large geographic area over which they would be dispersed (throughout the 79,350-acre Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS, New York AAQS, or New Jersey AAQS.

BOEM expects that the connected action alone would have **negligible** to **minor** impacts on air quality due to accidental releases and air pollutant emissions, because all concentrations would be well below the NAAQS and New York AAQS. Empire's use of the SBMT marine terminal for WTG staging and as an O&M facility would have **minor** impacts on existing air quality and long-term **minor** impacts on air quality due to the increased industrial and transportation activity at SBMT, because pollutant concentrations would remain below the NAAQS and New York AAQS.

Cumulative Impacts of the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action and the connected action to the air quality impacts of ongoing and planned activities would be **minor**. The main driver for this impact rating is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment, and fugitive emissions, would be higher during overlapping construction activities but temporary in nature, as the overlap would be limited in duration. Cumulative impacts on air quality in combination with other ongoing and planned activities would likely be **moderate** due to the contribution of moderate impacts from ongoing and planned activities on air quality in the geographic analysis area, as summarized in Section 3.4.3.3. Displacement of fossil-fuel energy by wind energy would result in **moderate beneficial** impacts regionally because the magnitude of the potential reduction in emissions from displacing fossil-fuel-generated power would be small relative to total energy generation emissions in the region.

3.4.6 Impacts of Alternatives B, C, D, E, F, G, and H on Air Quality

Impacts of Alternatives B, C, D, E, F, G, and H. The air quality and climate impacts associated with all action alternatives would be similar to those of the Proposed Action. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs and two OSS as defined in Empire's PDE.

Alternatives C-1, C-2, D, and G would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated emissions from WTG construction and operation. These alternatives would have differing locations and lengths of offshore and onshore cables, and so would have different emissions associated with cable construction and installation compared to the Proposed Action. Alternative H would have the same number of WTGs and the same cable configurations as the Proposed Action but could differ in the dredging and sediment disposal methods used for construction of the EW 1 landfall in the vicinity of the SBMT, so the emissions from this construction-related activity could differ as well. Overall, the differences in emissions among the action alternatives and the Proposed Action would be relatively small, and the air quality and climate impacts from all action alternatives would be substantially the same as described for the Proposed Action.

Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the other action alternatives would be similar to those of the Proposed Action and therefore the impacts on air quality from accidental releases are expected to be similar to those of the Proposed Action.

Cumulative Impacts of Alternatives B, C, D, E, F, G, and H. In context of reasonably foreseeable environmental trends, the contributions of the action alternatives to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.4.6.1. Conclusions

Impacts of Alternatives B, C, D, E, F, G, and H. Expected **minor** impacts associated with the Proposed Action would not change under the other action alternatives. The same construction, O&M, and decommissioning activities would still occur, albeit at slightly differing scales as identified. Alternatives B, E, and F could have slightly less, but not materially different, **minor** impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Alternatives C-1, C-2, D, and G would have the same number of WTGs, although with some differences in cable construction and installation, and therefore similar **minor** impacts on air quality to those of the Proposed Action. Alternative H would differ from the Proposed Action only in the dredging/disposal methods used at SBMT, and so would have similar **minor** impacts on air quality to those of the Proposed Action. As under the Proposed Action, the action alternatives would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Cumulative Impacts of Alternatives B, C, D, E, F, G, and H. In context of reasonably foreseeable environmental trends, the contributions of the action alternatives to the impacts of individual IPFs affecting air quality and climate from ongoing and planned activities would be the same as those of the Proposed Action. The combined air quality impacts of ongoing and planned non-offshore wind activities, offshore wind projects other than the action alternatives, and the action alternatives are expected to be **moderate**. Offshore wind projects, including the action alternatives, would result in **moderate beneficial** cumulative impacts due to reduced emissions from fossil-fueled power plants.

3.4.7 Proposed Mitigation Measures

Empire has committed to measures to avoid, minimize, and mitigate air quality impacts of the Projects. These measures include, among others, compliance with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts, as discussed in Section 3.4.5. COP Section 4.1.3.4 and Table 4.1-22 (Empire 2022) provide details of these measures. In addition, Empire will comply with the requirements of the OCS air permit, when issued, for emissions reduction and mitigation. The OCS air permit requirements may include emission controls that meet Best Available Control Technology or Lowest Achievable Emission Rate criteria, development of emission offsets, or other mitigation measures. No agency-proposed mitigation measures for air quality have been identified in Appendix H.

3.4.8 Comparison of Alternatives

This section provides a summary comparison of the anticipated impacts of ongoing activities, planned activities, the connected action, and Project impacts.

Under the No Action Alternative, air quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing and planned non-offshore wind activities and offshore wind activities would have continuing regional impacts primarily through air pollutant emissions and accidental releases. Combined impacts of ongoing and planned non-offshore wind activities as well as offshore wind activities, including air pollutant emissions and GHGs, would be **moderate** because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently **minor** to **moderate beneficial** impacts on air quality and climate.

Under the Proposed Action, air quality impacts would occur due to emissions associated with construction, O&M, and eventual decommissioning, but these impacts would be relatively small and limited in duration. Impacts would be **minor** because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS. There would be a **minor beneficial** impact on air quality in the region overall to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation.

Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs and two OSS as defined in Empire’s PDE. Regional benefits due to reduced emissions associated with fossil-fueled energy generation would be the same as described for the Proposed Action, as these alternatives have the same total generating capacity.

Alternative G would have the same number of WTGs and OSS as the Proposed Action but would use a cable bridge to cross Barnums Channel. The cable bridge is included in the PDE for the Proposed Action and narrowing the PDE to a cable bridge crossing of Barnums Channel would not result in substantially different onshore construction emissions for Alternative G. O&M emissions would be the same as for the Proposed Action. Overall, impacts under Alternative G are expected to be similar to those for the Proposed Action.

Alternative H would have the same number of WTGs and OSS as the Proposed Action and the same onshore facilities. However, construction at the SBMT would use a method of dredge or fill activities that would reduce the discharge of dredged material. The proposed method for dredge and fill activities under Alternative H is included in the PDE for the Proposed Action and narrowing the PDE to a preferred method for dredging for the EW 1 landfall would not result in substantially different construction emissions. O&M emissions would be the same as for the Proposed Action. Overall, impacts under Alternative H are expected to be similar to those for the Proposed Action.

In context of other reasonably foreseeable environmental trends, and considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse and **moderate beneficial**. The overall adverse impact on air quality would likely be moderate because pollutant concentrations are not expected to exceed the NAAQS, New Jersey AAQS, or New York AAQS. The Proposed Action and other offshore wind projects would benefit air quality in the region surrounding the Projects to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants. BOEM anticipates an overall **moderate beneficial** impact because the magnitude of this potential reduction would be small relative to total energy generation emissions in the area. Overall impacts with Alternatives B, E, and F would be similar to those with the Proposed Action. Overall impacts with Alternatives C, D, G, and H would be similar to those with the Proposed Action.

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3.5. Bats

This section discusses potential impacts on bat resources from the proposed Projects, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as shown on Figure 3.5-1, includes the United States coastline from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group.

3.5.1 Description of the Affected Environment for Bats

The number of bat species in the geographic analysis area varies by state, ranging from eight species (Rhode Island, New Hampshire, and Maine) to 17 (Virginia and North Carolina) (Rhode Island Department of Environmental Management n.d.; Maine Department of Inland Fisheries and Wildlife 2021; New Hampshire Fish and Game n.d.; Virginia Department of Wildlife Resources 2021; North Carolina Wildlife Resources Commission 2017).

There are nine species of bats present in the state of New York, eight of which may be present in the Project area and six that are year-round residents (Table 3.5-1) (Empire 2022). These species can be broken down into cave-hibernating bats and migratory tree bats based on their wintering strategy. Both groups are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer (Empire 2022 citing Barbour and Davis 1969). Cave-hibernating bats are generally not observed offshore at distances where WTGs are proposed (Empire 2022 citing Dowling and O'Dell 2018) and, in the winter, migrate from summer habitat to hibernacula in the Mid-Atlantic region (Empire 2022 citing Maslo and Leu 2013). Migratory tree bats fly to southern parts of the United States in the winter and are observed offshore during migration (Empire 2022 citing Hatch et al. 2013).

Table 3.5-1 Bats Present in New York and their Conservation Status

Common Name	Scientific Name	State Status	Federal Status
Cave-Hibernating Bats			
Eastern small-footed bat	*Myotis leibii*	SC	-
Little brown bat	*Myotis lucifugus*	SGCN	Under Review[3]
Northern long-eared bat[1]	*Myotis septentrionalis*	T	T
Indiana bat[2]	*Myotis sodalist*	E	E
Tri-colored bat	*Perimyotis subflavus*	SGCN	Under Review[4]
Big brown bat	*Eptesicus fuscus*	-	-
Migratory Tree Bats			
Eastern red bat	*Lasiurus borealis*	-	-
Hoary bat	*Lasiurus cinereus*	-	-
Silver-haired bat	*Lasionycteris noctivagans*	-	-

Source: Empire 2022; USFWS 2021a, 2021b.
[1] On March 23, 2022, USFWS published a proposal to reclassify the northern long-eared bat as endangered. The U.S. District Court for the District of Columbia has ordered USFWS to complete a new final listing determination by November 2022 (Case 1:15-cv-00477, March 1, 2021).
[2] Range does not indicate species presence in the Project area.
[3] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate. USFWS anticipates a decision in Fiscal Year 2022.

[4] Currently under 12-month finding review on a petition to list the species. If listing is warranted, USFWS would generally proceed with a concurrent proposed listing rule and proposed critical habitat. USFWS anticipates a decision in Fiscal Year 2022.
E = Endangered; SC = Special Concern; SGCN = Species of Greatest Conservation Need; T = Threatened; USFWS = U.S. Fish and Wildlife Service

There is uncertainty on the specific movements of bats offshore, but bats have been documented in the offshore marine environment, particularly during migration (Empire 2022 citing Grady and Olson 2006; Cryan and Brown 2007; Empire 2022 citing Johnson et al. 2011; Empire 2022 citing BOEM 2013; Empire 2022 citing Hatch et al. 2013; Empire 2022 citing Lagerveld et al. 2017; Empire 2022 citing Dowling and O'Dell 2018). Bats have been documented temporarily roosting on structures on nearshore islands such as lighthouses (Empire 2022 citing Dowling et al. 2017) and there is historical evidence of bats, particularly the eastern red bat, migrating offshore in the Atlantic (Empire 2022 citing Hatch et al. 2013). In a Mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010, the maximum distance that bats were detected from shore was 13.6 miles (21.9 kilometers) and the mean distance was 5.2 miles (8.4 kilometers) (Empire 2022 citing Sjollema et al. 2014). In Maine, bats were detected on islands up to 25.8 miles (41.6 kilometers) from the mainland (Empire 2022 citing Peterson et al. 2014). In the Mid-Atlantic acoustic study, eastern red bat represented 78 percent of all bat detections offshore and bat activity decreased as wind increased (Empire 2022 citing Sjollema et al. 2014). In addition, eastern red bats were detected in the Mid-Atlantic up to 27.3 miles (44 kilometers) offshore by high-definition video aerial surveys (Empire 2022 citing Hatch et al. 2013).

Cave-hibernating bats hibernate regionally in caves, mines, and other structures and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Empire 2022 citing Sjollema et al. 2014), with movements primarily during the fall. In the Mid-Atlantic, the maximum distance *Myotis* bats were detected offshore was 7.2 miles (11.5 kilometers) (Empire 2022 citing Sjollema et al. 2014). A recent nano-tracking study on Martha's Vineyard recorded little brown bat movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod (Empire 2022 citing Dowling et al. 2017). Big brown bats were also detected migrating from the island later in the year (October–November) (Empire 2022 citing Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys off the Gulf of Maine that indicated the greatest percentage of activity in July–October (Empire 2022 citing Peterson et al. 2014). Given that the use of the coastline as a migratory pathway by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment by cave-hibernating bats, and that cave-hibernating bats do not regularly feed on insects over the ocean, exposure to the Wind Farm Development Area is unlikely for this group.

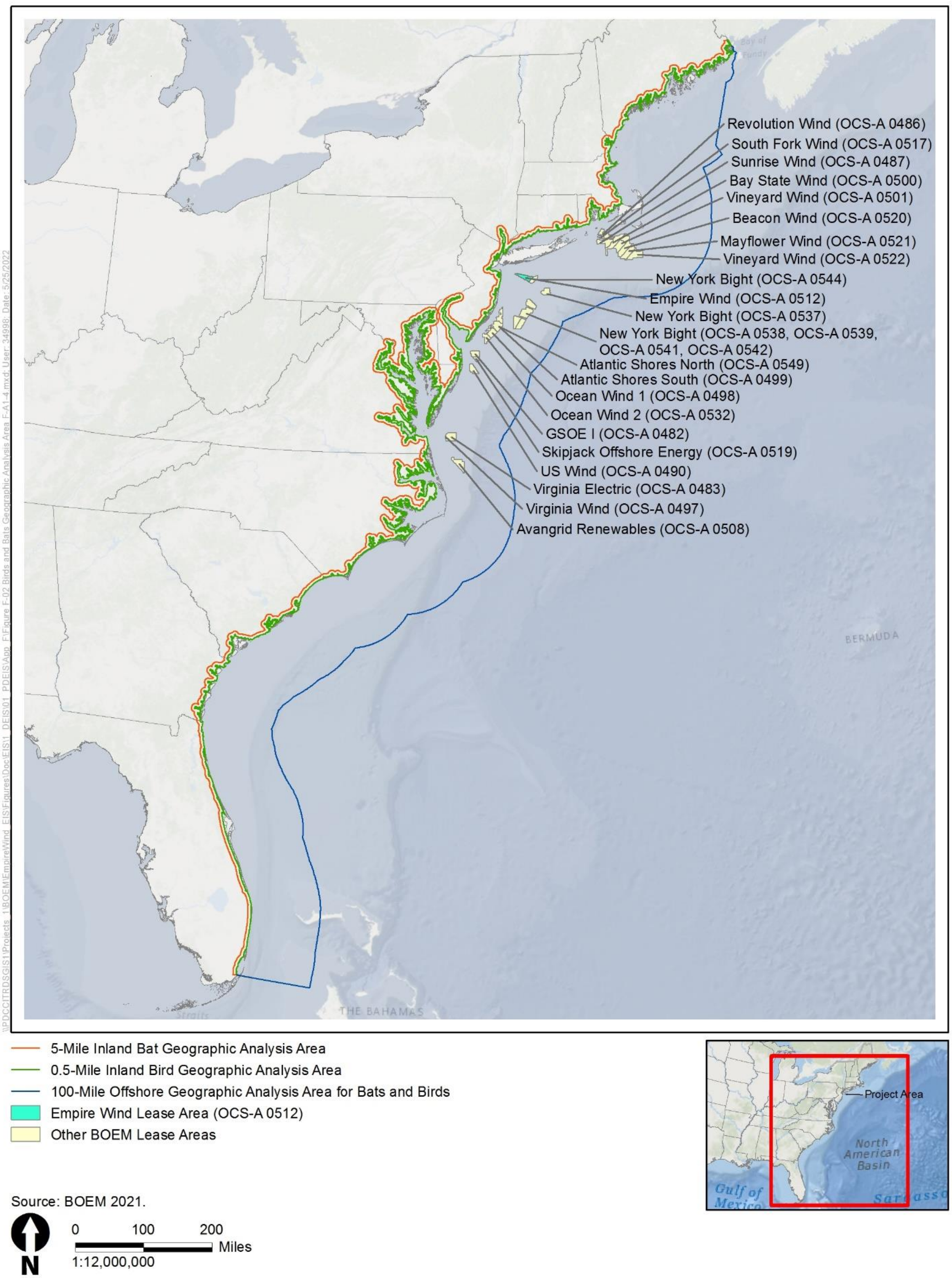

Figure 3.5-1 Bats Geographic Analysis Area

Tree bats migrate south to overwinter and have been documented in the offshore environment (Empire 2022 citing Hatch et al. 2013). Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, with one bat tracked as far south as Maryland (Empire 2022 citing Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore and recent acoustic and survey results (Empire 2022 citing Hatch et al. 2013; Empire 2022 citing Peterson et al. 2014; Empire 2022 citing Sjollema et al. 2014). While little local data are available for the Project area, recent offshore acoustic surveys recorded bats within the Lease Area, with observations primarily composed of eastern red bats and silver-haired bats, concentrated during fall migration. Big brown bats were documented infrequently in the Lease Area, and hoary bats were also detected in the offshore environment, but closer to shore and not within the Lease Area. NYSERDA remote metocean data from buoys 29 miles southeast and 45 miles south-southeast of the Lease Area, respectively, detected a total of nine silver-haired bats and one unknown low-frequency bat between September 2019 and February 2022 (NYSERDA 2022). The closest buoy detected three bats in September/October 2019 and no bats for the remaining years. The other buoy detected three bats in September 2019, one bat in August 2020, and two bats in October 2020; no bats were detected in the remaining time frame. These data suggest that some tree bats are most likely to pass through the Lease Area, mainly red and silver-haired bats during the migration period (late summer/early fall) (COP Volume 3, Appendix R; Empire 2022).

Onshore coastal areas throughout the geographic analysis area provide a variety of habitats that support a diversity of bat species. The EW 1 onshore substation site and O&M facility consist primarily of highly urbanized environments and existing infrastructure with few natural habitat areas. Because the EW 1 area is highly urbanized, it is not expected to provide bat habitat. The proposed onshore export cable routes and onshore substation sites for EW 2 occur in a highly developed area bordered by commercial and residential developments. A portion of the EW 2 Onshore Substation C site is characterized by an area with trees and shrubs, which may support bats for foraging and roosting during summer, but this area is not expected to be important habitat for any species and is completely isolated by surrounding developments. The EW 2 Onshore Substation A site is previously developed and currently supports a recycling facility.

Three isolated areas along onshore export cable route segment IP-C between Long Beach Road and Daly Boulevard consist of scrub-shrub habitat with some scattered trees/woody vegetation, but are unlikely to provide important bat habitat. Forested habitats can provide roosting areas for both migratory and non-migratory species. All bat species present in New York are known to utilize forested areas of varying types during summer for roosting and foraging. Some of these species roost solely in the foliage of trees, while others select dead and dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats (Empire 2022 citing Barbour and Davis 1969). None of the bat species that occur in New York are likely to use the urbanized, developed areas within the onshore portions of the Project area. However, there is some likelihood that they could utilize the treed areas for foraging and roosting and open water areas for foraging at EW 2 during the bat active period (generally April to October).

Hibernacula are documented in New York, but the numbers of individuals at the sites have declined dramatically because of the fungal disease white-nose syndrome (WNS) (Empire 2022 citing Ingersoll et al. 2016; Empire 2022 citing NJ Division of Fish and Wildlife 2017). Since 2011, WNS has substantially reduced *Myotis* bat populations in New York (Empire 2022 citing NJ Division of Fish and Wildlife 2017). The nearest known hibernaculum to the EW 2 onshore export and interconnection cable corridor occurs approximately 75 miles (120 kilometers) to the east, in the town of East Hampton. Overall, none of potentially suitable summer habitat in the EW 2 area would be reasonably considered optimal habitat given the lack of connectivity with contiguous forest and forested wetland habitats. Therefore, the presence of both cave-hibernating and migratory tree bats that may occur in areas around EW 2 is expected to be minimal.

One bat species protected under the ESA may occur or potentially occur in the Project area: the northern long-eared bat (USFWS 2021a). Northern long-eared bats are not expected to be exposed to the Wind Farm Development Area. This is substantiated by a tracking study on Martha's Vineyard (n = 8; July–October 2016) where no offshore movements were recorded (Empire 2022 citing Dowling et al. 2017) and by the 2018 acoustic data collected within the Lease Area (Empire 2022 citing Tetra Tech 2019). Because research on the movements of these bats in the marine environment is limited, there remains uncertainty as to whether this species travels offshore. If northern long-eared bats were to migrate over water, movements would likely be in close proximity to the mainland.

The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bats may likewise migrate to mainland hibernacula from these islands in August through September (Empire 2022 citing Dowling et al. 2017). In addition, while in a different area, the Vineyard Wind 1 BA concluded that "it is extremely unlikely northern long-eared bats would traverse offshore portions" of that project (Empire 2022 citing BOEM 2019). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the Wind Farm Development Area is anticipated to be minimal. None of the potentially suitable summer habitat in the EW 2 area would be reasonably considered optimal habitat for any bat species given the lack of connectivity with contiguous forest or forested wetland habitats. Maternity roosts, active detections (mist net captures and acoustic recordings), and hibernacula have been reported for northern long-eared bats in several areas of Long Island (particularly in the eastern portion), suggesting a year-round presence of northern long-eared bat. Although northern long-eared bat presence has been detected within approximately 19 miles (30 kilometers) of the EW 2 onshore substation sites, no detections have been reported within the Onshore Project area. The Empire Wind BA will provide a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Projects. Results of ESA consultation with USFWS will be included in the Final EIS.

Cave bat species, including the northern long-eared bat, are experiencing drastic declines due to WNS. WNS has been confirmed present in every state in the geographic analysis area, except Florida (Whitenosesyndrome.org 2021). WNS was confirmed present in New York in 2006 and has killed large numbers of cave bats during hibernation—more than 90 percent at many sites (Whitenosesyndrome.org 2021). Proposed Project-related impacts have the potential to affect cave bat populations already affected by WNS. The unprecedented mortality of more than 5.5 million bats in northeastern North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the proposed Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the proposed Projects, if any, may be increased.

3.5.2 Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-2. There are no beneficial impacts on bats.

Table 3.5-2 Impact Level Definitions for Bats

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
Moderate	Adverse	Impacts are unavoidable but would not result in population-level effects or threaten overall habitat function.

Impact Level	Impact Type	Definition
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.

3.5.3 Impacts of the No Action Alternative on Bats

When analyzing the impacts of the No Action Alternative on bats, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for bats. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.5.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1, *Description of the Affected Environment for Bats*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on bats include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance described in detail in Section 3.5.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.5.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect bats include new submarine cables and pipelines, oil and gas activities, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section F.2 in Appendix F for a complete description of planned activities). These activities may result in temporary or permanent displacement and injury or mortality to individual bats, but population-level effects would not be expected. See Table F1-2 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for bats.

BOEM expects planned offshore wind activities to affect bats through the following primary IPFs.

Noise: Anthropogenic noise on the OCS associated with planned offshore wind development, including noise from pile-driving and construction activities, has the potential to affect bats on the OCS. Additionally, onshore construction noise has the potential to affect bats. BOEM anticipates that these impacts would be temporary and highly localized.

In the planned activities scenario (Appendix F, *Planned Activities Scenario*), the construction of 2,803 WTGs and 66 OSS would create noise and may temporarily affect some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over an 8-year period. Construction activity would be temporary and highly localized. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as use of the OCS by bats is limited, and only during spring and fall migration.

Some potential for temporary, localized habitat impacts arising from onshore construction noise exists; however, no auditory impacts on bats would be expected to occur. Recent literature suggests that bats are less susceptible to temporary or permanent hearing loss from exposure to intense sounds (Simmons et al. 2016). Nighttime work may be required on an as-needed basis. Some temporary displacement or avoidance of potentially suitable foraging habitat could occur, but these impacts would not be expected to be biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

Non-routine activities associated with the offshore wind facilities would generally require intense, temporary activity to address emergency conditions. The noise made by onshore construction equipment or offshore repair vessels could temporarily deter bats from approaching the site of a given non-routine event. Impacts on bats, if any, would be temporary and last only as long as repair or remediation activities were necessary to address these non-routine events.

Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore or offshore noise associated with planned offshore wind development.

Presence of structures: Planned offshore wind-related activities would add up to 2,803 WTGs and 66 OSS to the geographic analysis area and the presence of these structures could result in potential long-term effects on bats. Cave bats (including the federally listed as threatened northern long-eared bat) do not tend to fly offshore (even during fall migration) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor-swept zone (RSZ) of operating WTGs in the offshore wind lease areas, is expected to be negligible, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013).

Tree bats, however, may pass through the offshore wind lease areas during the fall migration, with limited potential for migrating bats to encounter vessels during construction and decommissioning of WTGs, OSS, and offshore export cable corridors, although structure and vessel lights may attract bats due to increased prey abundance. As discussed above, while bats have been documented at offshore islands, relatively little bat activity has been documented in open water habitat. Several authors, such as Cryan and Barclay (2009), Cryan et al. (2014), and Kunz et al. (2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007).

Other hypotheses associated with the Atlantic OCS regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to EMF or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why, if at all, bats are attracted to WTGs; it is possible that some bats may encounter, or perhaps be attracted to, OSS and non-operational WTG towers to opportunistically roost or forage. Bats' echolocation abilities and agility make it unlikely that these stationary objects (OSS and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is relatively very low (Stantec 2016). Unlike with terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the offshore wind lease areas. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with planned offshore wind development. With the proposed 0.6 to 1-nm (1.9-kilometer) spacing between many structures associated with planned offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of project WTGs would likely pass through projects with only slight course corrections, if any, to avoid operating WTGs because, unlike with terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to offshore wind lease areas on the OCS.

The potential collision risk to migrating tree bats is associated with weather conditions; specifically, bat activity is associated with relatively low wind speeds and warm temperatures (Arnett et al. 2008; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005). Given the rarity of tree bats in the offshore environment, the WTGs being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bat activity is low during periods of strong winds, low temperatures, and rain (Arnett et al. 2008; Erickson et al. 2002).

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 8 years to connect planned offshore wind energy projects to the electrical grid. Typically, this would require only small amounts of habitat removal, if any, and would occur in previously disturbed areas. Short-term and long-term impacts associated with habitat loss or avoidance during construction may occur, but no injury or mortality of individuals would be expected. As such, onshore construction activities associated with planned offshore wind development would not be expected to appreciably contribute to cumulative impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from planned offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand.

3.5.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats primarily through the onshore construction impacts, the presence of structures, and climate change. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, ongoing offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **negligible** impacts on bats.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and bats would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on bats due to habitat loss from increased onshore construction. BOEM anticipates cumulative impacts of the No Action Alternative would likely be **negligible** because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.

3.5.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on bats:

- The onshore export cable routes, including routing variants, and extent of ground disturbance for new onshore substations, which could require the removal of trees suitable for roosting and foraging;
- The number, size, and location of WTGs; and
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG number, size, and location: The level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Onshore export cable routes and substation footprints: The route chosen (including variants within the general route) and substation footprints would determine the amount of habitat affected.

- Season of construction: The active season for bats in this area is from April through October. Construction outside of this window would have a lesser impact on bats than construction during the active season.

3.5.5 Impacts of the Proposed Action on Bats

The sections below summarize the potential impacts of the Proposed Action on bats during the various phases of the proposed Projects. Routine activities would include construction, O&M, and decommissioning of the proposed Projects, as described in Chapter 2, *Alternatives Including the Proposed Action*. BOEM will prepare a BA for the potential effects on USFWS federally listed species. The results of consultation with USFWS pursuant to Section 7 of the ESA will be included in the Final EIS.

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action is expected to result in temporary and highly localized impacts. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Presence of structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes, are described in detail in Section 3.5.3.2. The Proposed Action would add up to 147 WTGs and two OSS to the Lease Area where none currently exist. The structures associated with Proposed Action would remain until decommissioning of the proposed Projects is complete and could pose long-term effects on bats.

At this time, there is some uncertainty regarding the level of bat use of the OCS and the ultimate consequences of mortality, if any, associated with operating WTGs. Migratory tree bats have the potential to pass through the Lease Area, but overall a small number of bats is expected in the Lease Area given its distance from shore (Empire 2022 citing BOEM 2014). While there is evidence of bats visiting WTGs close to shore (2.5–4.3 miles [4–7 kilometers]) in the Baltic Sea (enclosed by land) (Empire 2022 citing Ahlén et al. 2009; Empire 2022 citing Rydell and Wickman 2015) and bats are demonstrated to be vulnerable to collisions, the individual bats entering the Lease Area and vulnerable to collision are expected to occur in low numbers, except possibly during late summer/fall migration.

Recent data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats and only during fall, and no northern long-eared bats (Stantec Consulting Services 2020). Empire would implement measures to avoid and minimize bat impacts, including implementing a monitoring program (COP Volume 2f, Table 9-1, APM 86; Empire 2022) and reporting dead and injured bats (APM 83) to further understand the long-term effects of structures. In addition, Empire has committed to implementing a *Bird and Bat Monitoring Framework* that outlines an approach to post-construction bat monitoring that supports advancement of the understanding of bat interactions with offshore wind farms (Appendix H, Attachment H-3). Therefore, population-level impacts are unlikely given what appear to be high numbers of these species in the region relative to the low numbers likely to be affected by Project operations and the measures that would be implemented by Empire to avoid and minimize bat impacts.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. The primary potential effect on bats from the Projects' onshore components is localized and minor habitat modification. The majority of the proposed onshore export and interconnection cable routes are in already-disturbed urban areas (e.g., roadways). No tree clearing is anticipated to be required at the EW 1 onshore substation site, the EW 2 Onshore Substation A site, or the O&M facility. If tree cutting along the route is required, particularly in the three isolated areas along segment IP-C between Long Beach Road and Daly Boulevard, it would be a long-term impact but is not expected to cause loss of important habitat. Similarly, some of the scattered trees at the EW 2 Onshore Station C site could be cut, but this is not expected to cause a loss of important habitat. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Projects' operational lifetime, which would be considered a long-term effect. Overall, habitat loss would be limited, and any potential effects would be indirect and unlikely to affect individual or population levels of bat species.

New York State restricts tree clearing between March through November on Long Island; however, as the northern long-eared bat has not been documented at the EW 2 onshore substation sites, Empire intends to work with the applicable agencies to minimize this restriction, as appropriate. Furthermore, Empire would implement measures to avoid and minimize bat impacts, including time of year clearing restrictions (COP Volume 2f, Table 9-1, APMs 77, 78, 79; Empire 2022), siting onshore Project components in disturbed areas as much as practicable (APM 76), and revegetating disturbed areas (APM 87). With the lack of suitable habitat in most of the onshore area and with Empire's commitment to implement measures to avoid and minimize bat impacts, BOEM anticipates that land disturbance would not result in individual fitness or population-level effects on bats.

Empire could leave some onshore facilities in place for future use (see COP Volume 1, Section 3.6, *Decommissioning Activities*; Empire 2022). Disturbance to the land surface or terrestrial habitat during the course of Proposed Action decommissioning would be minimal, such as disconnecting and cutting buried cables at the fence site below ground (and retiring cable in place). Therefore, onshore temporary impacts of decommissioning would be negligible.

3.5.5.1. Impact of the Connected Action

As described in Chapter 2, infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders), as well as some upland activities (building construction and paving). BOEM expects the connected action to affect bats through the noise IPF. Because there is no bat habitat in the vicinity of the SBMT, land disturbance and presence of structures IPFs would not pose a risk to bats.

Noise: As stated for the Proposed Action, pile-driving noise and onshore construction noise alone is expected to be temporary and highly localized. However, because there is no bat habitat in the area of the SBMT due the highly developed nature of the area, noise impacts on bats are not anticipated. Even if a bat were flying within a distance of the SBMT where construction noise could be detected above ambient urban noise conditions, auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

3.5.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to submarine cables and pipelines, oil and gas activities, marine minerals extraction, onshore development, and port expansions would contribute to impacts on bats through the primary IPFs of noise, presence of structures, and land disturbance. Construction related to the connected action would generate temporary and localized noise impacts on bats. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of noise, presence of structures, and land disturbance. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of onshore habitat may occur as a result of constructing onshore infrastructure such as onshore substations and onshore export cables for offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,031 WTGs, of which the Proposed Action would contribute 147 or about 5 percent.

The cumulative impacts on bats would likely be negligible because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative noise, presence of structures, and land disturbance impacts on bats.

3.5.5.3. Conclusions

Impacts of the Proposed Action. Construction and decommissioning of the Proposed Action would have **negligible** impacts on bats, especially if conducted outside the active season. The main significant risk would be from operation of the offshore WTGs and potential onshore removal of habitat, which could lead to negligible long-term impacts in the form of mortality, although BOEM anticipates this to be rare. Noise effects from construction are expected to be limited to temporary and localized behavioral avoidance that would cease once construction is complete. Similarly, the connected action is anticipated to have **negligible** impacts on bats with the potential for temporary and localized noise impacts during construction.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on bats in the geographic analysis area would be **negligible**. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on bats would be undetectable. Because the occurrence of bats offshore is low, the Proposed Action would contribute to the cumulative impacts primarily through the long-term impacts from onshore habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three isolated habitat areas.

3.5.6 Impacts of Alternatives B, E, and F on Bats

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire’s PDE. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternatives B, E, and F would be the same as those described under the Proposed Action because the same number of WTGs would be constructed throughout the Lease Area. While the WTGs may move to a different position in the Lease Area under Alternatives B, E, and F, impacts on bats would not materially change compared to the Proposed Action. All other offshore and onshore Project components of Alternatives B, E, and F would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. The cumulative impacts on bats would likely be negligible for the same reasons described for the Proposed Action (i.e., bat presence offshore is low and onshore habitat loss would be minimal). In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on bats would be the same as those of the Proposed Action.

3.5.6.1. Conclusions

Impacts of Alternatives B, E, and F. As discussed above, the expected **negligible** impacts associated with the Proposed Action would not change under Alternative B, E, or F.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B, E, or F to the cumulative impacts on bats would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives B, E, and F, BOEM anticipates that the cumulative impacts of Alternatives B, E, and F would be the same as described for the Proposed Action: **negligible**. Like the Proposed Action, because the occurrence of bats offshore is low, Alternatives B, E, and F would contribute to the overall impact rating primarily through the long-term impacts from onshore habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three small, isolated habitat areas.

3.5.7 Impacts of Alternative C, D, and G on Bats

Impacts of Alternatives C, D, and G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, or G would be the same those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), to avoid the sand borrow area (Alternative D), or to use a cable bridge to cross Barnums Channel (Alternative G) are already covered under the Proposed Action as part of the PDE approach, and narrowing the submarine and onshore cable route options under Alternative C, D, or G would not materially change the analyses of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. The cumulative impacts on bats would likely be negligible because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C, D, or G to the cumulative impacts on bats would be the same as those of the Proposed Action.

3.5.7.1. Conclusions

Impacts of Alternatives C, D, and G. As discussed above, the expected **negligible** impacts associated with the Proposed Action would not change under Alternative C, D, or G.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C, D, or G to the cumulative impacts on bats would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives C, D, and G, BOEM anticipates that the cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action: **negligible**. Like the Proposed Action, because the occurrence of bats offshore is low, Alternatives C, D, and G would contribute to the cumulative impact rating primarily through the long-term impacts from onshore habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three small, isolated habitat areas.

3.5.8 Impacts of Alternative H on Bats

Impacts of Alternative H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be the same those described under the Proposed Action. An alternate method of dredge and fill activity at the SBMT would not materially change the analysis of any IPF, as the Onshore Project area is heavily developed with no natural bat habitat. BOEM does not anticipate that any change in dredge and fill activity would affect undisturbed or natural areas. All other offshore and onshore Project components of Alternative H would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. The cumulative impacts on bats would likely be negligible because the occurrence of bats offshore is low, and onshore habitat loss is expected to be minimal. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to cumulative impacts would be the same as described under the Proposed Action.

3.5.8.1. Conclusions

Impacts of Alternative H. As discussed above, the expected **negligible** impacts associated with the Proposed Action would not change under Alternative H.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to cumulative impacts on bats would be undetectable. Because the impacts of the Proposed Action would not change under Alternative H, BOEM anticipates that the cumulative impacts of Alternative H would be the same as described for the Proposed Action: **negligible**. Like the Proposed Action, because the occurrence of bats offshore is low, Alternative H would contribute to the cumulative impact rating primarily through the long-term impacts from onshore habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three small, isolated habitat areas.

3.5.9 Proposed Mitigation Measures

If the reported post-construction bat monitoring results (generated as part of Empire's *Bird and Bat Monitoring Framework* [Appendix H, Attachment H-3]) indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Empire must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-1).

BOEM has also proposed annual mortality reporting to minimize impacts on birds and bats (refer to Appendix H, Table H-1). As part of this measure, the lessee would prepare and submit annual reports to BOEM, USFWS, and BSEE documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The lessee would report carcasses with federal or research bands to the United States Geological Survey Bird Band Laboratory. The lessee would report occurrences of dead ESA birds or bats to BOEM, USFWS, and BSEE within 24 hours of the sighting and, if practicable, carefully collect the dead specimen and preserve the material in the best possible state.

3.5.10 Comparison of Alternatives

Alternatives B, E, and F would have the same number of WTGs as the Proposed Action, which would result in the same impacts on bats; the overall impact level would not change—**negligible**.

Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level on bats would not change—**negligible**.

Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is heavily developed with no bat habitat. Therefore, the overall impact level on bats would not change—**negligible**.

In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives B, C, D, E, F, G, and H when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action—**negligible**.

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3.7. Birds

This section discusses potential impacts on bird resources from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area for birds. The geographic analysis area for birds, as shown on Figure 3.7-1, includes the United States coastline from Maine to Florida; the offshore limit is 100 miles (161 kilometers) from the Atlantic shore and the onshore limit is 0.5 mile (0.8 kilometer) inland.

3.7.1 Description of the Affected Environment for Birds

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the proposed Project area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall or spring migration. Detailed information regarding habitats and bird species potentially present can be found in the COP Volume 2, Section 5.3, Appendix P, and Appendix Q (Empire 2022). Given the differences in life history characteristics and habitat use between offshore and onshore birds, the sections below provide a discussion of each group. This section also discusses bald and golden eagles. This section addresses federally listed threatened and endangered birds; BOEM will also prepare a BA for the USFWS to analyze the effects of the Projects on these species per ESA Section 7 requirements. Results of ESA consultation with USFWS will be included in the Final EIS.

The Mid-Atlantic Coast plays an important role in the ecology of many bird species. The Atlantic Flyway is one of four major North American north-south migration routes for many species of seabirds, shorebirds, waterfowl, raptors, and songbirds. The Atlantic Flyway is 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. 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 seaducks). Chapter 4.2.4 of the Atlantic OCS Proposed Geological and Geophysical Activities Programmatic EIS (BOEM 2014a) discusses the use of Atlantic Coast habitats by migrating birds.

Birds in the geographic analysis area are subject to pressure from ongoing activities, such as onshore construction, marine minerals extraction, port expansions, and installation of new structures in the OCS, but particularly from accidental releases; new cable, transmission line, and pipeline emplacement; interactions with fisheries and fishing gear; and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). BOEM assumes that the North American Bird Conservation Initiative's (NABCI) 2016 estimate is true for the condition of birds in the geographic analysis area. This is likely representative of the conditions of birds within the geographic analysis area. The Northeastern United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (approximately 86,000 seaducks harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds are killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]; recent estimates for long lines is 3,066 [Bi et al. 2021]), and climate change, which have the potential to have adverse impacts on bird species.

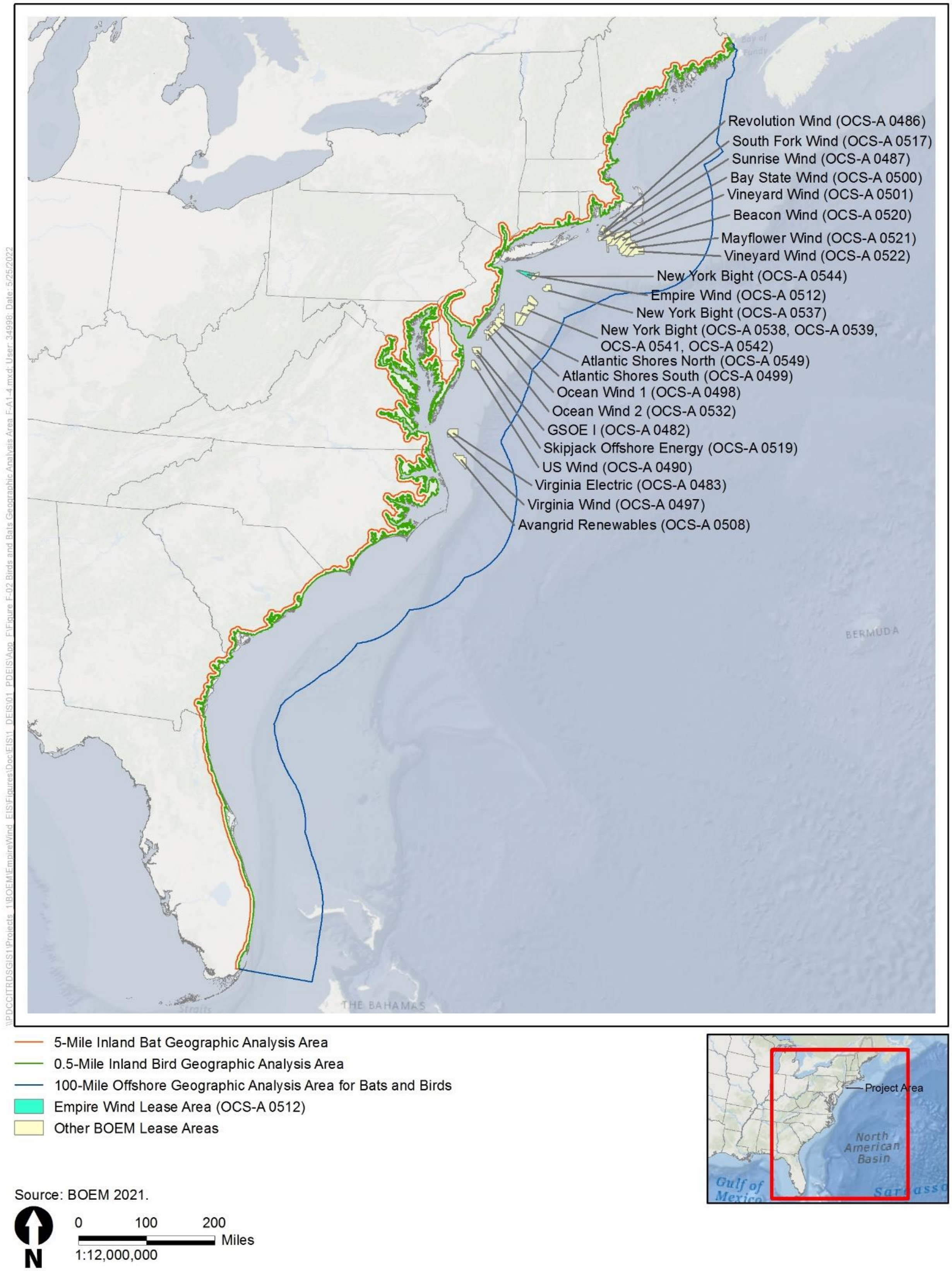

Figure 3.7-1 Birds Geographic Analysis Area

According to NABCI, more than half of the offshore Atlantic bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats. This watch list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Atlantic OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Birds that nest in coastal marshes and other low-elevation habitats are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size or restricted distributions, making them especially vulnerable to habitat loss or degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout New York, 48 percent of New York’s 280 bird species are vulnerable to climate change across all seasons (Audubon 2019), some of which occur in the geographic analysis area. A rapidly changing climate could lead to population declines if species are not able to adapt. In addition, the reshuffling of bird communities at a continental scale will bring together species that previously lived in isolation, leading to unpredictable interactions. Disruptions in food and nesting resources would further compound vulnerabilities to climate change. These ongoing impacts on birds would continue regardless of the offshore wind industry.

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 seaducks). The Lease Area is within the New York Bight, which is part of the larger Mid-Atlantic Bight. The Mid-Atlantic Bight supports a high diversity of marine birds and is an ecologically important area for birds due to its central location in a major migratory flyway. Approximately 61 bird species have been identified as occurring in the Offshore Project area through public databases and Project-associated baseline studies (see Table 2-9 in COP Appendix Q; Empire 2022). Of these 61 species, four are state-listed as threatened or endangered (black tern, least tern, common tern, roseate tern) and one is federally listed as endangered (roseate tern). Two additional federally and state-listed birds have the potential to occur in the Offshore Project area: the piping plover (state listed as endangered, federally listed as threatened) and red knot (state- and federally listed as threatened).

The Lease Area is within the Atlantic Flyway, which, as mentioned above, is one of four major North American north-south migration routes for many species of seabirds, shorebirds, waterfowl, raptors, and songbirds. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and seaducks), taking them directly through the New York Bight region in spring and fall.

The New York Bight 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, migrate 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, while species that breed farther north migrate south and spend 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 (Empire 2022).

Table 3.7-1 briefly summarizes the bird presence in the Offshore Project area by bird group based on information in the *Avian Impact Assessment* conducted for the Projects (see COP Appendix Q; Empire

2022). The table breaks down birds into six groups—shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds—that coincide with the *Avian Impact Assessment* bird groupings. Marine birds are further broken down by family group. The *Avian Impact Assessment* evaluates baseline conditions for birds in the onshore and offshore portions of the Projects by documenting which species are likely to occur in the Project area, based on the best available data. It then evaluates the risk of the impact of Project construction, operations, and decommissioning activities on those species likely to occur based on their habitat requirements, behavior, seasonal use of the Project area, and potential sensitivity to each Project activity. Additional Project-specific bird survey information, which is incorporated into the *Avian Impact Assessment*, can be found in the *Ornithological and Marine Fauna Aerial Survey* conducted for the Projects (COP Appendix P; Empire 2022).

Table 3.7-1 Bird Presence in the Offshore Project Area by Bird Group

Bird Group	Potential Bird Presence in Offshore Project Area
Shorebirds	Shorebirds (e.g., black-bellied plover, semipalmated plover) are typically coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Of the shorebirds that range into and migrate through the Offshore Project area, only red phalarope and red-necked phalarope are generally considered marine species, meaning that they swim and forage in offshore marine waters. Red phalaropes are also known to regularly winter in Atlantic waters just south of the Offshore Project area. Primarily, exposure of shorebirds to the offshore infrastructure would be limited to the spring and fall migration periods
Wading Birds	Most long-legged wading birds, such as herons and egrets, breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are believed to avoid straying out over deep waters (Kushlan and Hafner 2000), but may traverse the Lease Area during spring and fall migration periods. The USFWS IPaC database does not indicate any wading birds in the Lease Area or adjacent waters that are identified as vulnerable or Birds of Conservation Concern, and digital aerial surveys and site-specific surveys conducted by Empire (see COP Appendix P) showed no wading birds within the Lease Area (see maps in COP Appendix Q).
Raptors	The degree to which raptors might occur offshore is dictated primarily by their morphology and flight strategy (i.e., flapping versus soaring), which influences species' ability or willingness to cross large expanses of open water where thermal formation is poor (Kerlinger 1985). Among raptors, falcons are the most likely to be encountered in offshore settings along the Atlantic flyway (Cochran 1985; DeSorbo et al. 2012, 2018). Merlins are the most abundant diurnal raptor observed at offshore islands during migration. Both have been observed offshore on vessels and offshore oil platforms considerable distances from shore. Therefore, these raptors are considered to be the most likely to pass through the Lease Area during migration.

Bird Group	Potential Bird Presence in Offshore Project Area
Songbirds	Songbirds (e.g., warblers, sparrows) almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Many North American breeding songbirds migrate to the tropical regions, many in flocks. On their migrations, neotropical migrants generally travel at night and at high altitudes where favorable winds can aid them along their trip. Songbirds regularly cross large bodies of water (Bruderer and Lietchi 1999; Gauthreaux and Belser 1999), and there is some evidence that species migrate over the northern Atlantic (Adams et al. 2015). Some birds may briefly fly over the water while others, like the blackpoll warbler, are known to 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), when the frequency of overwater flights increases perhaps due to consistent tailwinds (Morris et al. 1994; Hatch et al. 2013; Adams et al. 2015; DeLuca et al. 2015). Based on the *Avian Impact Assessment* for the Projects (COP Appendix Q), the exposure of songbirds to the Lease Area would be minimal to low and limited to the months of migration.
Coastal Waterbirds	Coastal waterbirds use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. This group includes aquatic species not captured in other groupings, such as grebes and waterfowl, that are generally restricted to freshwater or use saltmarshes or beaches. Waterfowl comprise a broad group of geese and ducks, most of which spend much of the year in terrestrial or coastal wetland habitats. 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. Because most coastal waterbirds spend a majority of the year in freshwater aquatic systems and nearshore marine systems, there is little to no use of the Lease Area during any season. A subset of diving ducks has a strong affinity for saltwater, either year-round or outside of the breeding season; these species are known as seaducks. Seaducks are discussed below in the marine bird section.
Marine Birds (by family group)	
Loons	Common loons and red-throated loons are known to use the Atlantic OCS in winter. Analysis of satellite-tracked red-throated loons, captured and tagged in the Mid-Atlantic area, found their winter distributions to be largely inshore of the Mid-Atlantic WEAs, although they did overlap with the Lease Area during spring migration (Gray et al. 2016). The digital aerial surveys and MDAT models show lower use of the Lease Area by loons in the summer than in other seasons.
Seaducks	The seaducks (e.g., black scoter, surf scoter, common eider) use the Atlantic OCS heavily in winter. Most of these seaducks dive to forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. Seaducks tracked with satellite transmitters remained largely inshore of the Lease Area, with exception of surf scoter and black scoter during spring migration (Spiegel et al. 2017). Based on the *Avian Impact Assessment* (COP Appendix Q), including digital aerial survey data and MDAT models, seaduck exposure to the Projects is expected to be minimal and would be primarily limited to migration or travel between wintering sites.

Bird Group	Potential Bird Presence in Offshore Project Area
Petrel group	In the Atlantic, this group consists mostly of shearwaters (e.g., Cory's shearwater, great shearwater, sooty shearwater) and storm-petrels (e.g., leach's storm-petrel, Wilson's storm-petrel) that breed in the southern hemisphere and visit the northern hemisphere in vast numbers during the austral winter (boreal summer) and may pass through the Lease Area. These species use the Atlantic OCS region so heavily that, in terms of sheer numbers, they easily outnumber the locally breeding species and year-round residents at this time of year. Several of the species (e.g., Cory's shearwater, Wilson's storm-petrel) are found in high densities across the broader region, concentrating beyond the Atlantic OCS and in the Gulf of Maine as shown in the MDAT avian abundance models.
Gannets, Cormorants, and Pelicans	Northern gannets use the Atlantic OCS during winter and migration. They are opportunistic foragers, capable of long-distance oceanic movements, and may pass through the Lease Area regularly during the non-breeding period. The double-crested cormorant is the most likely species of cormorant exposed to the Lease Area, but regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered well offshore (Curtice et al. 2016; Winship et al. 2018), and few cormorants were observed during digital aerial surveys. Brown pelicans are rare in the area, as only one was detected during project-specific surveys (COP Appendix P) and New Jersey is at the northern extent of its range; therefore, they are unlikely to pass through the Lease Area in any numbers.
Gulls, skuas, and jaegers	14 species of gulls, skuas, and jaegers were observed in digital aerial surveys in the Lease Area (COP Appendices P and Q). The regional MDAT abundance models show that these birds have wide distributions, 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 farther offshore during the non-breeding season. The parasitic jaeger is often observed closer to shore during migration than the other species and great skuas may migrate along the Atlantic OCS outside the breeding season.
Terns	During Project-specific surveys (COP Appendix P), Black tern, least tern, common tern, Forster's tern, roseate tern, and royal tern have been observed in the Lease Area; least tern, common tern, and unidentified tern were identified with in 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. Roseate terns are federally listed.
Auks	Auk species present in the Project area are generally northern or Arctic-breeders that winter along the Atlantic OCS (e.g., common murre, dovekie, razorbill). 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. The MDAT abundance models show that during winter auks are generally concentrated offshore, along the shelf edge, and southwest of Nova Scotia.

Sources: Empire 2022; USFWS 2021a.
IPaC = Information for Planning and Consultation; MDAT = Marine-life Data and Analysis Team

Habitats within and in the vicinity of the EW 1 Onshore Project area are significantly altered by human development and are primarily used for industrial and commercial operations (see Figure 5.3-5 in COP Volume 2b, *Biological Resources*; Empire 2022). The EW 1 area and surrounding vicinity serve as a transportation and service corridor and associated infrastructure is a dominant feature. The SBMT is dominated by a paved lot and warehouse buildings, with over 95 percent impervious surfaces; vegetation is limited to volunteer invasives and a line of poplar trees on the north side of the 35th Street Pier

(AECOM 2022). Due to the mobility of birds, a variety of species have the potential to pass through the EW 1 Onshore Project area. However, due to the highly developed nature of the EW 1 Onshore Project 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, European starlings). A bird survey conducted from August to October 2020 identified approximately 50 bird species in and around the SBMT, none of which were federally listed threatened or endangered species (AECOM 2022). A low number of four state special status birds were observed, including common tern (state-listed as threatened), osprey (state species of special concern), American black duck (high-priority species), and peregrine falcon (state-listed as endangered). Overall, the Onshore Project area has low value to these species due to the low resource levels, high levels of disturbance, and overall low-quality habitat for nesting, roosting, and foraging (AECOM 2022). The nearest Audubon Important Bird Area (IBA) is approximately 1.5 miles (2.4 kilometers) 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 (see Figure 5.3-5 in COP Volume 2b, *Biological Resources*; Empire 2022). The complete list of birds identified within 15 kilometers of the EW 1 onshore site is found in COP Appendix Q, Table 3-7 (Empire 2022).

Habitats within and in the vicinity of the EW 2 Onshore Project area are significantly altered by human development (see Figure 5.3-6 in COP Volume 2b, *Biological Resources*; Empire 2022). 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. EW 2 Onshore Substation C is composed of several active commercial properties with approximately 70 percent of the site devoid of vegetation and includes commercial buildings, supporting ancillary appurtenances, roads, and gravel parking areas. The remaining 30 percent of the site consists of vegetated perimeters (some trees and shrubs) of parking lots and an approximately 1-acre area that has been routinely disturbed with land clearing and soil disturbance. The undeveloped areas of the EW 2 Onshore Substation C site may have the potential to provide some habitat for certain urban bird species, but this area is not expected to be important habitat for any species and is completely isolated by surrounding developments. The EW 2 Onshore Substation A site is previously developed and currently supports a recycling facility. There is some beach and dune habitat along shoreline that is developed for tourism and recreational use. Long Beach is sandy with no vegetation and could provide foraging habitat for common marine bird species (e.g., gulls), while Lido Beach includes vegetated dunes that provide nesting habitat to various coastal nesting species. The landfall sites are in a paved parking area site, directly adjacent to commercial areas and existing roadways. The EW 2 Onshore Project area is surrounded by the West Hempstead Bay/Jones Beach West IBA (a global IBA), which includes most of the beach areas and inland waterways around the EW 2 Onshore Project area (see Figure 3-2 in COP Appendix Q; Empire 2022). This IBA has over 60 recorded species known to occur, with known breeding of the piping plover and short-eared owl. Outside of the beach areas, the IBA does not include the islands of Long Beach and Island Park, however. Because the EW 2 Onshore Project area is highly developed, the birds most likely to be present in the EW 2 Onshore Project area are common coastal, urban (some introduced), and upland species. The birds most likely to be exposed to the Project activities at EW 2 Landfall A, EW 2 Landfall B, and EW 2 Landfall E sites include gulls, geese, dabbling ducks, and cormorants, while some coastal nesting species may be exposed at the EW 2 Landfall C site. Upland species are likely to include European starling, house sparrow, song sparrow, and mockingbird.

The complete list of birds identified within 15 kilometers of the EW 2 Onshore Project area is found in COP Appendix Q, Table 3-7 (Empire 2022) and includes 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. In the eBird database there are 23 species listed as high-priority Species of

Greatest Conservation Need (SGCN),[1] five of which are state-listed: piping plover (also federally listed), black tern, roseate tern (also federally listed), peregrine falcon, and short-eared owl. The two state-listed birds that utilize 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 in an urban developed area. It is possible that the coastal species (e.g., terns, warblers, sparrows) may pass through the beach areas at the export cable landfall site during migration (Empire 2022).

Bald eagles (*Haliaeetus leucocephalus*), which are listed as endangered (breeding) and threatened (non-breeding) in New Jersey and threatened in New York, are federally protected by the Bald and Golden Eagle Protection Act, 16 USC 668 et seq., as are golden eagles (*Aquila chrysaetos*). Bald eagles are broadly distributed across North America and generally nest and perch in areas associated with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining largely within roughly 1,640 feet of the shoreline (Buehler 2000). Bald eagles are present year-round in New Jersey and New York. In New Jersey, nesting is concentrated on the edge of Delaware Bay (NJDEP 2017); in New York, eagle territories are primarily inland, and in 2010 no territories were identified on Long Island (Nye 2010). In a study evaluating the space use of bald eagles captured in Chesapeake Bay, the coast of New Jersey was associated with moderate levels of use and the coast of New York had low to moderate levels of use (Mojica et al. 2016). The general morphology of bald eagles dissuades long-distance movements in offshore settings, as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, bald eagles are unlikely to fly through the Lease Area. Bald eagles were rarely observed in Mid-Atlantic offshore surveys (all observations were less than 3.7 miles [6 kilometers] from shore), and only one bald eagle was observed in the APEM[2] surveys; this individual was close to shore (see Figure 2-16 in COP Appendix Q) and none were documented in the Lease Area (Empire 2022).

Golden eagles are found throughout the United States, but mostly in the western half of the United States and are rare in the eastern states (Cornell University 2019). The species is now virtually extirpated as a breeding bird east of the Mississippi River (NYSDEC n.d.). Although sightings occur every year in New York, most are during migration and no active nests are known to occur (NYSDEC n.d.). In New Jersey, golden eagles are associated with forest habitats in the Delaware Bay, Piedmont Intercoastal Plain, Pinelands, and Skylands landscape regions (NJDEP 2018). The area of New Jersey closest to the Lease Area is within the Atlantic Coastal Landscape region, which is not associated with golden eagles (New Jersey Bureau of GIS 2019). Like with bald eagle, the general morphology of golden eagle dissuades long-distance movements in offshore settings (Kerlinger 1985), as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, golden eagles are unlikely to fly through the Lease Area.

Three species of birds listed as threatened or endangered under the ESA may occur in the Onshore and Offshore Project areas: the threatened piping plover (*Charadrius m. melodus*), endangered roseate tern (*Sterna d. dougallii*), and threatened *Rufa* subspecies of the red knot (*Calidris canutus rufa*) (USFWS 2021a; Empire 2022).

[1] High-priority SGCN species are wildlife species experiencing a population decline or have identified threats that may put them in jeopardy, and are in need of timely management intervention or are likely to reach critical population levels in New York (NYSDEC 2015).
[2] APEM is a European environmental consultant that specializes in aerial surveys.

3.7.2 Impact Level Definitions for Birds

Definitions of impact levels are provided in Table 3.7-2.

Table 3.7-2 Impact Level Definitions for Birds

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
	Beneficial	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
	Beneficial	Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat.
Moderate	Adverse	Impacts would be unavoidable but would not result in population-level effects or threaten overall habitat function.
	Beneficial	Impacts would affect more than a few individuals in a broad area but not regionally, and would not result in population-level effects.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.
	Beneficial	Long-term beneficial population-level effects would occur.

3.7.3 Impacts of the No Action Alternative on Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for birds. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.7.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for birds described in Section 3.7.1, *Description of the Affected Environment for Birds*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on birds are generally associated with construction and climate change, and may also include interactions with commercial fisheries and anthropogenic light in the coastal environment. Onshore construction activities and associated impacts are expected to continue and have the potential to affect birds through temporary and permanent habitat removal and temporary noise impacts, which can cause avoidance behavior and displacement. Mortality of individual birds could occur but population-level effects would not be anticipated. Impacts of climate change such as increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, and increased erosion and sediment deposition have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on birds include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance. Ongoing offshore wind activities would have the same type of impacts from accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance described in detail in Section 3.7.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.7.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section F.2 in Appendix F for a complete description of planned activities). These activities may result in short-term and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion. See Table F1-4 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for birds.

BOEM expects planned offshore wind development activities to affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids, other contaminants, and trash and debris could occur as a result of future offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Based on the volumes potentially involved (refer to Table F2-3 in Appendix F, *Planned Activities Scenario*), the likely amount of releases associated with future offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities and would represent a negligible impact on birds.

Vessel compliance with USCG regulations would minimize trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019). Given that accidental releases are anticipated to be rare and localized, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.

Lighting: Nighttime lighting associated with offshore wind structures and vessels (during construction, operations, and decommissioning) could represent a source of bird attraction, which can result in disorientation and increased collision and predation risks (Hüppop et al. 2006). Under the No Action Alternative, up to 2,803 WTGs and 66 OSS would have navigational and FAA hazard and aviation lighting that would be incrementally added beginning in 2023 and continuing through 2030. However, BOEM anticipates this impact to be significantly reduced due to the anticipated use of ADLS, which is a system that would activate WTG lighting only when an aircraft enters a predefined airspace. For example, the recently approved Vineyard 1 offshore wind project will implement ADLS and, based on historical air traffic data, WTG light activation under ADLS is estimated to occur 235 times per year, for a total illumination duration of less than 4 hours per year (illuminating less than 0.1 percent of the nighttime hours per year) (BOEM 2021a). Another recently approved offshore wind project—South Fork—will also implement ADLS as part of BOEM’s COP approval terms and conditions, and several offshore wind projects currently under BOEM consideration are proposing/considering ADLS (pending FAA and BOEM approval) (e.g., Atlantic Shores, Ocean Wind, Coastal Virginia Offshore Wind). As such, BOEM anticipates ADLS to significantly reduce the potential WTG lighting impacts on birds. In addition, and as discussed in more detail below in the *Presence of Structures* IPF, the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.7-2), and the relative seasonal exposure of bird populations is generally very low (Table 3.7-2). BOEM anticipates long-term but minor impacts on birds due to lighting of offshore structures.

Construction vessels are also a source of artificial lighting, which could attract birds and cause disorientation and collision or predation risk. However, the potential impact would be short term, lasting only the duration of construction and, as previously described, the abundance of bird species on the OCS that overlap with the anticipated wind development of wind energy facilities is relatively small. Therefore, BOEM anticipates vessel lighting would result in short-term and minor impacts on birds.

Cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may affect diving birds, result in displacement of foraging individuals or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). The total area of seafloor disturbed by offshore export and interarray cables for offshore wind facilities is estimated to be 36,125 acres (146.2 km^2). Impacts associated with cable emplacement would be short term and localized, and birds would be able to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could contribute to additional impacts. Disturbed seafloor from construction of future offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Empire Wind COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance relatively quickly (as stated Section 3.6, *Benthic Resources*, and Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). Given that impacts would be short term and generally localized to the emplacement corridor, no individual fitness or population-level effects on birds would be expected.

Noise: Anthropogenic noise on the OCS associated with future offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that these impacts would be localized and short term. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft flying at low altitudes may cause birds to flush, resulting in increased energy expenditure. Disturbance to birds, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects would be expected.

Construction of up to 2,803 WTGs and 66 OSS would create noise and may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause temporary stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016). Additionally, noise impacts on prey species may affect bird foraging success. Similar to pile driving, G&G site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts on birds.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and short-term impacts, including avoidance and displacement, although no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a short-term loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

Presence of structures: The presence of structures can lead to long-term beneficial and adverse impacts on birds. Beneficial impacts from the presence of structures could result for some bird species through a reduction in derelict fishing gear (by entanglement with foundations) and increased prey items, which could result in fish aggregation and associated increase in foraging opportunities. Adverse impacts could include migration disturbances, strikes with structures (e.g., WTGs, buoys), and displacement.

The primary threat to birds from future offshore wind development is the presence of WTGs that could cause collisions and displacement. The Atlantic Flyway is an important migratory pathway for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline.

Building on this information, Robinson Wilmott et al. (2013) evaluated the sensitivity of bird resources to collision and displacement due to future wind development on the Atlantic OCS and included the 164 species selected by Watts (2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (2013) and consistent with Garthe and Hüppop (2004), Furness and Wade (2012), and Furness et al. (2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. It should be noted that, although Robinson Wilmott et al. (2013) use a comprehensive set of metrics in the study, may other environmental factors could influence bird vulnerability to offshore wind facilities (e.g., weather, lighting, area of RSZ).

Many of the species addressed in Robinson Willmott et al. (2013) that were identified as having low collision sensitivity include passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. As described by Watts (2010), approximately 55 seabirds occur on the Atlantic OCS at a distance from shore where WTGs could be operating. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.7-2). Of the 55 seabird species, 47 seabird species have sufficient survey data to calculate the modeled percentage of a species population by season that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018). Looking at all 47 birds across all four seasons, the relative seasonal exposure is generally very low, ranging from 0.0 to 5.2 percent of the seabird populations (Table 3.7-3). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

Offshore wind development would add up to 2,803 WTGs in the bird geographic analysis area (Table F2-1). In the contiguous United States, bird collisions with operating WTGs are believed to be relatively rare events, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually from about 49,000 onshore wind turbines in 39 states (USFWS 2018). Bird collisions with turbines in the eastern United States have been estimated at 6.86 birds per turbine per year (USFWS 2018). Based on this mortality rate, an estimated 19,229 birds could be killed annually from the 2,803 WTGs that would be added for offshore wind development. Given that the relative density of birds in the OCS is low, relatively few birds are likely to encounter WTGs (see Figure 3.7-2).

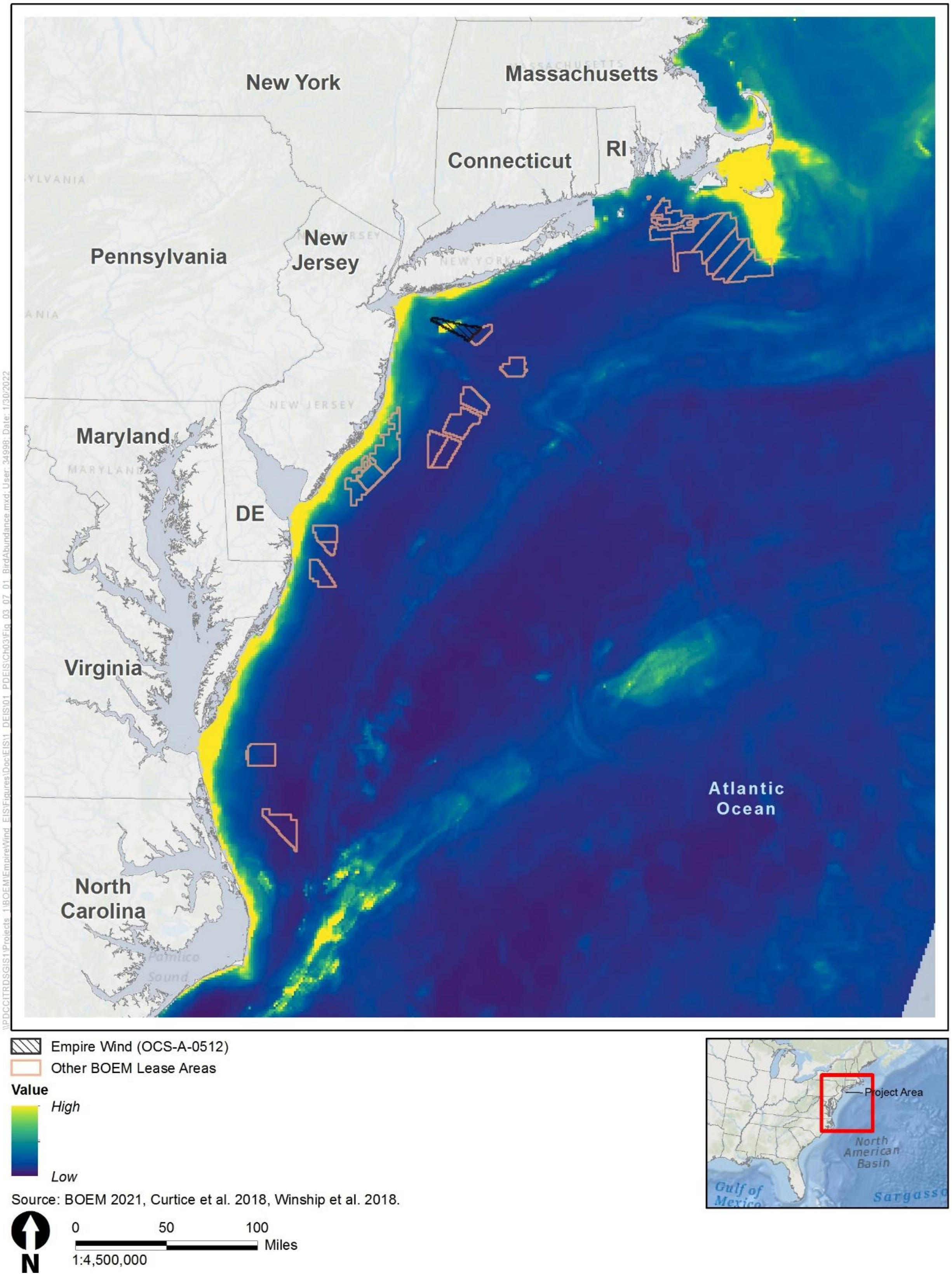

Figure 3.7-2 Total Avian Relative Abundance Distribution Map

Potential annual bird kills from WTGs would be relatively low compared to other causes of migratory bird deaths in the United States; feral cats are the primary cause of migratory bird deaths in the United States (2.4 billion per year), followed by collisions with building glass (599 million per year), collisions with vehicles (214.5 million per year), poison (72 million per year), collisions with electrical lines (25.5 million per year), collisions with communication towers (6.6 million per year), and electrocutions (5.6 million per year) (USFWS 2021b). Not all individuals that occur or migrate along the Atlantic Coast are expected to encounter the RSZ of one or more operating WTGs associated with future offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.7-3).

Table 3.7-3 Percentage of Atlantic Seabird Populations that Are Expected to Overlap with Anticipated Offshore Wind Energy Development on the Outer Continental Shelf by Season

Species	Spring	Summer	Fall	Winter
Artic Tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic Puffin (*Fratercula arctica*)[1]	0.2	0.1	0.1	0.2
Audubon Shearwater (*Puffinus lherminieri*)	0.0	0.0	0.0	0.0
Black-capped Petrel (*Pterodroma hasitata*)	0.0	0.0	0.0	0.0
Black Guillemot (*Cepphus grille*)	NA	0.3	NA	NA
Black-legged Kittiwake (*Rissa tridactyla*)[1]	0.7	NA	0.7	0.5
Black Scoter (*Melanitta americana*)	0.2	NA	0.4	0.5
Bonaparte's Gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown Pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped Storm-Petrel (*Oceanodroma castro*)	NA	0.0	NA	NA
Bridled Tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common Eider (*Somateria mollissima*)[1]	0.3	0.1	0.5	0.6
Common Loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common Murre (*Uria aalge*)	0.4	NA	NA	1.9
Common Tern (*Sterna hirundo*)[1]	2.1	3.0	0.5	NA
Cory's Shearwater (*Calonectris borealis*)	0.1	0.9	0.3	NA
Double-crested Cormorant (*Phalacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great Black-backed Gull (*Larus marinus*)[1]	1.3	0.5	0.7	0.6
Great Shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great Skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring Gull (*Larus argentatus*)[1]	1.0	1.3	0.9	0.5
Horned Grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing Gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach's Storm-Petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least Tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed Ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx Shearwater (*Puffinus puffinus*)[1]	0.0	0.5	0.1	NA
Northern Fulmar (*Fulmarus glacialis*)[1]	0.1	0.2	0.1	0.2
Northern Gannet (*Morus bassanus*)[1]	1.5	0.4	1.4	1.4
Parasitic Jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA

Species	Spring	Summer	Fall	Winter
Pomarine Jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA
Razorbill (*Alca torda*)[1]	5.2	0.2	0.4	2.1
Ring-billed Gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted Merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red Phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA
Red-necked Phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate Tern (*Sterna dougallii*)	0.6	0.0	0.5	NA
Royal Tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated Loon (*Gavia stellate*)[1]	1.6	NA	0.5	1.0
Sooty Shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty Tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South Polar Skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA
Surf Scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5
Thick-billed Murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson's Storm-Petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged Scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Winship et al. 2018.
[1] Species used in collision risk modeling.
NA = not applicable

The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. Displacement and avoidance can cause birds to expend more energy and to forage in other areas. However, overall habitat loss due to displacement as a result of a single project is unlikely to affect population trends because of the relatively small size of the Project area in relation to the available foraging habitat (Fox and Petersen 2019). In addition, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas and no individual fitness or population-level impacts would be expected to occur. Because most structures would be spaced 1 nm apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. Adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. BOEM anticipates that any additional flight distances would be relatively small when compared with the overall migratory distances traveled by migratory birds, and no individual fitness or population-level effects would be expected to occur.

In the Northeast and Mid-Atlantic waters, there are 2,570 documented annual seabird fatalities through interaction with commercial fishing gear; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). The presence of structures may also increase recreational fishing (see Section 3.9) and thus expose individual birds to harm from fishing line and hooks.

The presence of new structures could result in increased prey items for some marine bird species. Offshore wind foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structures may create habitat for structure-oriented and hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind energy facilities could generate beneficial long-term impacts on local ecosystems, indicating that offshore wind energy facilities may increase foraging opportunities for individuals of some marine bird species, potentially contributing to beneficial impacts on local ecosystems. BOEM anticipates that the presence of structures may result in permanent beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Traffic (aircraft): General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic would not be expected to appreciably contribute to overall impacts on birds.

Land disturbance: Onshore construction of offshore wind development infrastructure has the potential to result in some impacts due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Onshore construction would be expected to generally occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur. As such, onshore construction associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on birds.

3.7.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through construction and climate change. Given that the abundance of bird species that overlap with ongoing wind energy facilities on the Atlantic OCS is relatively small, ongoing wind activities would not appreciably contribute to impacts on birds. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **minor** impacts on birds.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and birds would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on birds due to habitat loss from increased onshore construction and interactions with offshore developments.

BOEM anticipates that the impacts associated with offshore wind activities in the geographic analysis area would result in adverse impacts but could potentially include beneficial impacts because of the presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or experience long-term functional habitat loss due to behavioral avoidance and displacement from wind lease areas on the OCS.

The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant. BOEM anticipates that the cumulative impacts of the No Action Alternative would have a **moderate** adverse impact on birds but could also include **moderate beneficial** impacts because of the presence of offshore structures.

3.7.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on birds:

- The new EW 2 onshore substations, which could require the removal of trees and shrubs in or on the edge of the construction footprint;
- The number, size, and location of the WTGs;
- The routing variants within the selected onshore export cable system, which could require removal of trees and shrubs along the construction corridor; and
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Onshore export cable routes and substations footprint: the route chosen (including variants within the general route) and substation footprint would determine the amount of habitat affected.
- Season of construction: The activity and distribution of birds exhibit distinct seasonal changes. For instance, summer and fall months (generally May through October) constitute the most active season for birds in the Project area, and the months on either side coincide with major migration events. Therefore, construction during months in which birds are not present, not breeding, or less active would have a lesser impact on birds than construction during more active times.

3.7.5 Impacts of the Proposed Action on Birds

The sections below summarize the potential impacts of the Proposed Action on birds during the various phases of the proposed Projects. Routine activities would include construction, O&M, and decommissioning of the proposed Projects, as described in Chapter 2, *Alternatives Including the Proposed Action*. The most impactful IPF is expected to be the presence of structures, which could lead to adverse impacts including injury and mortality or elicit an avoidance response. BOEM will prepare a BA for the potential effects on USFWS federally listed species. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of consultation will be presented in the Final EIS.

Accidental releases: Some potential exists for mortality, decreased fitness, and health effects due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Empire has prepared and would implement an OSRP (COP Volume 2f, Table 9-1, APM 84; Empire 2022), which would minimize the potential for spills and identify procedures in the event of a spill (see COP Appendix F). These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds.

Lighting: Under the Proposed Action, up to 147 WTGs and two OSS would be lit with USCG navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). In accordance with BOEM lighting guidelines (2021b) and as outlined in the COP (Volume 1, Section 3.5.2; Empire 2022), all WTGs in excess of 699 feet about ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 870 new red flashing lights to the offshore environment where none currently exist. However, red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013).

Marine navigation lighting would consist of multiple types of flashing yellow lights on corner WTGs/significant peripheral structures, outer boundary WTGs, and interior WTGs. Empire has committed to using an FAA-approved ADLS (COP Volume 2f, Table 9-1, APM 88; Empire 2022), which is a lighting system that would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur 30 hours per month over the course of 1 year, which equals just 7.5 percent of the time that full-time obstruction lights would be active (COP Volume 2, Section 8.6, and Appendix B; Empire 2022). To further reduce impacts on birds, Empire would limit, where practicable, lighting (not required by FAA and USCG) during offshore construction to reduce attraction of birds (COP Volume 2f, Table 9-1, APM 82; Empire 2022). As such, BOEM expects impacts, if any, to be long term but negligible from WTG and OSS lighting. Vessel lights during construction, O&M, and decommissioning would have short-term but minimal effects and would be limited to vessels transiting to and from construction areas.

Cable emplacement and maintenance: The Proposed Action would disturb up to 1,895 acres (7.6 km^2) of seafloor associated with the installation of array cable and export cable (EW 1 and EW 2), which would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. 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 COP Volume 3, Appendix J for details). In areas that consist predominantly of gravels and sands, the analysis indicates a limited extent of increased sediment concentrations, as the larger grain size sediments immediately deposit in the trench (Empire 2022). In locations that are dominated by fine sand, silts, or clays, these sediments can be released into the water column, temporarily increase total suspended solids near the trench, and cause sediment deposition outside of the trench. These impacts are expected to be temporary, with sediments settling quickly to the seabed and potential plumes limited to right above the seabed and not within the water column.

During jet plow activities, silts and clays are anticipated to remain suspended for 4 hours and deposit no farther than 492 feet from the trench, with most of the deposition near the trench. Mass flow excavations were found to have a similar disturbance to sediment, with deposition from the trench no farther than 246 feet. Results from the analysis were also consistent with other sediment transport models completed for wind farm installation projects in the Mid-Atlantic region. Data collections and modeling studies of plowing, trenching, and dredging projects showed that displacement of sediments is low, and they typically dissipated to background levels very close to the site (Empire 2022). Individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable impacts, if any, on individuals or populations would be expected given the localized and temporary nature of the potential impacts.

Noise: The expected impacts of aircraft (e.g., helicopters), G&G survey, and pile-driving noise associated with the Proposed Action would not increase the impacts of noise beyond those described under the No Action Alternative. Effects on offshore bird species could occur during the construction phase of the Proposed Action because of equipment noise (including pile-driving noise). The pile-driving noise impacts would be temporary (5 hours per pile) and would cease after piles are installed. Vessel and construction noise could temporarily disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). BOEM anticipates the temporary impacts, if any, related to construction and installation of the offshore components would be negligible.

Normal operation of the substations would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises near the proposed substations.

Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, entanglement and fishing gear loss or damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section 3.7.3.2, *Cumulative Impacts of the No Action Alternative*. The impacts of the Proposed Action as a result of presence of structures would be long term but minor and may include some beneficial impacts. Due to the anticipated use of flashing red tower lights, restricted time period of exposure during migration, and small number of migrants that could cross the Lease Area, BOEM determined that the Proposed Action would not likely adversely affect roseate terns, piping plovers, and red knots.

Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). However, operation of the Proposed Action would result in impacts on some individuals of offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016).

The predicted occurrence of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. 2013) is relatively low across the OCS during all seasons of the year (Figure 3.7-3), suggesting that bird fatalities in the overall OCS due to collision are likely to be low. The Marine-life Data and Analysis Team models predict an area of high bird abundance, however, in the northwestern portion of the Lease Area, but this is believed to be due to the high predicted winter use of just one species, common murre, and not that of all birds. Furthermore, more recent offshore high-definition digital surveys (2016–2019) of the Lease Area conducted by NYSERDA and Empire did not detect any common murres (see COP Appendix Q, Tables 2-16 and 2-36; Empire 2022). Therefore, regardless of the high predicted abundance shown on Figure 3.7-2, Figure 3.7-3, and Figure 3.7-4, the predicted occurrence of overall bird populations in the Lease Area is still relatively low.

When WTGs are present, many birds would avoid the WTG site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid WTGs by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczkier and Simms 2012; Skov et al. 2018) and others may take extra precautions to avoid WTGs when the WTGs are moving (Johnston et al. 2014). Several species have very high avoidance rates; for example, the northern gannet, black-legged kittiwake, herring gull, and great black-backed gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018). As previously stated in Section 3.7.3.2, displacement and avoidance can cause birds to expend more energy and to forage in other areas. However, overall habitat loss due to displacement as a result of a single project is unlikely to affect population trends because of the relatively small size of the Project area in relation to the available foraging habitat (e.g., Fox and Petersen 2019).

Empire performed an exposure and relative vulnerability assessment to estimate the collision and displacement risk of various offshore bird species encountering the Lease Area (COP Appendix Q, Avian Impact Assessment; Empire 2022). Most species were identified as having “minimal” to “low” overall exposure risk. With the exception of migratory falcons and songbirds, coastal birds are considered to have minimal exposure (occurrence) to the Lease Area because it is far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. 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 WTGs or collide with them.

To minimize the introduction of perching structures to the offshore environment, Empire has committed to installing bird deterrent devices, where appropriate, on offshore, above-water structures (COP Volume 2f, Table 9-1, APM 81; Empire 2022).

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. All marine birds were identified as having minimal to low exposure except terns (not including the roseate tern), which received a medium exposure assessment. Terns would be most exposed during spring migration. Generally, terns are thought to fly below the RSZ, but do have some vulnerability to collision when they are not avoiding WTGs.

Loons also initially received a medium exposure score during the summer, but this was reduced to minimum to low because the exposure score was driven by a low sample size in the summer when most individual are breeding on inland lakes. Local density estimates showed very low to no density during the summer. For these reasons, overall loon exposure is considered minimal to low. Loons are documented to avoid wind farms, but displacement from the Lease Area is unlikely to affect population trends because of the relatively small size of the Lease Area in relation to available foraging habitat. As previously mentioned, while the Marine-life Data and Analysis Team 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 Marine-life Data and Analysis Team models and APEM surveys are assessed together. Generally, auks are not considered vulnerable to collision, as they primarily fly much lower than the RSZ.

During migration, many bird species, including songbirds, likely fly at heights well above or below the RSZ (98 feet to 951 feet [30 to 290 meters] above highest astronomical tide) (COP Appendix Q; Empire 2022). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. It is generally assumed that inclement weather and reduced visibility cause changes to migration altitudes (Ainley et al. 2015) and could potentially lead to large-scale mortality events. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006; Pettersson 2005; Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019).

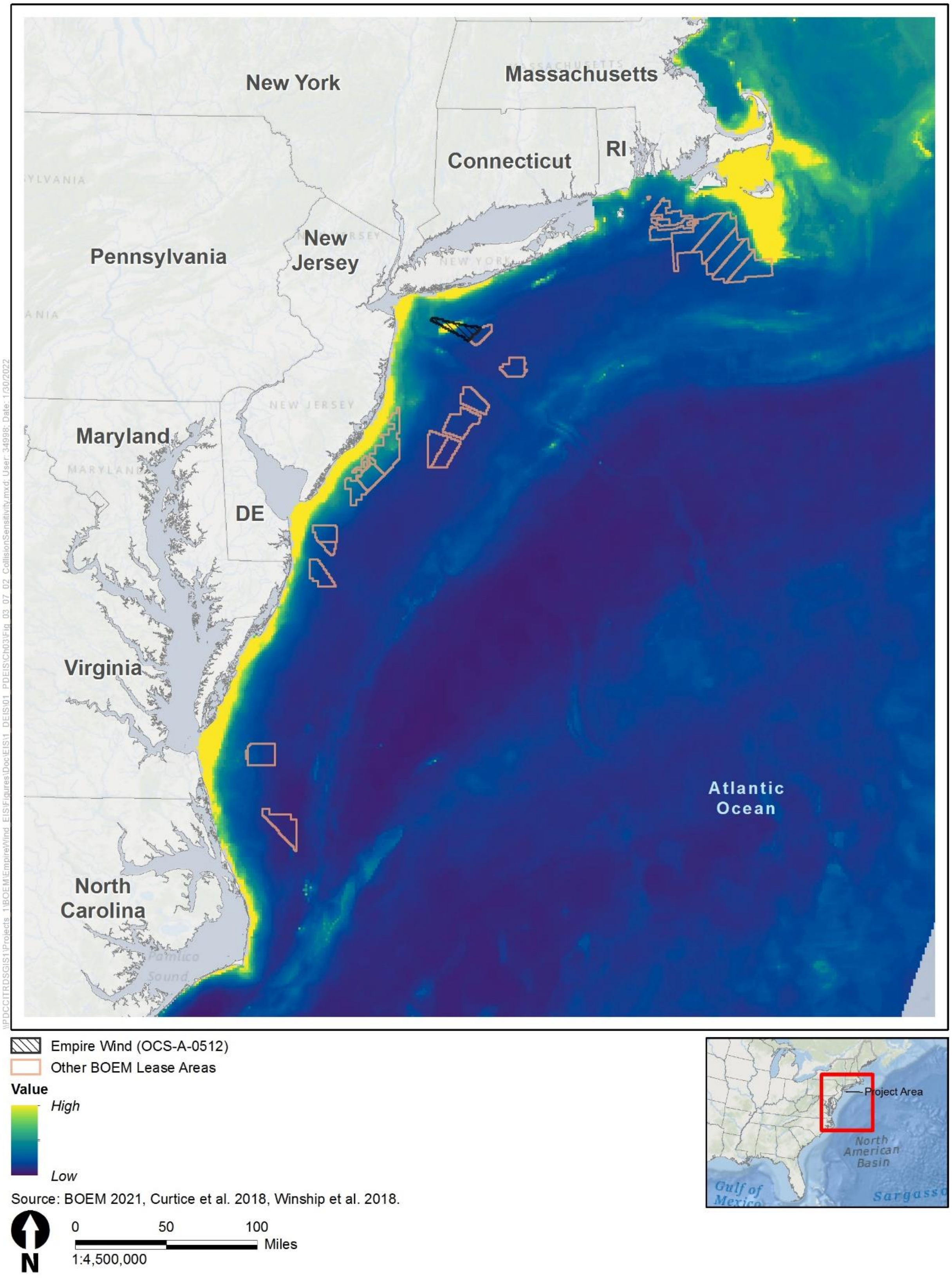

Figure 3.7-3 Total Avian Relative Abundance Distribution Map for the Higher Collision Sensitivity Species Group

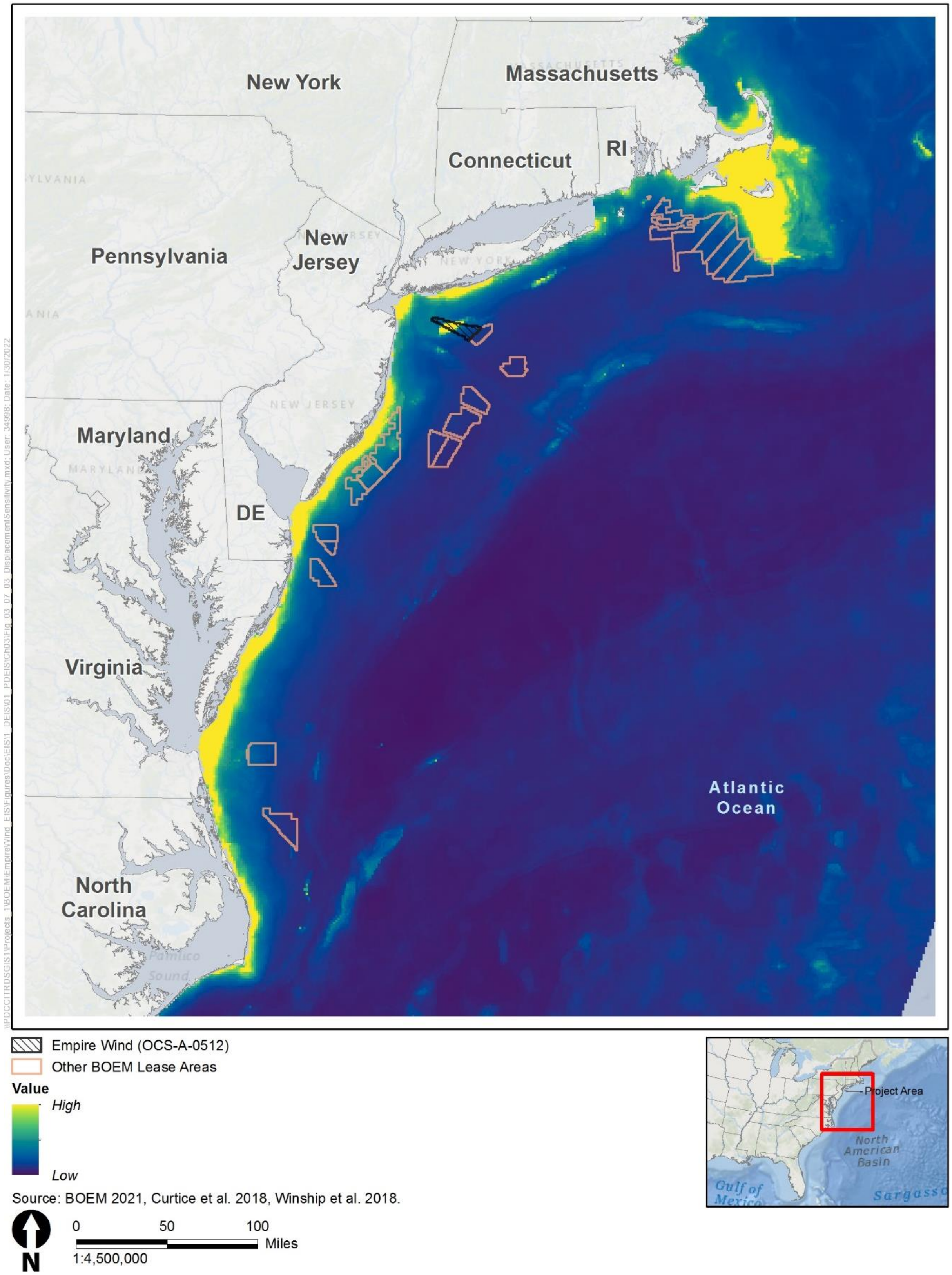

Figure 3.7-4 Total Avian Relative Abundance Distribution Map for the Higher Displacement Sensitivity Species Group

Many of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Robinson Willmott and Forcey 2014), were documented in relatively low numbers. Most of the activity (including blackpoll warblers) was during windspeeds less than 10 kilometers per hour—below the turbine cut-in speed (see Figure 109 in Robinson Willmott and Forcey 2014)—and thus minimizing risk to migrating passerines from spinning turbine blades. Most carcasses of small migratory songbirds found at land-based wind energy facilities in the Northeast were within 2 meters of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020). Although it is possible that migrating passerines, including flocks, could collide with offshore structures (including vessels), migrating passerines are also occasionally found dead on boats, presumably from exhaustion (e.g., Stabile et al. 2017). Equinor documented dead or injured birds found on vessels during G&G surveys for the Lease Area since 2018, and observed 0 birds in 2018, 37 in 2019, 19 in 2020, and 7 in 2021 (Equinor 2019, 2021). The majority of birds found in 2019 (month of May) were white-throated sparrows. In 2020 (mid-October to mid-November) about half of the birds found were pine siskins, with the remaining consisting of one or more swamp sparrow, purple finch, dark-eyed junco, northern parula, American robin, ruby-crowned kinglet, red-breasted nuthatch, and common redpoll. In 2021 (one day each in February, May, and August), observed birds included one or more white-throated sparrow, pine siskin, gray catbird, and herring gull. Empire has committed to implementing a monitoring program to answer specific questions, including identifying key bird species of interest and, when possible, contributing to the understanding of long-term, project-specific impacts and larger-scale efforts to understand cumulative impacts on birds (COP Volume 2f, Table 9-1, APM 86; Empire 2022). In addition, Empire has committed to implementing a *Bird and Bat Monitoring Framework* that outlines an approach to post-construction bird monitoring that supports advancement of the understanding of bird interactions with offshore wind farms (Appendix H, Attachment H-3).

Some marine bird species might avoid the Lease Area during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016; Drewitt and Langston 2006; Lindeboom et al. 2011; Percival 2010; Petersen et al. 2006), grebes (Dierschke et al. 2016; Leopold et al. 2011; Leopold et al. 2013), seaducks (Drewitt and Langston 2006; Petersen et al. 2006), and northern gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) typically avoid offshore wind developments. The proposed Projects would no longer provide foraging opportunities to those species with high displacement sensitivity, but suitable foraging habitat exists in the immediate vicinity of the proposed Projects and throughout the region. However, as depicted on Figure 3.7-4, modeled use of the Lease Area by bird species with high displacement sensitivity is low (see explanation above for the high abundance rating in part of the Lease Area related to common murre). A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (2013). Because the Lease Area is not likely to contain important foraging habitat for the species susceptible to displacement, BOEM expects this loss of habitat to be insignificant. Population-level, long-term impacts resulting from habitat loss would likely be negligible.

The expected impacts of the Proposed Action would increase incrementally beyond those described under the No Action Alternative. The structures associated with the Proposed Action and the consequential impacts would be long term and would remain at least until decommissioning of the proposed Projects is complete.

Generally, onshore operation is not expected to pose any significant IPFs (i.e., hazards) to birds because activities would disturb little if any habitat, and the onshore export cables would be below ground. The EW 1 and EW 2 onshore Project components would be within highly disturbed areas with little or no natural habitats.

Traffic (aircraft): The expected impacts of aircraft traffic associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative.

Land disturbance: The expected impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. Empire would implement trenchless technology (e.g., HDD) for the EW 2 offshore export cable landing to go under beaches, which would avoid beach habitat for nesting shorebirds (COP Volume 2b, Section 5.1.1.2; Empire 2022); as such, temporary impacts on birds, particularly nesting shorebirds, resulting from the landfall location would be negligible. Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts, if any, would be negligible, as most individuals would avoid noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013).

Impacts on bird habitat from onshore construction activities would be limited. The EW 1 Onshore Project area (which also includes the O&M facility) lacks natural bird habitat (i.e., significantly altered by human development and primarily used for industrial and commercial operations) and does not support native species or species of conservation concern; some species that associate with coastal urbanized areas (e.g., pigeons, seagulls) occur in the geographic analysis area. Therefore, impacts on birds from construction and operations of EW 1 onshore components and the O&M facility would be negligible, as no natural habitat would be affected.

While habitats in the EW 2 Onshore Project area have also been significantly altered by human development, there are some small areas of tree and shrub habitat that could be affected, depending on the substation and onshore cable route; however, these more natural areas are isolated and surrounded by developed and urbanized areas. During construction, the onshore export and interconnection cables and onshore substations for EW 2 would require varying acreage of tree removal, which would be a long-term impact lasting until decommissioning and restoration. To minimize disturbance, the majority of the proposed onshore export and interconnection cable routes would be sited in already disturbed areas (e.g., existing roadways) to the extent practicable (COP Volume 2f, Table 9-1, APM 76; Empire 2022).

Construction of onshore export cable segment IP-C would require vegetation removal in three isolated areas between Long Beach Road and Daly Boulevard (6.44 acres herbaceous, 1.99 acres forest/wooded vegetation, and 0.41 acre scrub/shrub). Construction of EW 2 Onshore Substation C would require the removal of approximately 0.55 acre of tree/shrub habitat along the existing railroad corridor. Clearing and grading during construction within temporary workspaces would result in short-term loss of forage and cover for birds within the area. Construction of Onshore Substation C would result in long-term impacts on habitat from construction of the permanent substation facilities and short-term impacts for temporary construction workspaces. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Projects' operational lifetime. Landscaped areas would provide some habitat for species acclimated to human activity. Tree and shrub removal for onshore export cable installation would likely result in a maintained right-of-way of herbaceous/low shrub vegetation, which would be a short-term impact for herbaceous/low shrub vegetation and a long-term impact for tree removal. No tree clearing is expected for EW 2 Onshore Substation A. In addition, Empire would implement measures to avoid and minimize bird impacts, including time of year clearing restrictions (COP Volume 2f, Table 9-1, APMs 77, 78; Empire 2022) and revegetating disturbed areas (APM 87). Given the nature of the existing conditions of the Onshore Project area (i.e., developed and highly urbanized with little or no natural habitat), the temporary nature of construction, and Empire's commitment to measures to avoid and reduce bird impacts, the impacts on birds are not expected to be measurable.

3.7.5.1. Impact of the Connected Action

As described in Chapter 2, infrastructure improvements have been proposed at SBMT that include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders), as well as some upland activities (building construction and paving). As previously stated in Section 3.7.1, habitats within and in the vicinity of the EW 1 Onshore Project 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 Project area. However, due to the highly developed nature of the EW 1 Onshore Project area, the SBMT does not provide important bird habitat. BOEM expects the activities associated with the connected action to affect birds primarily through the noise, accidental releases, and land disturbance IPFs. Other IPFs considered under the Proposed Action do not apply (e.g., cable emplacement and maintenance, traffic [aircraft]), and because the surrounding area consists of existing structures and other infrastructure, the presence of structures IPF would not pose a substantial risk to birds.

Noise: The expected impacts of noise associated with the connected action's activities could affect any birds that may be in the vicinity of the SBMT. However, similar to under the Proposed Action, construction noise would be temporary and localized and would not be anticipated to be significantly different than the noise levels in the surrounding urban environment. If pile driving is necessary during construction, the noise would be temporary and would cease after piles are installed. Similarly, dredging vessels and other construction noise could temporarily disturb and displace bird species, but they are likely already acclimated to noise in an urban environment and would be able to move away from the noise. Normal operation at the SBMT would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises in the EW 1 Onshore Project area. BOEM anticipates noise impacts associated with the connected action to be negligible.

Accidental releases: Onshore construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Some potential exists for bird impacts (e.g., injury from exposure) due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with dredging and construction equipment in the aquatic and terrestrial environment around SBMT. BOEM assumes an SPCC plan would be developed and implemented to avoid, minimize, and contain spills. Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. In addition, all dredging equipment/use of watercraft and in-water work would comply with federal, state, and local permitting (e.g., CWA Section 404 and 401) requirements for prevention and control of petrochemical spills, including oil and fuel. Normal operation at the SBMT could result in accidental releases, but BOEM expects negligible impacts due to federal, state, and local requirements to contain and clean up releases. Therefore, BOEM anticipates accidental releases associated with the connected action to be negligible.

Land disturbance: Improvement activities at the SBMT would remove all existing structures and approximately 40 percent of the currently paved area. After additional excavation for installation of subsurface piles, utilities, and building structures, only minor grade changes are anticipated. The site would be repaved and new structures installed. Impacts on upland vegetation would be limited to removal of approximately 0.05 acre of volunteer invasive vegetation throughout the SBMT site and three poplar trees along the north side of the 35th Street Pier to replace a bulkhead, with each tree being approximately 4 inches in diameter at breast height. The removal of this vegetation is not anticipated to affect birds because it is low-quality habitat and not considered significant or important to birds. Therefore, BOEM anticipates land disturbance associated with the connected action to be negligible.

3.7.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS would contribute to impacts on birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Construction related to the connected action could affect birds through the removal a few small trees, by generating temporary and localized noise, and with potential accidental releases of fuels and hazardous materials. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Given that the abundance of bird species that overlap with wind energy facilities on the Atlantic OCS is relatively small, offshore wind activities would not appreciably contribute to impacts on bird populations. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,031 WTGs, of which the Proposed Action would contribute 147 or about 5 percent, and would include up to more than 37,353 acres (155.4 km^2) of seafloor disturbed from the offshore export cable and interarray cables.

The cumulative impacts on birds would likely be moderate because, although bird abundance on the OCS is low, there could be unavoidable impacts offshore and onshore; however, BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance impacts on birds.

3.7.5.3. Conclusions

Impacts of the Proposed Action. Activities associated with the construction, installation, O&M, and eventual decommissioning of the Proposed Action would have **minor** impacts on birds, depending on the location, timing, and species affected by an activity. The primary impacts of the Proposed Action affecting birds are habitat loss and collision-induced mortality from rotating WTGs and long-term habitat loss and conversion from onshore construction. The Proposed Action would also potentially result in **minor beneficial** impacts associated with foraging opportunities for some marine birds. The primary impacts of the connected action are related to noise, accidental releases, and land disturbance, which could affect birds in the EW 1 Onshore Project area. However, given the developed nature of the EW 1 Onshore Project area, birds are likely acclimated to activities similar to those related to the connected action; therefore, BOEM anticipates impacts of the connected action would be **negligible**.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on birds in the geographic analysis area would be **moderate**, as well as **moderate beneficial**. In context of other reasonably foreseeable environmental trends in the area, the incremental impacts contributed by the Proposed Action to the cumulative impacts on birds would be undetectable. The Proposed Action would contribute to the cumulative impacts primarily through the permanent impacts from the presence of structures and long-term impacts from habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three isolated habitat areas.

3.7.6 Impacts of Alternatives B, E, and F on Birds

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternatives B, E, and F would be the same as those described under the Proposed Action because the same number of WTGs would be constructed throughout the Lease Area. While the WTGs may move to a different position in the Lease Area under Alternatives B, E, and F, impacts on birds would not materially change compared to those of the Proposed Action. All other offshore and onshore Project components of Alternatives B, E, and F would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on birds would be the same as those described under the Proposed Action.

3.7.6.1. Conclusions

Impacts of Alternatives B, E, and F. As discussed above, the expected **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action would not change under Alternative B, E, or F.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B, E, or F to cumulative impacts on birds would be undetectable. Because the impacts of the Proposed Action would not change under Alternative B, E, or F, BOEM anticipates that the cumulative impacts of Alternatives B, E, and F would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, E, and F would be **moderate** and **moderate beneficial**.

3.7.7 Impacts of Alternative C, D, and G on Birds

Impacts of Alternatives C, D, and G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, or G would be the same those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), to avoid the sand borrow area (Alternative D), or to use a cable bridge to cross Barnums Channel (Alternative G) are already covered under the Proposed Action as part of the PDE approach and narrowing the submarine and onshore cable route options under Alternative C, D, or G would not materially change the analyses of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on birds would be the same as those described under the Proposed Action.

3.7.7.1. Conclusions

Impacts of Alternatives C, D, and G. As discussed above, the expected **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action would not change under Alternative C, D, or G.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C, D, or G to cumulative impacts on birds would be undetectable. Because the impacts of the Proposed Action would not change under Alternative C, D, or G, BOEM anticipates that the cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, E, and F would be **moderate** and **moderate beneficial**.

3.7.8 Impacts of Alternative H on Birds

Impacts of Alternative H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be the same those described under the Proposed Action. An alternate method of dredge and fill activity at the SBMT would not materially change the analysis of any IPF, as the Onshore Project area is heavily developed with little or no bird habitat. BOEM does not anticipate that any change in dredge and fill activity would affect undisturbed or natural areas. All other offshore and onshore Project components of Alternative H would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on birds would be the same as those described under the Proposed Action.

3.7.8.1. Conclusions

Impacts of Alternative H. As discussed above, the expected **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action would not change under Alternative H.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on birds would be undetectable. Because the impacts of the Proposed Action would not change under Alternative H, BOEM anticipates that the cumulative impacts of Alternative H would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative H would be **moderate** and **moderate beneficial**.

3.7.9 Proposed Mitigation Measures

If the reported post-construction bat monitoring results (generated as part of Empire's *Bird and Bat Monitoring Framework* [Appendix H, Attachment H-3]) indicate bird impacts deviate substantially from the impact analysis included in this EIS, then Empire must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-1).

BOEM has also proposed annual mortality reporting to minimize impacts on birds and bats (refer to Appendix H, Table H-1). As part of this measure, the lessee would prepare and submit annual reports to BOEM, USFWS, and BSEE documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The lessee would report carcasses with federal or research bands to the United States Geological Survey Bird Band Laboratory. The lessee would report occurrences of dead ESA birds or bats to BOEM, USFWS, BSEE within 24 hours of the sighting and, if practicable, carefully collect the dead specimen and preserve the material in the best possible state.

3.7.10 Comparison of Alternatives

Alternatives B, E, and F would have the same number of WTGs as the Proposed Action, which would result in the same impacts on species with high collision sensitivity and high displacement sensitivity; the overall impact level would not change—**minor** with **minor beneficial** impacts.

Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level would not change—**minor** with **minor beneficial** impacts.

Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is heavily developed with little or no bird habitat. Therefore, the overall impact level would not change—**minor** with **minor beneficial** impacts.

In context of reasonably foreseeable environmental trends, BOEM anticipates that the cumulative impact of Alternatives B, C, D, E, F, G, and H in combination with ongoing and planned activities would result in **moderate** and **moderate beneficial** impacts on birds in the geographic analysis area.

3.8. Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the proposed Projects, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna within state waters (which extend 3 nm from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area, as shown on Figure 3.8-1, includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substations, the connection from the onshore substations to the POI, and the O&M facility. This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species. The affected environment and environmental consequences of Project activities that are within the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.6, *Benthic Resources*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals*; 3.19, *Sea Turtles*; and 3.21, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.7, *Birds*, Section 3.5, *Bats*, and Section 3.22, *Wetlands*, respectively.

3.8.1 Description of the Affected Environment for Coastal Habitat and Fauna

The geographic analysis area is within urbanized landscapes in the New York metropolitan area, and the onshore export and interconnection cables, onshore substations, and O&M facility are primarily along or within existing roadway corridors. Vegetation almost entirely consists of landscape plants, including trees, shrubs, other ornamental plants, and maintained grass. This includes landscaped areas along roadways, within roadway medians, and in local parks and cemeteries (e.g., Green-Wood Cemetery). 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 expected to occur will be limited to those adapted to living in association with human-influenced landscapes, disturbance, and noise. Shorebirds may forage on the public beaches adjacent to the export cable landfall locations, and marsh islands at the periphery of the geographic analysis area may serve as foraging or nesting habitat. Invasive plant species commonly associated with disturbed and urban areas occur, often at high densities, throughout the Onshore Project area. Due to the high level of development, impervious surfaces, and other such areas that are devoid of vegetation within the onshore export and interconnection cable construction corridors, onshore substations, and O&M facility, invasive plant species are concentrated within and adjacent to disturbed wetlands and streams as well as along vegetated edges of public roadways (Empire 2022).

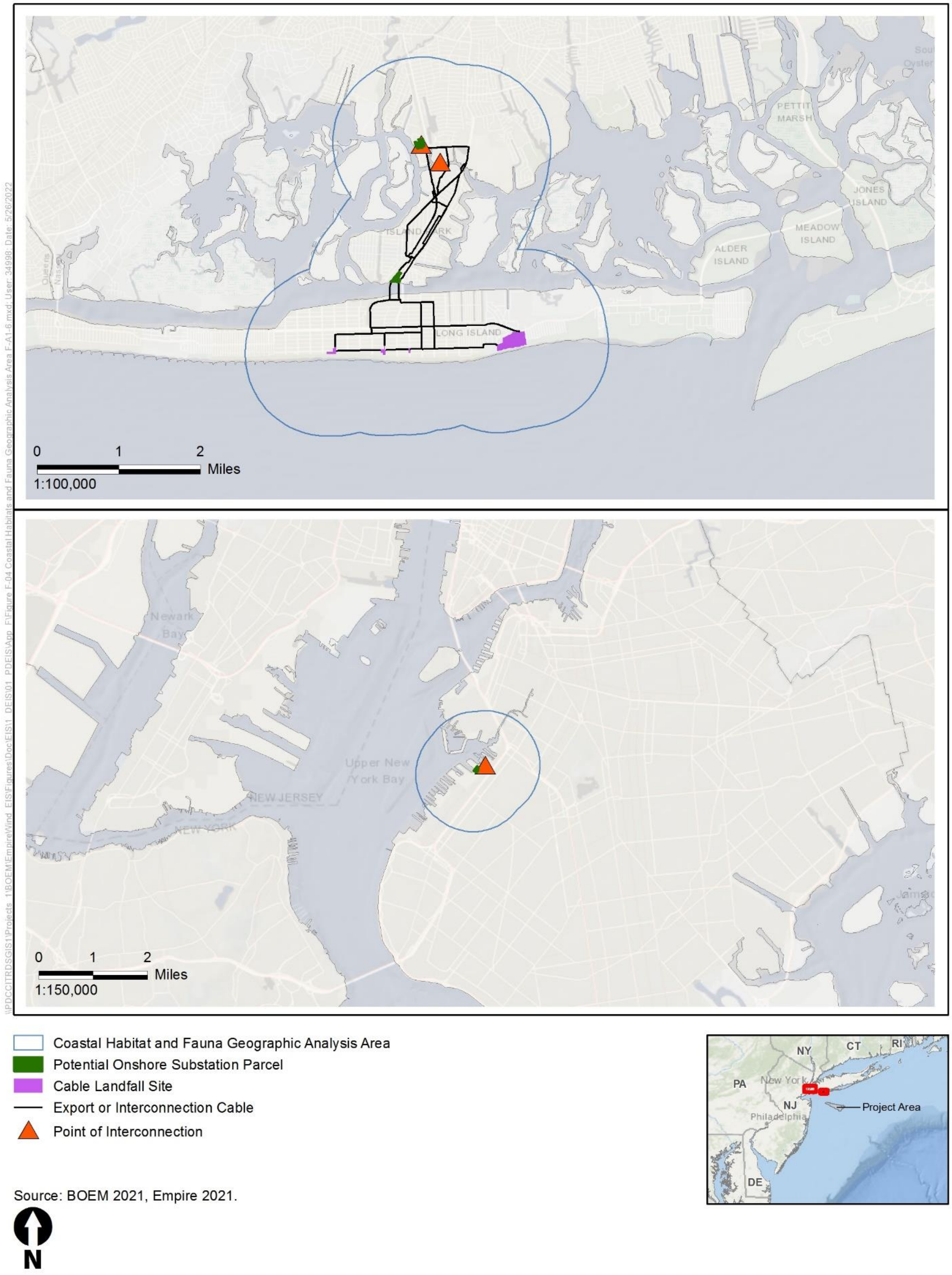

Figure 3.8-1 Coastal Habitat and Fauna Geographic Analysis Area

EW 1

The SBMT is a commercial shipping terminal dominated by a paved lot and warehouse buildings, with over 95 percent impervious surfaces; vegetation is limited to volunteer invasives and a line of poplar trees on the north side of the 35th Street Pier (AECOM 2022). From the EW 1 landfall at SBMT, where the onshore substation would also be located, the interconnection cable route would travel northeast along an existing public roadway to the Gowanus POI. The O&M facility would 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 and aerial imagery, the onshore substation parcel is primarily situated within developed lands (see COP Volume 2, Figure 5.1-3; Empire 2022).

As the EW 1 interconnection cable route and onshore substation would be within an urban landscape and an area mostly 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 could occur along the route; however, due to the lack, and already-fragmented nature, of natural habitat, these are not expected to occur at high densities (Empire 2022).

One plant listed as threatened under the ESA may occur in the EW 1 geographic analysis area: seabeach amaranth (*Amaranthus pumilus*) (USFWS 2022; Empire 2022). However, the primary habitat associated with the species—foredunes, non-eroding beaches, and overwash flats at the end of islands—does not exist in the EW 1 geographic analysis area. Sites visits conducted in August to October 2020 for the SBMT Improvement Project included vegetation surveys at the SBMT and seabeach amaranth and associated habitat was not observed (AECOM 2022). Three bird species and one mammal listed as threatened or endangered under the ESA may also occur or potentially occur in the geographic analysis area; these species are addressed in Section 3.7, *Birds*, and Section 3.5, *Bats*. The Empire Wind BA will provide a detailed discussion of ESA-listed species and potential impacts of the Projects on these species. Results of ESA consultation with USFWS will be included in the Final EIS.

The EW 1 Onshore Project area is not within New York State Significant Coastal Fish and Wildlife Habitats. Natural Heritage Database inquiries were submitted to the NYSDEC Division of Fish and Wildlife, and results 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 (see COP Appendix N; Empire 2022); however, the bridge is outside of the geographic analysis area.

EW 2

Overall, EW 2 would be situated within developed lands of variable development intensity, with vegetation primarily limited to the area within and adjacent to Onshore Substation C, as well as strips along transportation corridors (i.e., roads and rail) and maintained lawn. Four export cable landfall options (Landfalls A, B, C, and E) are currently under review for EW 2. Proposed Landfalls consist of a bare vacant parcel used for parking (Landfall A), existing paved parking lots devoid of vegetation (Landfalls B and C), and a previously disturbed vacant lot (Landfall E). Barrier beaches are present between the landfall locations and the shoreline. Long Beach (Landfalls A, B, and E) is sandy with no vegetation while Lido Beach (Landfall C) includes vegetated dunes. A total of six 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. These routes would travel along existing roads in areas dominated by high-intensity development (see COP Volume 2, Figure 5.1-4; Empire 2022). After crossing the Reynolds Channel into Island Park, a total of five cable routes under review would traverse Island Park to Onshore Substation A. These routes would travel along existing roads in areas dominated by high- and medium-intensity development (see COP Volume 2, Figure 5.1-5; Empire 2022); there are three isolated vegetated areas (e.g., herbaceous, forest/wooded vegetation, and scrub/shrub) along onshore export cable segment IP-C between Long Beach Road and Daly Boulevard. Onshore Substation A would be on a developed parcel with no natural vegetation (see COP Volume 2, Table 5.1-2 and Figure 5.1-5; Empire 2022). EW 2 Onshore Substation C would be on the north side of Reynolds Channel along an existing railroad corridor and, if selected, would eliminate the need for the five cable routes under review that would traverse Island Park to Onshore Substation A. The EW Onshore Substation C site is composed of several active commercial properties with approximately 70 percent of the site devoid of vegetation and includes commercial buildings, supporting ancillary appurtenances, roads, and gravel parking areas. The remaining 30 percent of the site consists of vegetated perimeters (some trees and shrubs) of parking lots and an approximately 1-acre area that has been routinely disturbed with land clearing and soil disturbance.

Considering the high percentage of development within the onshore export cable route corridor, this portion of EW 2 would be suitable for species common to urban environments comprising sparsely vegetated and highly fragmented habitat. Gulls, pigeons, and seabird species may occur as transients in low densities, with seabird species increasing in relative density closer to the landfall. Species occurring along the beach may include foraging individuals or transient migrants; however, the beach is highly developed and routinely raked and therefore contains poor-quality breeding habitat. Areas in the northern portion of the onshore export cable route corridor in the vicinity of onshore export cable segments IP-C and IP-G north and west of Long Beach Road and south of Daly Boulevard are composed primarily of scrub/shrub habitats that may provide foraging and nesting habitat for wildlife species (Empire 2022). The undeveloped areas of the EW 2 Onshore Substation C site may have the potential to provide some habitat for certain urban bird species, but this area is not expected to be important habitat for any species and is completely isolated by surrounding developments.

One plant listed under the ESA may occur in the EW 2 geographic analysis area: seabeach amaranth (threatened) (USFWS 2022). As previously mentioned, seabeach amaranth habitat generally consists of foredunes, non-eroding beaches, and overwash flats at the ends of islands. Individuals or populations of seabeach amaranth have been identified as potentially occurring within Project components at Lido Beach (see COP Volume 2, Table 5.1-3; Empire 2022). BOEM notes that COP Section 5.1.1.2 and Table 5.1-3 indicate a second federally listed plant potentially present in the geographic analysis area: sandplain gerardia (endangered). However, the ESA species information in the COP is based on an Information for Planning and Consultation query from June 2021, and the species no longer occurs or potentially occurs in the geographic analysis area based on BOEM's more recent Information for Planning and Consultation queries in preparation for this EIS and the Empire Wind BA. Three bird species and one mammal listed as threatened or endangered under the ESA may also occur or potentially occur in the geographic analysis area; these species are addressed in Section 3.7, *Birds*, and Section 3.5, *Bats*. The Empire Wind BA will provide a detailed discussion of ESA-listed species and potential impacts of the Projects on these species. Results of ESA consultation with USFWS will be included in the Final EIS.

Natural Heritage Database inquiries were submitted to NYSDEC, Division of Fish and Wildlife, and results indicated that nine threatened, endangered, or species of conservation concern have been documented in the vicinity of EW 2, including seven bird species and two plant species (seabeach amaranth and sandplain gerardia) (see COP Appendix N; Empire 2022). Three significant communities were also identified as potentially occurring within the tidal channels in the vicinity of onshore export cable segments IP-C and IP-G north and west of Long Beach Road and south of Daly Boulevard and two significant natural communities, both comprising sensitive beach habitats, were identified at Landfall C and the temporary work area associated with the landfall site. A small area of the Landfall C parcel overlaps with the western tip of the state designated Nassau Beach Significant Coastal Fish and Wildlife Habitat site (New York State 2008). A review of the New York State Wildlife Action Plan found that the geographic analysis area is most closely associated with six habitat types defined in the State Wildlife Action Plan: (1) brackish intertidal mesohabitat, (2) marine intertidal mesohabitat, (3) brackish subtidal shallow mesohabitat, (4) coastal grassland/shrubland, (5) maintained grasses and mixed cover, and (6) urban/suburban (NYSDEC 2015). These habitat types are associated with 116 SGCN,[1] of which 59 are birds, 2 are bats, and 24 are aquatic species (e.g., fish, crabs, clams). Examples of non-avian (i.e., birds and bats) SGCN that may be found in the Project area include diamondback terrapin, three-banded lady beetle, smooth greensnake, northern copperhead, black-bordered lemon moth, Jersey jair underwing, and Rambur's forktail. However, as previously stated, natural habitat is limited along the cable routes due to the developed nature of the Onshore Project area.

3.8.2 Impact Level Definitions for Coastal Habitat and Fauna

Definitions of impact levels are provided in Table 3.8-1. There are no beneficial impacts on coastal habitat and fauna.

Table 3.8-1 Impact Level Definitions for Coastal Habitat and Fauna

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
Minor	Adverse	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur are temporary or short term in nature.
Moderate	Adverse	Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.
Major	Adverse	Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them.

3.8.3 Impacts of the No Action Alternative on Coastal Habitat and Fauna

When analyzing the impacts of the No Action Alternative on coastal habitat and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for coastal habitat and fauna. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities, as described in Appendix F, *Planned Activities Scenario*.

3.8.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for coastal habitats and fauna described in Section 3.8.1, *Description of the Affected Environment for Coastal Habitat and Fauna*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitats and fauna include onshore residential, commercial, and industrial

[1] SGCN species are wildlife species experiencing a population decline (or some level of population decline) or have identified threats that may put them in jeopardy, are in need of timely management intervention or are likely to reach critical population levels in New York, or need conservation actions to maintain stable populations levels or sustain recovery (NYSDEC 2015).

development and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal habitats and fauna. Onshore construction activities and associated impacts are expected to continue and have the potential to affect coastal habitat and fauna through temporary and permanent loss of coastal habitat and temporary noise impacts, which can cause avoidance behavior and displacement. Injury or mortality of individual animals could occur, but population-level effects would not be expected. Climate change would contribute to impacts on coastal habitats and fauna through global warming, sea level rise, and resulting modifications to habitat and ecology. Climate change is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown intensity (Friggens et al. 2018). Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides (USDA n.d.). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species. The effects of climate change on animals will likely include loss of habitat, population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution (NJDEP 2020).

There are no ongoing offshore wind activities within the geographic analysis area for coastal habitat and fauna.

3.8.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include onshore development activities (see Appendix F, Section F.2.13 for descriptions) These activities may result in short-term and permanent impacts on coastal habitat and fauna, including habitat degradation, removal, and conversion; and disturbance, displacement, injury, and mortality of individual wildlife species.

Planned offshore wind activities could contribute to individual displacement, injury, mortality, and habitat loss or modification via noise, land disturbance, vehicle collisions, and climate change if there is overlap with the geographic analysis area. Activities from these projects would be temporary, and some fauna would likely return to disturbed areas following completion of construction, depending on the amount of land disturbance. BOEM is not aware of any planned offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna. However, if any planned offshore wind activities are identified and occur within the highly urbanized landscape of the geographic analysis area, impacts would be similar to those under the Proposed Action, and any adverse impacts on coastal habitats and fauna under the No Action Alternative would be minimal. While planned offshore wind activities may result in minimal onshore habitat impacts, offshore wind energy is expected to have a cumulative positive impact by helping to counteract climate change.

BOEM expects planned offshore wind activities to affect coastal habitat and fauna through the following primary IPFs.

Noise: Onshore construction noise associated with any planned offshore wind activities could result in temporary and highly localized impacts at the landing site, along the onshore export cable route, and at the onshore substation location. Impacts, if any, would be limited to behavioral avoidance of construction activity and noise. Displaced wildlife could use adjacent habitat and would likely repopulate these areas once construction ceases. Construction would likely occur in the highly developed and urbanized landscape areas of the New York metropolitan area where wildlife is already habituated to human activity and noise. Therefore, no individual fitness or population-level effects on wildlife would be expected.

Land disturbance: BOEM anticipates that any planned offshore wind activities would require minimal disturbance of undisturbed lands and habitats given the extent of the highly developed areas and urbanized landscapes of the geographic analysis area. Some clearing of vegetation may be required for constructing the landfall, widening a transmission right-of-way, or clearing the substation footprint, but construction would be expected to generally occur in previously disturbed areas and areas generally fragmented or disconnected from other natural habitats. Use of construction and maintenance equipment could result in collisions with wildlife. However, it is anticipated that wildlife collisions would be rare because wildlife presence is expected to be limited due to the urban environment and because most individuals are expected to avoid construction areas or have the mobility to avoid construction equipment. Therefore, no individual fitness or population-level impacts on wildlife would be expected to occur during land disturbance activities, and onshore construction associated with planned offshore wind development would not be expected to appreciably contribute to cumulative impacts on wildlife.

3.8.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, coastal habitats and fauna would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitats and fauna primarily through onshore construction and climate change. BOEM anticipates that the potential impacts of ongoing construction activities on coastal habitats and fauna would be minor, but impacts from climate change could be moderate. Therefore, the No Action Alternative would result in **moderate** impacts on coastal habitats, primarily driven by climate change.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on coastal habitat and fauna through construction-related activities that affect habitat, vegetation, and wildlife. Currently, there are no planned offshore wind activities proposed in the geographic analysis area. If any were to occur, they would have some potential to result in temporary disturbance and permanent loss of onshore habitat. However, habitat removal is anticipated to be minimal due to the developed and urbanized landscape of the geographic analysis area, and any impacts resulting from habitat loss or disturbance would not be expected to result in population-level effects within the geographic analysis area. BOEM anticipates the No Action Alternative would result in **moderate** impacts on coastal habitat and fauna, primarily driven by ongoing construction activities and climate change.

3.8.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on coastal habitat and fauna:

- The onshore export cable routes, including routing variants, and extent of ground disturbance, which could require the removal of vegetation; and

- The EW 2 onshore substations, which could require the removal of trees and shrubs in or on the edge of the construction footprint for Onshore Substation C.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- Onshore export cable routes and substation footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

3.8.5 Impacts of the Proposed Action on Coastal Habitat and Fauna

The sections below summarize the potential impacts of the Proposed Action on coastal habitat and fauna and special-status species during the various phases of the Projects. Routine activities would include construction, O&M, and decommissioning of the Projects, as described in Chapter 2, *Alternatives Including the Proposed Action*. BOEM will prepare a BA for the potential effects on USFWS federally listed species. Results of consultation with USFWS pursuant to Section 7 of the ESA will be presented in the Final EIS.

Noise: Construction noise could lead to temporary and highly localized disturbance and displacement of wildlife. Displaced individuals would likely return to the affected areas once the noise has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. BOEM expects these impacts to be limited and temporary in nature. Normal operation of the substation would generate continuous noise, but BOEM expects minimal associated impacts in the context of existing noises near the proposed substations that are generated from the highly developed and urbanized landscape around the substation sites. The impacts on coastal habitats and fauna of noise from the Proposed Action would add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that most of the onshore area where the onshore Project components would be constructed consists of the highly developed and urbanized landscape of the New York metropolitan area, terrestrial fauna in this area are likely to be already subject and habituated to anthropogenic noise. The impacts on coastal habitats and fauna from noise from the Proposed Action are anticipated to be minimal, and no individual fitness or population-level effects on wildlife would be expected.

Land disturbance: The expected impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. The EW 1 geographic analysis area (which also includes the O&M facility) is mostly devoid of natural habitat (i.e., is significantly altered by human development and primarily used for industrial and commercial operations) and would support species that associate with coastal urbanized areas (e.g., pigeons, seagulls, rodents). Therefore, impacts on wildlife from construction and operation of EW 1 onshore components and the O&M facility would be negligible, as no natural habitat would be affected.

Empire would implement trenchless technology (e.g., HDD or direct pipe) for the EW 2 offshore export cable landing to go under beaches and dunes, which would avoid beach and dune habitat (COP Volume 2b, Section 5.1.1.2; Empire 2022) and the state-designated Nassau Beach Significant Coastal Fish and Wildlife Habitat site; as such, temporary impacts on wildlife resulting from the landfall location would be minor. While habitats in the EW 2 geographic analysis area have also been significantly altered by human development, there are some small areas of tree and shrub habitat that could be affected, depending on the substation and onshore cable route selected; however, these more natural areas are isolated and surrounded by developed and urbanized areas.

To minimize disturbance, the majority of the proposed onshore export and interconnection cable routes would be sited in already-disturbed areas (e.g., existing roadways) to the extent practicable. Construction of EW 2 onshore export cable segment IP-C would require vegetation removal in three isolated areas between Long Beach Road and Daly Boulevard (6.44 acres herbaceous, 1.99 acres forest/wooded vegetation, and 0.41 acre scrub/shrub). Construction of EW 2 Onshore Substation C would require the removal of approximately 0.55 acre of tree/shrub habitat along the existing railroad corridor. Removal of trees would be a long-term impact while removal of scrub/shrub habitat would be short term.

Clearing and grading during construction within temporary workspaces would result in temporary loss of forage and cover for wildlife within the area. Construction of Onshore Substation C would result in short-term and permanent impacts on habitat from construction of the permanent substation facilities and use of temporary construction workspace. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Projects' operational lifetime. Landscaped areas would provide some habitat for species acclimated to human activity, which are the primary species types in the area given the surrounding developed and urbanized landscape. Any tree and shrub removal for onshore export cable installation would likely result in a maintained right-of-way of herbaceous/low shrub vegetation. No tree clearing is expected for EW 2 Onshore Substation A.

Empire would implement measures to avoid and minimize habitat impacts, including revegetating disturbed areas (COP Volume 2f, Table 9-1, APM 49; Empire 2022), implementing an invasive species control plan and invasive species survey (APM 48 and APM 57), limiting construction beyond existing disturbed areas (APM 55), implementing erosion and sediment control plans (APMs 45,46, 50, 52), and conducting site-specific mitigation (APM 54). Given the nature of the existing conditions of the Onshore Project areas (i.e., developed and highly urbanized with little or no natural habitat), Empire's commitment to measures to avoid and reduce habitat impacts, and the temporary nature of construction, the impacts on wildlife and habitat are expected to be minor.

3.8.5.1. Impact of the Connected Action

As described in Chapter 2, infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders), as well as some upland activities (building construction and paving). BOEM expects the connected action to affect coastal flora and fauna through the noise and land disturbance IPFs.

Noise: The expected impacts of noise associated with the connected action's activities alone could affect any wildlife that may be in the vicinity of the SBMT. However, similar to under the Proposed Action, construction noise would be temporary and localized and would not be anticipated to be significantly different than the noise levels in the surrounding urban environment. If pile driving is necessary during construction, the noise would be temporary and would cease after piles are installed. Similarly, dredging vessels and other construction noise could temporarily disturb wildlife, but wildlife that may be in the area are likely already acclimated to noise in an urban environment and would be able to move away from the noise. Normal operation at the SBMT would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises in the EW 1 Onshore Project area. BOEM anticipates noise impacts associated with the connected action to be negligible.

Land disturbance: Improvement activities at the SBMT would remove all existing structures and approximately 40 percent of the currently paved area. After additional excavation for installation of subsurface piles, utilities, and building structures, only minor grade changes are anticipated. The site would be repaved and new structures installed. Impacts on upland vegetation would be limited to removal of approximately 0.05 acre of volunteer invasive vegetation throughout the SBMT site and three poplar trees along the north side of the 35th Street Pier to replace a bulkhead, with each tree being approximately 4 inches in diameter at breast height. The removal of this vegetation is not anticipated to affect wildlife because it is low-quality habitat. Therefore, BOEM anticipates land disturbance associated with the connected action to be negligible.

3.8.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the primary IPFs of noise and land disturbance. Construction related to the connected action could affect coastal habitat and fauna through the removal of a few small trees and by generating temporary and localized noise. The construction, O&M, and decommissioning of onshore infrastructure for offshore wind activities in the geographic analysis area would also contribute to the primary IPFs of noise and land disturbance. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. BOEM is not aware of any planned offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna. However, if habitat removal is anticipated, it would be minimal and any related impacts would not be expected to result in individual fitness or population-level effects in the geographic analysis area.

The cumulative impact on coastal habitat and fauna would likely be moderate, mostly driven by climate change. The onshore cable routes and substation location are within highly developed areas and within the urbanized landscapes in the New York metropolitan area, where limited natural habitat and habitat connectivity are present. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative noise and land disturbance impacts on coastal habitat and fauna.

3.8.5.3. Conclusions

Impacts of the Proposed Action. In summary, activities associated with the construction, installation, O&M, and eventual decommissioning of the Proposed Action would have **minor** impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the geographic analysis area. The primary impacts of the Proposed Action affecting habitats and wildlife would be long-term habitat loss and conversion from onshore construction at Onshore Substation C and onshore export cable segment IP-C. The primary impacts of the connected action would be related to noise and land disturbance, which could affect wildlife in the EW 1 Onshore Project area. However, given the developed nature of the EW 1 Onshore area, wildlife are likely acclimated to activities similar to those related to the connected action; therefore, BOEM anticipates impacts of the connected action would be **negligible**.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on coastal habitat and fauna in the geographic analysis area would be **moderate**. In context of other reasonably foreseeable environmental trends in the area, the incremental impacts contributed by the Proposed Action to the cumulative impacts on coastal habitat and fauna would be undetectable. The Proposed Action would contribute to cumulative impacts primarily through the permanent impacts on habitat associated with the long-term impacts from habitat loss related to the EW 2 Onshore Station C site and cable route that would cross three isolated habitat areas.

3.8.6 Impacts of Alternatives B, E, and F on Coastal Habitat and Fauna

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. Coastal habitat and fauna impacts under Alternatives B, E, and F would be the same as those of the Proposed Action because these alternatives would differ only with respect to the WTG offshore component (WTGs in different positions in the Lease Area), and the WTGs would be outside of the geographic analysis area. Therefore, the impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives B, E, and F on coastal habitat and fauna would be the same as those of the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on coastal habitat and fauna would be undetectable. The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action.

3.8.6.1. Conclusions

Impacts of Alternatives B, E, and F. As discussed above, the expected **minor** impacts associated with the Proposed Action would not change under Alternative B, E, or F because the alternatives would only differ in offshore WTG components, which would be outside of the geographic analysis area.

Cumulative Impacts of Alternatives B, E, and F. Because the impacts of the Proposed Action would not change under Alternative B, E, or F, BOEM anticipates that the cumulative impacts of Alternatives B, E, and F would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, E, and F would be **moderate**.

3.8.7 Impacts of Alternative C, D, and G on Coastal Habitat and Fauna

Impacts of Alternatives C, D, and G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, or G would be the same as those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), to avoid the sand borrow area (Alternative D), or to use a cable bridge to cross Barnums Channel (Alternative G) are already covered under the Proposed Action as part of the PDE approach, and narrowing the submarine and onshore cable route options under Alternative C, D, or G would not materially change the analyses of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives, C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C, D, or G to the cumulative impacts on coastal habitat and fauna would be undetectable. The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action.

3.8.7.1. Conclusions

Impacts of Alternatives C, D, and G. As discussed above, the expected **minor** impacts associated with the Proposed Action would not change under Alternative C, D, or G.

Cumulative Impacts of Alternatives C, D, and G. Because the impacts of the Proposed Action would not change under Alternative C, D, or G, BOEM anticipates that the cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives C, D, and G would be **moderate**.

3.8.8 Impacts of Alternative H on Coastal Habitat and Fauna

Impacts of Alternative H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be the same those described under the Proposed Action. An alternate method of dredge and fill activity at the SBMT to reduce the discharge of dredged material would not materially change the analysis of any IPF, as the Onshore Project area is highly developed with a lack of natural habitats. BOEM does not anticipate any change in dredge and fill activity would affect undisturbed or natural areas. All other offshore and onshore Project components of Alternative H would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on coastal habitat and fauna would be undetectable. The cumulative impacts on coastal habitat and fauna would be moderate for the same reasons described for the Proposed Action.

3.8.8.1. Conclusions

Impacts of Alternative H. As discussed above, the expected **minor** impacts associated with the Proposed Action would not change under Alternative H.

Cumulative Impacts of Alternative H. Because the impacts of the Proposed Action would not change under Alternative H, BOEM anticipates that the cumulative impacts of Alternative H would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative H would be **moderate**.

3.8.9 Comparison of Alternatives

Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on coastal habitat and fauna from those alternatives would be the same as those under the Proposed Action—**minor**.

Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is highly developed with little or no habitat. Therefore, the overall impact level would not change—**minor**.

In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H in combination with ongoing and planned activities would be the same as that of the Proposed Action for individual IPFs—minor. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative B, C, D, E, F, G, or H to the impacts from ongoing and planned activities would result in **moderate** cumulative impacts on coastal habitats and fauna in the geographic analysis area. Ongoing and planned activities contributing to impacts on coastal habitats and fauna in the geographic analysis area include climate change and habitat impacts.

3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographic, employment, and economic conditions from the Projects, alternatives, and ongoing and planned activities in the geographic analysis area for demographics, employment, and economics (shown on Figure 3.11-1). The demographics, employment and economics geographic analysis area includes the counties and municipalities where proposed onshore infrastructure and potential port cities are located: Kings, Nassau, and Albany Counties, including Town of Hempstead, City of Long Beach, and Village of Island Park in New York State and Nueces and San Patricio Counties in Texas (a port in the Corpus Christi, Texas area could be a starting point for transporting the OSS topsides for EW 1 and EW 2). Tables I-7 through I-24 in Appendix I provide detailed demographic and employment information for these areas, including information from the 2020 census (U.S. Census Bureau 2020). Data for New York State is also provided for reference. This section also considers the other counties that may be affected by visual or recreation and tourism impacts, which may have impacts on property values or recreation and tourism economies (i.e., Manhattan, Queens, and Suffolk in New York State and Monmouth and Ocean Counties in New Jersey). For these counties and states, data on the economic value of the recreation and tourism industries are provided in Table I-21 in Appendix I.

3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics

Kings, Nassau, and Albany Counties

New York has always been one of the top tourism destinations in the world. The industry is mainly centered around the New York City region (including Brooklyn). The Long Island region is the second largest tourism region. As a result, the tourism industry is a key component and driver of these local economies (COP Volume 2e, Section 8.3; Empire 2022).

Kings County

The population of Kings County increased by 11.0 percent from 2000 to 2020, compared to 6.5 percent in New York State overall. The population of Kings County is younger than in the other affected New York counties and New York State as a whole, with 23.0 percent aged 0–17 and 26.6 percent aged 18–34 (U.S. Census Bureau 2019a).

In 2021, the annual unemployment rate in Kings County was approximately 10.1 percent, and the overall New York State unemployment rate was 6.9 percent (U.S. Bureau of Labor Statistics 2021a, 2021b). In 2015–2019, the unemployment rate in Kings County was relatively high (6.2 percent) compared to the other affected areas and New York State as a whole (5.5 percent) (U.S. Census Bureau 2019a). In 2020, the Kings County gross domestic product (GDP) totaled approximately $86.2 billion (U.S. BEA 2021).

Kings County (i.e., Brooklyn) is notable for the importance of coastal tourism and recreation to its economy and a relatively high proportion of seasonal housing compared with the other affected counties and municipalities in the geographic analysis area (aside from the City of Long Beach). In 2018, Kings County had 3,759 establishments, 33,229 employees, $899.2 million in total wages, and $1.8 billion in GDP resulting from tourism and recreation (National Ocean Economics Program 2018). In Kings County, nearly 1 percent of housing units are seasonally occupied (similar to Nassau County), compared to approximately 4 percent in New York State overall (U.S. Census Bureau 2019a).

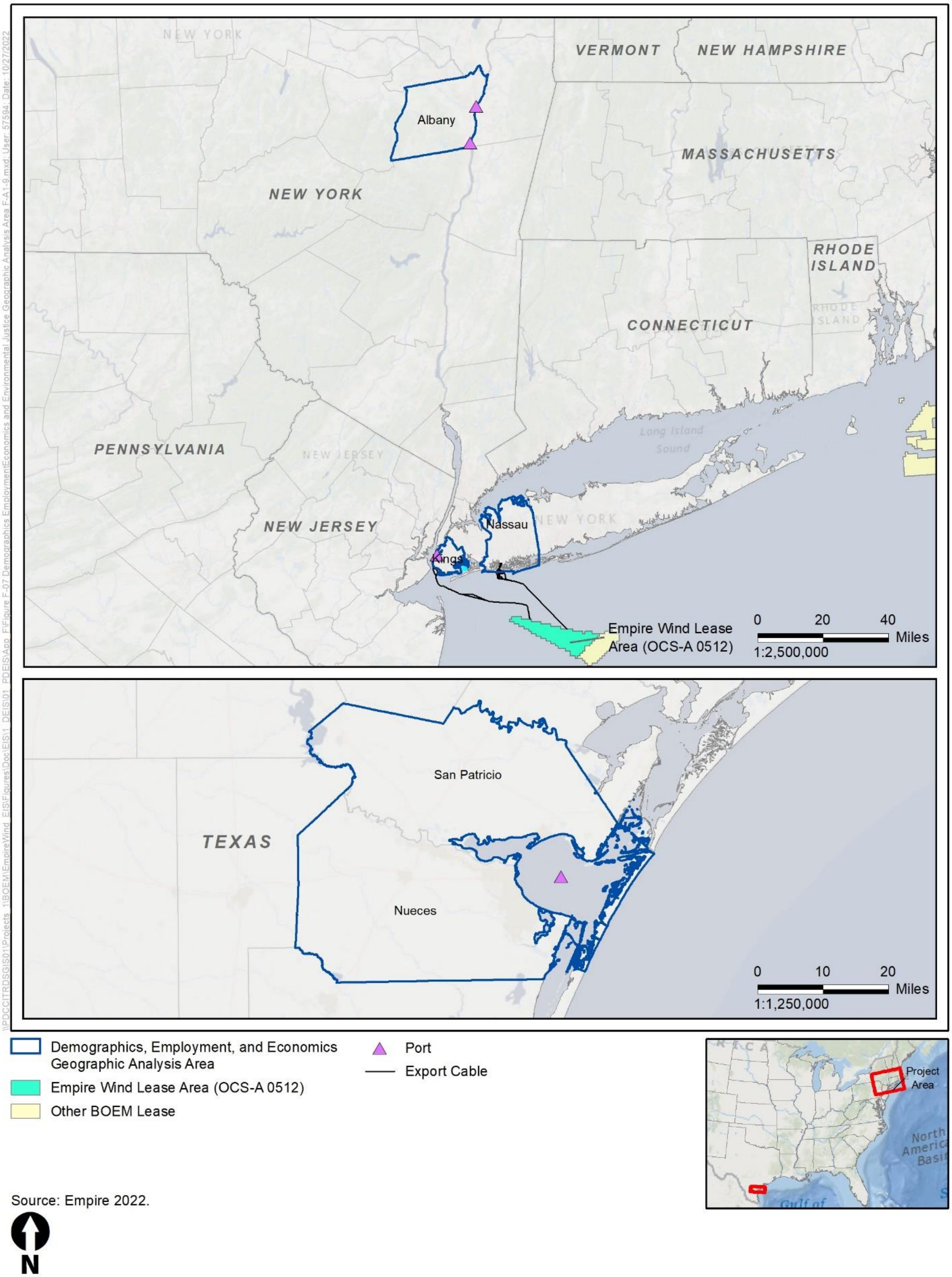

Figure 3.11-1 Demographics, Employment, and Economics Geographic Analysis Area

The industries that would be most affected by the Proposed Action include recreation and tourism, retail, and construction. A review of the industries that employ workers in Kings County (Table I-14 in Appendix I) reveals that Brooklyn has one of the lowest proportion of jobs in the entertainment, recreation, accommodation, and food services sectors (7.3 percent), aside from the City of Albany (4.3 percent) and Albany County (7 percent). Meanwhile, New York State overall has 9.9 percent of its jobs in the recreation and tourism-related sectors, and the City of Long Beach has the highest at 16.9 percent. In terms of other industries that may be affected by the Proposed Action, Kings County has a modest proportion of retail trade jobs (8.8 percent), compared to 9.3 percent in New York State overall, and 3.9 percent of jobs are in construction (compared to 4.1 percent in New York State as a whole) (U.S. Census Bureau 2019b). The largest proportion of jobs in Brooklyn is in Health Care and Social Assistance (31.4 percent), followed by Education Services (11.6 percent).

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation, among others. Tables I-17 and I-18 in Appendix I report data on the Ocean Economy as a whole in terms of GDP and employment, respectively. In Kings County, tourism and recreation accounted for 87.8 percent of the overall Ocean Economy GDP (NOAA 2018) (see Table I-17 in Appendix I). This category includes recreational and charter fishing, as well as commercial ferry services.

The "living resource" sector of the Ocean Economy includes commercial fishing, aquaculture, seafood processing, and seafood markets. Although the number employed or self-employed in this sector in Kings County is small compared to recreation and tourism, Brooklyn has a higher proportion of these jobs (3.9 percent) compared to Nassau County (2.5 percent), of all the Ocean Economy sectors.

Nassau County

The population of Nassau County increased by 4.6 percent from 2000 to 2020, compared to 11.0 percent growth in Kings County, and 6.5 percent in New York State overall. The population of Nassau County is slightly older than in the other affected New York counties and New York State as a whole, with 40.5 percent aged 35–64 and 17.5 percent aged over 65 (U.S. Census Bureau 2019a). Nassau County also has the oldest median age (42) compared to the other affected New York counties (35–40) and New York State overall (39).

In 2021, the annual unemployment rate in Nassau County was 4.5 percent, compared to the overall State of New York average of 6.9 percent (U.S. Bureau of Labor Statistics 2021a, 2021b). In 2015–2019, the unemployment rate in Nassau County was relatively low (3.9 percent) compared to the other affected areas and New York State as a whole (5.5 percent) (U.S. Census Bureau 2019a). In 2020, Nassau County had approximately $83.0 billion in GDP (U.S. BEA 2021). In 2018, Nassau County had 1,396 establishments, 17,392 employees, $421.9 million in total wages, and $794.1 million in GDP resulting from tourism and recreation (National Ocean Economics Program 2018). In Nassau County, nearly 1 percent of housing units are seasonally occupied (similar to Kings County), compared to approximately 4 percent in New York State overall (U.S. Census Bureau 2019a).

A review of the industries that employ workers in Nassau County (Table I-14 in Appendix I) reveals that Nassau County has 9.5 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors compared with 9.9 percent in New York State overall. In terms of other industries that may be affected, Nassau County has a relatively high proportion of retail trade jobs (12.0 percent compared to 9.3 percent in New York State overall), and 4.9 percent of jobs are in construction (compared to 4.1 percent in New York State as a whole) (U.S. Census Bureau 2019b).

In 2018, tourism and recreation (including recreational and charter fishing, and commercial ferry services) in Nassau County accounted for 74.6 percent of the overall Ocean Economy GDP, compared to 87.8 percent in Brooklyn (NOAA 2018) (see Table I-17 Appendix I).

The "living resource" sector of the Ocean Economy, which includes commercial fishing, aquaculture, seafood processing, and seafood markets, includes 2.5 percent of the Ocean Economy jobs in Nassau, compared to 3.9 percent in Brooklyn.

Albany County

The population of Albany County increased by 6.9 percent from 2000 to 2020, which was similar to the population increase in New York State overall (6.5 percent). The age of the population of Albany County is comparable to New York State as a whole, with a median age of 38 compared to 39 in New York State overall.

In 2021, the annual unemployment rate for Albany County was relatively low at 4.4 percent (U.S. Bureau of Labor Statistics 2021a). In 2015–2019, the unemployment rate in Albany County (4.5 percent) was slightly lower than the rate for New York State overall (5.5 percent) (U.S. Census Bureau 2019a). The Albany County GDP totaled approximately $28.2 billion in GDP in 2020 (U.S. BEA 2021). Data on the economic value of the tourism and recreation sector for Albany County are not available from the National Ocean Economics Program for 2018 (likely because Albany is a watershed county, not a coastal county). Albany County has one of the largest percentages of seasonal housing units (1.3 percent) of the affected areas, compared to approximately 1 percent in Brooklyn and Nassau and 4 percent in New York State overall (U.S. Census Bureau 2019a).

A review of the industries that employ workers in Albany County (Table I-14 in Appendix I) reveals that Albany County has 7.0 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors, which is the second lowest proportion of all the affected areas in New York State (with the lowest being in the City of Albany). In terms of other industries that may be affected, Albany County has a relatively modest proportion of retail trade jobs (8.2 percent) compared to 8.8 percent in Brooklyn, 12.0 percent in Nassau County, and 9.3 percent in New York State overall. In Albany County, 3.2 percent of jobs are in construction, which is the second lowest of any affected area in New York State (with the lowest again being the City of Albany) (U.S. Census Bureau 2019b). The sectors with the highest proportion of jobs include Public Administration (21.7 percent) and Health Care and Social Assistance (16.2 percent).

In Albany County, tourism and recreation data are not available from the National Ocean Economics Program for 2018. The Ocean Economy GDP is just 0.1 percent of the total county GDP (NOAA 2018). Marine Transportation is the only sector of the Ocean Economy for which employment data are available for Albany County in 2018 (594 employees) (NOAA 2018).

City of Albany, Albany County

The proposed port in Albany County is the Port of Albany in the City of Albany. The population of the City of Albany increased by 3.7 percent from 2000 to 2020, which was lower than in Albany County (6.9 percent) and New York State overall (6.5 percent). The median age of the population of the City of Albany (31 years) is lower than in any other affected area, likely due to the presence of colleges and universities. Correspondingly, the percentage of population aged 18–34 is higher in the City of Albany than in the other affected areas (37.9 percent) compared with 27.8 percent in Albany County and 24 percent in New York State overall.

In 2015–2019, the unemployment rate in the City of Albany was the highest (7.1 percent) of other affected areas (5.5 percent in New York State overall) (U.S. Census Bureau 2019a).

As in Albany County, the industries in the City of Albany with the largest proportion of jobs are Public Administration (37.9 percent) followed by Health Care and Social Assistance (19.3 percent).

The City of Albany has the lowest percentage of its jobs in the entertainment, recreation, accommodation, and food services sectors (4.3 percent) compared with the other affected areas, next to Albany County (7.0 percent). Correspondingly, the City of Albany also has the lowest percentages of seasonal homes (0.3 percent), aside from the Village of Island Park, which does not contain any seasonal homes.

Town of Hempstead, City of Long Beach, and Village of Island Park, Nassau County

The affected municipalities within Nassau County include the Town of Hempstead, City of Long Beach, and Village of Island Park. Of these areas, the City of Long Beach has the most notable recreation and tourism economy, with 16.9 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors (compared with 10.6 percent in the Town of Hempstead and 11.9 percent in Island Park). Long Beach also has the highest percentage of seasonal homes (approximately 6 percent) compared with any other affected area in New York State (including less than 1 percent in the Town of Hempstead and 0 percent in Island Park).

Nueces and San Patricio Counties, Texas

Nueces County, Texas

In 2020, the population of Nueces County totaled 353,178 people, an increase of 12.6 percent from 2000. The age distribution of the population of Nueces County is comparable to that of San Patricio County, with the largest share of residents falling into the 35–64 age bracket and the median age being 36 years old.

In 2021, the annual unemployment rate in Nueces County (6.7 percent) was lower than in the neighboring San Patricio County (8.6 percent), but greater than the state average (5.7 percent) (U.S. Bureau of Labor Statistics 2021a, 2021b). In 2015–2019, the unemployment rate in Nueces County (5.7 percent) was similar to the rate for New York State overall (5.5 percent) and slightly higher than in neighboring San Patricio County (5.1 percent) (U.S. Census Bureau 2019a). In 2020, Nueces County had a GDP of approximately $18.9 billion (U.S. BEA 2021). In 2018, the National Ocean Economics Program totaled $1.5 billion in GDP across all ocean sectors in Nueces County. In 2018, Nueces County had 13,488 employees and $574.6 million in GDP resulting from tourism and recreation (National Ocean Economics Program 2018). Nueces County has the third largest percentage of seasonal housing units (3.2 percent) of the affected areas, next to San Patricio County (3.7 percent) (U.S. Census Bureau 2019a).

A review of the industries that employ workers in Nueces County (Table I-14 in Appendix I) reveals that the county has roughly 13 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors. In terms of other industries that may be affected, Nueces County has a relatively modest proportion of retail trade jobs (9.8 percent). The other sectors with the highest proportion of jobs include Health Care and Social Assistance (20.8 percent) and Construction (11.1 percent) (U.S. Census Bureau 2019b).

In addition to the tourism and recreation sector, Nueces County employs individuals in offshore mineral extraction (2,453 employees) and marine transportation (558 employees). The Ocean Economy GDP is approximately 7.5 percent of the total GDP in Nueces County (NOAA 2018) (see Table I-17 in Appendix I).

San Patricio County, Texas

In 2020, the total population of San Patricio County was 68,755 individuals, a 6.1-percent increase from 2010, although the population experienced a slight decline between 2000 and 2010 (-3.5 percent). The age distribution of residents in San Patricio County is similar to that of Nueces County, with the largest share being aged 35–64. The median age of the county's population is 36 years.

As mentioned above, in 2021, the San Patricio County annual unemployment rate was relatively high, at 8.6 percent (U.S. Bureau of Labor Statistics 2021a). In 2015–2019, the unemployment rate in San Patricio County was 5.1 percent, which was the same as the rate for Texas overall, and just lower than the rate for New York State overall (5.5 percent) (U.S. Census Bureau 2019a). The GDP in San Patricio County was notably lower than in the neighboring Nueces County, with approximately $2.6 billion in 2020 compared to $18.9 billion (U.S. BEA 2021).

The Ocean Economy GDP totaled $588.6 million across all ocean sectors in San Patricio County. In 2018, San Patricio County employed 1,766 individuals in the tourism and recreation sector, which totaled $60.4 million in GDP (National Ocean Economics Program 2018). San Patricio County has the second largest percentage of seasonal housing units among affected areas for the proposed Projects (3.7 percent) (U.S. Census Bureau 2019a).

A review of the industries that employ workers in San Patricio County (Table I-14 in Appendix I) reveals that San Patricio County has 12.5 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors compared to 12.8 percent in Nueces County. In terms of other industries that may be affected, San Patricio County has a relatively high proportion of retail trade jobs (10.6 percent compared to 9.8 percent in Nueces County), and 31.2 percent of jobs are in construction (compared to 11.1 percent in Nueces County) (U.S. Census Bureau 2019b).

In San Patricio County, tourism and recreation accounted for 10.3 percent of the overall Ocean Economy GDP, compared to 37.6 percent in Nueces County (NOAA 2018) (see Table I-17 in Appendix I). However, the Ocean Economy GDP makes up 24.7 percent of San Patricio County's total county GDP, the largest share of all affected areas (NOAA 2018) (see Table I-17 in Appendix I).

Other Counties in Visual/Recreation and Tourism Affected Areas

Recreation and tourism play a major role in New York's and New Jersey's environments and economies. Visitors from all over the world travel to the area to partake in a variety of onshore and marine recreational activities. Marine recreational activities include wildlife viewing tours, scuba diving, and recreational fishing and boating. Popular onshore recreational activities include beach going, surfing, golfing, and scenic viewing. In 2017, New York State reported that tourists directly spent $67.6 billion in the state, a record high for the state. In New Jersey, visitors directly spent over $45 million in the state (COP Volume 2e, Section 8.3; Empire 2022).

New York, Queens, and Suffolk Counties, New York

In 2020, the New York State GDP was approximately $1.42 trillion (U.S. BEA 2021). The New York County GDP totaled approximately $610.4 billion, compared to $82.3 billion in Queens and $84.8 billion in Suffolk County. In 2018, Manhattan had 9,621 establishments, 217,305 employees, $9,207.3 million in total wages, and $22.2 billion in GDP resulting from tourism and recreation—greater than in any other affected area in New York State (National Ocean Economics Program 2018). In 2018, in Suffolk County there were 2,741 establishments, 36,385 employees, $921.1 million in total wages, and $1.9 billion in GDP; and in Queens there were 1,299 establishments, 11,581 employees, $277.4 million in total wages, and $510.0 million in GDP resulting from tourism and recreation. In New York State overall, there were

22,270 establishments, 359,194 employees, $12.6 billion in total wages, and $29.0 billion in GDP resulting from tourism and recreation in 2018.

Monmouth and Ocean Counties, New Jersey

In 2020, the GDP for the State of New Jersey was approximately $535.8 billion (U.S. BEA 2021). In 2021, the annual New Jersey unemployment rate was approximately 6.3 percent, which was higher than that of Monmouth (4.9 percent) and Ocean (5.3 percent) Counties (U.S. Bureau of Labor Statistics 2021a, 2021b). The Monmouth County GDP in 2020 was approximately $32.0 billion compared to $19.0 billion in Ocean County (U.S. BEA 2021).

As discussed above, recreation and tourism plays a major role in New Jersey's economy. New Jersey overall had 7,949 establishments, 96,261 employees, $2.2 billion in total wages, and $4.3 billion in GDP resulting from tourism and recreation in 2018. Within New Jersey, Monmouth County has a stronger tourism and recreation economy compared with Ocean County (see Table I-21 in Appendix I). In 2018, Monmouth County had 1,324 establishments, 17,767 employees, $369.0 million in total wages, and $704.7 million in GDP resulting from tourism and recreation, compared with 1,155 establishments, 14,049 employees, $288.2 million in total wages, and $569.5 million in GDP in Ocean County.

Trends under the No Action Alternative

Over the Projects' proposed lifetime, BOEM does not anticipate major changes to the distribution of economic sectors in the geographic analysis area. The affected counties would continue to rely economically on coastal tourism and recreation. The geographic analysis area may experience substantial increased economic activity associated with offshore wind activities, as discussed in the next section.

3.11.2 Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-1.

Table 3.11-1 Impact Level Definitions for Demographics, Employment, and Economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts would not disrupt the normal or routine functions of the affected activity or geographic place.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Projects.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.11.3 Impacts of the No Action Alternative on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for demographics, employment, and economics. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.11.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for demographics, employment, and economics described in Section 3.11.1, *Description of the Affected Environment for Demographics, Employment, and Economics,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on demographics, employment, and economics include growth in onshore development; ongoing installation or upgrades of piers, bridges, pilings, and seawalls or submarine cables and pipelines; ongoing commercial shipping; continued port upgrades and maintenance; and ongoing effects from climate change (e.g., damage to property and coastal infrastructure) (see Section F.2 in Appendix F for a complete description of ongoing activities). These ongoing activities contribute to numerous IPFs including energy generation/security, which has implications for employment and state and regional energy markets; noise, which can affect residential and other sensitive populations; port utilization, which can affect jobs, populations, and economies; marine traffic, which can affect commercial fishing/shipping and recreation and tourism economies; land disturbance/onshore construction, which supports local population growth, employment, and economies; and climate change, which has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors. See Table F1-9 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for demographics, employment, and economics.

There are no ongoing offshore wind activities within the geographic analysis area for demographics, employment, and economics.

3.11.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Offshore wind could become a new industry for the Atlantic states and the nation. Several recent reports provide national estimates of employment and economic activity. These studies acknowledge that offshore wind component manufacturing and installation capacity exists primarily outside the United States; however, domestic capacity is anticipated to increase. This EIS uses available data, analysis, and projections to make reasoned conclusions on potential economic and employment impacts within the geographic analysis area. The EIS provides no analysis or conclusions about impacts outside the geographic analysis area (i.e., regional, national, or worldwide).

The BVG (2017) study estimated that during the initial implementation of offshore wind projects along the U.S. northeast coast, a base level of 35 percent of jobs, with a high probability of up to 55 percent of jobs, would be sourced from within the United States. The proportion of jobs filled within the United

States would increase as the offshore wind energy industry grows, due to growth of a supply chain and supporting industries along the East Coast, as well as a growing number of local O&M jobs for established wind facilities. By 2030 and continuing through 2056, approximately 65 to 75 percent of jobs associated with offshore wind are projected to be within the United States. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would fill jobs outside of the United States (BVG 2017). As an example of the mix of local, national, and foreign job creation, for the five-turbine Block Island Wind Farm, turbine blade manufacturing occurred in Denmark, generator and nacelle manufacturing occurred in France, tower component manufacturing occurred in Spain, and foundation manufacturing occurred in Louisiana (Gould and Cresswell 2017).

The American Wind Energy Association (AWEA) estimates that the offshore wind industry will invest $80 to $106 billion in U.S. offshore wind development by 2030, including $28 to $57 billion invested within the United States, depending on installation levels and supply chain growth (other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects) (AWEA 2020). Economic and employment impacts would occur nationwide, but would be most concentrated in Atlantic coastal states that host offshore wind development. The AWEA report lists over $1.3 billion in announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction in Atlantic states (AWEA 2020). The AWEA report analyzes a base scenario and a high scenario for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030. The high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Under the base scenario, offshore wind energy development would support $14.2 billion in economic output and $7 billion in value added by 2030. Under the high scenario, offshore wind energy development would support $25.4 billion in economic output and $12.5 billion in value added by 2030. The AWEA analysis does not specify where supply chain growth would occur in the U.S.

The AWEA estimates are consistent with the University of Delaware (2019) projections, which estimate that deployment of 18.6 GW of planned and contracted offshore wind energy projects through 2030 would require capital expenditures of $68.2 billion over the next 10 years (University of Delaware 2019). The study notes that, while the offshore wind supply chain is global and the expenditures would be directed to both domestic and foreign sources, a growing number of U.S. suppliers are preparing to enter the industry. Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2019 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $63.5 billion in Rhode Island to $1.73 trillion in New York (U.S. BEA 2020), and totaled nearly $5.0 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.5 percent of the combined GDP of these states.

The AWEA study estimates offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) jobs—full-time equivalent (FTE) jobs at a given point in time—in the year 2030 nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs are created during the temporary construction phase. About 60 percent of jobs would be short term (development and construction) and 40 percent would be long term (O&M). A 2020 study commissioned by the Responsible Offshore Development Alliance estimated that offshore wind projects through 2030 would generate 55,989 to 86,138 job-years (an FTE job lasting 1 year) for construction and 5,003 to 6,994 long-term jobs for O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the Georgetown Economic Services study concludes that a greater proportion of jobs would be in the construction phase. As with the AWEA estimates of economic output, the Responsible Offshore Development Alliance study assumed that offshore wind energy jobs would be focused in states hosting offshore wind projects, but would also be generated in other states where manufacturing and other supply chain activities occur.

In 2019, employment in New York and New Jersey combined was 13.6 million (U.S. Census Bureau 2019b). Because projected offshore wind jobs could be anywhere in the United States, the extent of impacts on the geographic analysis area cannot be clearly foreseen; however, a substantial portion of the workforce for planned New York and New Jersey offshore wind projects would likely be drawn from, or would relocate to, areas within commuting distance of ports that would be used for offshore wind staging, construction, and operations.

Some local economic activity has already begun in preparation for the anticipated offshore wind industry. For example, New York is one of several states working together with industry to develop a regional offshore wind training infrastructure to support a growing U.S. offshore wind industry. The establishment of a New York State Advisory Council on Offshore Wind Economics and Workforce Development as well as public investments will support the development of an offshore wind workforce. In 2020, the $20 million New York State Offshore Wind Training Institute was launched through State University of New York’s Farmingdale State College and Stony Brook University campuses. These academic centers on Long Island are developing a plan for deploying the public funds and have issued the first solicitation for $3 million to support organizations focusing on early training and skills development for disadvantaged communities. The developers of New York’s Sunrise Wind project have invested $10 million in a National Offshore Wind Training Center at Suffolk County Community College on Long Island. The training center will train and certify workers through the nation’s first Global Wind Organization Training Center for offshore wind, also on Long Island. In addition, the Center of Excellence for Offshore Energy at State University of New York’s Maritime College was launched with a grant from New York State; the center is working to develop classroom and online training programs (NYSERDA 2021).

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects planned offshore wind activities to affect demographics, employment, and economics through the following primary IPFs.

Energy generation/security: Once built, over the long term, planned offshore wind could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Offshore wind could significantly increase the proportion of energy from renewable sources not subject to fossil fuel costs, with a potential for 9,000 MW of power (30.7 trillion British thermal units, compared to 933.1 trillion British thermal units currently provided by all power generation sources in New York) from offshore wind development for New York (U.S. Energy Information Administration 2019). The economic impacts of offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security could be long term, minor, and beneficial.

Lighting: The aviation warning lighting required for offshore WTGs would be visible from some beaches and coastlines and could have effects on economic activity in certain locations; for example, if the lighting influences visitors and residents in selecting coastal locations to visit or reside in, respectively. At night, required aviation obstruction lighting on the WTGs would consist of red lights on the nacelle flashing 30 times per minute, as well as mid-tower red lights flashing at the same frequency. No readily available studies characterize the impacts of nighttime offshore lighting on economic activity. Studies cited in Section 3.18, *Recreation and Tourism*, suggest that WTGs visible from more than 15 miles (24.1 kilometers) away would have negligible effects on businesses dependent on recreation and tourism activity. The vast majority of the WTG positions envisioned offshore of the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs, so impacts are anticipated to be negligible. As a result, lighting on WTGs would have a continuous, long-term negligible impact on demographics, employment, and economics, due to the distant and variable views of nighttime lighting from coastal businesses.

ADLS is an emerging technology that, if implemented, would only activate aviation warning lighting on WTGs when aircraft enter a predefined airspace. Depending on exact location and layout, ADLS would likely result in similar limits on the frequency of WTG aviation warning lighting use on offshore wind facilities. Implementation of ADLS could thus reduce the amount of time that WTG lighting is visible, thereby making WTG lighting visible only sporadically, rather than continuously, at night. This would reduce the time when WTG lighting is visible.

Nighttime construction and maintenance of offshore wind projects would require lighting for vessels in transit and at offshore construction work areas. Concurrent construction of planned offshore wind projects in the New York and New Jersey region between 2023 and 2030 (Appendix F, Table F2-1) would all potentially contribute to nighttime vessel lights. Vessel lighting would enable commercial shipping and commercial fishing operations to safely navigate around the vessels and work areas and would be visible from coastal locations, primarily while the vessels are in transit. Vessel lighting is not anticipated to affect the volume of business at visitor-oriented businesses or other businesses. Vessel lighting would be visible from coastal businesses, especially near the ports used to support offshore wind construction, but would be anticipated to have negligible impacts on demographics, employment, and economics.

Noise: Noise from G&G survey activities, O&M, pile driving, trenching, and vessels could result in temporary impacts on employment and economics via the impacts on marine businesses, including commercial fishing, for-hire recreational fishing, and recreational sightseeing, among others. Noise (especially from G&G surveys and pile driving) would also affect fish populations, with effects on commercial and for-hire fishing (see Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*).

Population-level impacts on marine mammals would have impacts on employment and economic activity as a result of the impact on marine sightseeing businesses, such as whale watching tours, that benefit from the visible presence of marine mammals in the waters offshore from the geographic analysis area. As stated in Section 3.15, *Marine Mammals*, noise impacts associated with future offshore wind development could contribute to impacts on individual marine mammals. If construction activities from multiple projects occur in close spatial and temporal proximity, population-level impacts are possible; however, as noted in Section 3.15, BMPs can minimize exposure of individual mammals to harmful impacts and avoid population-level effects.

Offshore wind-related construction noise from pile driving, cable laying and trenching, and vessels are anticipated to have an impact on tour boat and for-hire fishing businesses, potentially making the affected areas temporarily unattractive for visitor-oriented businesses. Impacts would be localized and temporary.

Overall, offshore wind–generated noise could result in visitor-oriented services avoiding areas of noise and impacts on marine life important for fishing and sightseeing. Section 3.9 provides detail on potential economic impacts on commercial and for-hire fishing businesses. Both types of impacts would be localized and short term, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance. Noise impacts during surveys and construction would be more widespread when multiple offshore wind projects are under construction at the same time in the marine area off the coast of the geographic analysis area. As indicated in Appendix F, Table F2-1, the New York and New Jersey Lease Areas could have 1,205 WTGs installed between 2023 and 2030.

Onshore construction noise could temporarily inconvenience visitors, workers, and residents, possibly resulting in a short-term reduction of economic activity for businesses near installation sites for onshore cables, substations, or port improvements. Because the location of onshore improvements is not known and cannot be determined until specific projects are proposed, the magnitude of noise associated with onshore construction and the number of businesses and homes affected cannot be determined. Impacts on demographics, employment, and economics from noise would be intermittent, short term, and negligible, similar to those of other onshore utility construction activity.

Port utilization: Planned offshore wind development would support use and expansion of ports and supporting industries in New York and New Jersey, including the ports indicated as possibly supporting construction of the proposed Projects. The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro and SBMT are being upgraded specifically to support the construction of offshore wind energy facilities.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to beneficial local and regional economic activity. Where existing ports are improved and channels are dredged for use in support of offshore wind, the improvements would also be beneficial to other port activity. Port utilization in the geographic analysis area associated with offshore wind would occur primarily during development and construction of projects offshore of New York and New Jersey, which are anticipated to occur primarily between 2023 and 2030. Ongoing maintenance and operational support would sustain port activity and employment at a lower level once construction is complete.

The port investment and usage generated by offshore wind would have long-term, beneficial impacts on employment and economic activity by providing employment opportunities and supporting marine service industries such as marine construction, ship construction and servicing, and related manufacturing. The most intensive beneficial impacts would occur during construction of offshore wind projects near the geographic analysis area between 2023 and 2030. The beneficial impact of offshore wind O&M services and improved port facilities would provide sustained, long-term employment and economic activity.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries such as marine construction, ship construction and servicing, and related manufacturing. If offshore wind construction results in competition for scarce berthing space and port service, port usage could potentially have short- to medium-term adverse impacts on commercial shipping (see Section 3.9).

Presence of structures: The structures required for planned offshore wind, including the 1,205 WTGs planned offshore New York and New Jersey (Appendix F, Table F2-1), could affect marine-based businesses. Commercial fishing operators, marine recreational businesses, and shore-based supporting services (such as seafood processing) could experience both short-term impacts during construction and long-term impacts from the presence of structures (see Section 3.9).

Although the likelihood of recreational vessels visiting offshore foundations would vary based on relative proximity to shore, increasing offshore wind development could change recreational fishing patterns within the larger socioeconomic geographic analysis area, as the tourist industry learns to make use of the structures. Businesses that would benefit from fish aggregation and reef effects—such as those that cater to highly migratory species and offshore fishing recreationists—may grow. The attraction of anglers to offshore wind structures is not anticipated to result in a volume of new recreational fishing large enough to replace or displace commercial fishing businesses by recreational fishing businesses.

In summary, as a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities such as fishing and tourism—and the possibility of tours for visitors interested in a close-up view of the wind structures, as has occurred for the Block Island Wind Farm.

The views of offshore WTGs could have impacts on certain businesses serving the recreation and tourism industry. Impacts could be adverse for particular locations if visitors and customers avoid certain businesses (i.e., hotels or rental dwellings) due to views of the WTGs; impacts could be neutral or beneficial if views do not affect visitor decisions or influence some visitors beneficially. As presented in Section 3.10.5.2, up to 111 WTGs associated with planned offshore wind projects would be visible from beaches and coastal areas in the geographic analysis area for recreation and tourism.

A joint research study of the University of Connecticut and Lawrence Berkeley National Laboratory found no net effects from WTGs on property values (Atkinson-Palombo and Hoen 2014). The study examined impacts of 41 onshore WTGs 0.25 to 1 mile (0.4 to 1.6 kilometers) from residences. The study noted weak evidence linking the announcement of new WTGs to adverse impacts on home prices, and found that those effects were no longer apparent after the start of WTG operations. The effects of offshore wind structures would be different from those in the report data in that offshore WTGs would be much larger than the onshore WTGs, but much farther from residences, and would appear small on the horizon.

Overall, the presence of offshore wind structures would have continuous, long-term negligible impacts on demographics, employment, and economics. As discussed above, the commercial fishing industry is anticipated to be able to adjust to changes in fishing practices to maintain the viability of the industry in the presence of offshore wind structures. The presence of structures could also result in beneficial impacts for the recreational fishing and tourism industries.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel and highway traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses, investment in the ports proposed for the Projects, and investment in other ports outside of the geographic analysis area. Increased vessel traffic would have continuous, beneficial impacts during all Project phases, with moderate impacts during construction and decommissioning.

Impacts of short-term increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. As stated in Section 3.9, planned offshore wind projects would result in a small, incremental increase in vessel traffic, with a short-term peak during construction. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass), and could decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Collisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup) as well as indirect costs from damage caused by spills.

The magnitude of increased vessel traffic is described in more detail in Section 3.16, *Navigation and Vessel Traffic*, and would depend upon the vessel traffic volumes generated by each offshore wind project, the extent of concurrent or sequential construction of wind energy projects, and the ports selected for each project. Increased vessel and highway traffic congestion and collision risk are anticipated to have negligible impacts on demographics, employment, and economics during all project phases due to the implementation of environmental protection measures.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances.

These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and beneficial (jobs and revenues to local businesses that participate in onshore construction), although there could be potential for adverse effects as well (lost revenue due to construction disturbances).

3.11.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing activities would continue to sustain and support growth of the geographic analysis area's diverse economy, based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies, protect environmental resources, and maintain or increase their year-round population.

BOEM anticipates that ongoing activities related to continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy would have **negligible** to **minor adverse** impacts and **minor beneficial** impacts on demographics, employment, and economics, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation and tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise.

Cumulative Impacts of the No Action Alternative. BOEM recognizes that while many of the jobs generated by offshore wind projects are temporary construction jobs, the combination of these jobs over multiple projects would create notable benefits during the construction phases of these projects. This would particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs; long-term tax revenues; long-term economic benefits of improved ports and associated industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce.

Regional offshore wind development is anticipated to generate increased investment within the geographic analysis area in ports, shipping and logistics capability (both land and marine), component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. If U.S. supply chains develop as anticipated, additional manufacturing and servicing businesses would result, either in the geographic analysis area or at other locations in the United States. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, planned offshore wind activities would result in notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, that occur as a result of offshore wind development.

Accordingly, based on the impact definitions in Table 3.11-1 in Section 3.11.2, BOEM anticipates that planned offshore wind activities in the geographic analysis area, combined with ongoing and planned activities other than offshore wind, would result in cumulative **moderate beneficial** impacts.

In addition to the beneficial economic activity from regional offshore wind development, BOEM anticipates **negligible** to **minor adverse** cumulative impacts on demographics, employment, and economics. Planned offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through noise and vessel traffic during construction and the presence of offshore structures during operations. These IPFs would temporarily disturb fish and marine mammal species and displace commercial or for-hire fishing vessels, potentially resulting in conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also affect these marine industries due primarily to increased navigational constraints and risks as well as potential gear damage and loss. However, temporary disturbances such as from noise and traffic would not be expected to result in measurable adverse impacts on population, employment, or economics. It is expected that temporary adverse effects would be minimized and would not disrupt community cohesion or the economies of the affected areas. The long-term presence of structures is not expected to have adverse impacts on the economy overall; rather, employment impacts would be beneficial and there could be beneficial impacts on the commercial fishing and recreation and tourism economies as well, as discussed above.

3.11.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following design parameters for the proposed Projects (Appendix E) would influence the magnitude of the impacts on demographic, employment, or economic characteristics:

- Overall size of the Projects (the 816-MW EW 1 Project and 1,260-MW EW 2 Project in Lease Area OCS-A 0512) and number of WTGs;
- The extent to which Empire hires local residents and obtains supplies and services from local vendors;
- The onshore export cable routes, including routing variants, and extent of ground disturbance for new onshore substations;
- The time of year during which construction occurs;
- The port(s) selected to support construction, installation, and decommissioning;
- The port(s) selected to support O&M; and
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG number, size, and location: The level of impact related to WTGs is proportional to the number of WTGs installed; more WTGs would present greater economic benefits.
- Onshore export cable routes and substation footprints: The route chosen (including variants within the general route) and substation footprints would determine the communities that may be affected by construction activities.
- Beneficial impacts on employment and the economy in the geographic analysis area would be highly dependent on the percentage of workers, materials, equipment, vessels, and services that can be locally sourced.

- Season of construction: Construction outside of the recreation and tourism season would have a lesser impact on the recreation and tourism economy than construction during the active season.

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

Effects on demographics, employment, and economics from the Proposed Action would include population changes due to workforce needs associated with the Proposed Action; housing needs for Proposed Action workforce; job creation; tax revenues, payroll, and other Proposed Action expenditures; and other funds provided by Empire in connection with the Proposed Action. Other effects include economic activity generated within the geographic analysis area through spending by employees or vendors; payment of personal income taxes by the Empire workforce; and spending by governments, based upon income received from Empire in connection with the Proposed Action.

Economic effects may occur in the recreation, tourism, and commercial fishing sectors, as discussed below in the analysis of individual IPFs. Impacts on commercial fisheries may in turn affect the economic health of the communities as well as the cultural identity and values—and therefore the well-being—of individuals and communities that identify as "fishing" communities. Impacts on recreation and tourism could affect the economic health of businesses and individuals that serve tourists and seasonal residents.

The Proposed Action could have a broader economic impact than indicated by its payroll and expenditures due to its position as one of the nation's first large-scale offshore wind energy projects. The approval of the Proposed Action would encourage and support continued investment in other offshore wind projects and the creation of a domestic supply chain for the offshore wind industry in the eastern United States.

Regarding demographics, jobs and economic activity, the Proposed Action's beneficial impacts on employment and the economy in the geographic analysis area would be highly dependent on assumptions regarding the percentage of workers, materials, equipment, vessels, and services that can be locally sourced.

In the COP (Appendix O; Empire 2022), Empire provides estimates of expected local economic and employment benefits of the two phases of development proposed by Empire for Lease Area OCS-A 0512. Empire's economic impact study estimates that the Proposed Action would directly support the following employment in New York State alone.

The Proposed Action is expected to support over 6,300 total job-years during the construction phase and 302 annual jobs (133 direct jobs and 169 indirect/induced jobs) during the operations phase (Tables I-23 and I-25 in Appendix I; COP Appendix O; Empire 2022). In addition to the estimated job impacts, Empire is also investing in various community development and workforce training and readiness funds in New York State. Empire estimates that the aggregate value for these funds could be between $25 million and $30 million for both EW 1 and EW 2 over the entire lifetime of the two facilities. The actual annual contributions of these funds would be relatively small, at less than a $1 million per year, and are likely to support an additional 10 to 15 jobs annually in New York State for the entire 30+ years of operation. The socioeconomic impacts of these contributions are likely to be far greater than the jobs they would support in the region. These funds would provide vital resources in supporting workforce training and readiness and help support efforts for just transition of the workforce. These investments would also help further the development of the offshore wind industry in New York State.

Tables I-23, I-24, and I-25 in Appendix I summarize the estimates of construction-phase economic activity, tax revenues (state and local and federal), and O&M-phase economic activity, respectively, generated by the Proposed Action within New York State.

A study from the New York Workforce Development Institute provided estimates of salaries for jobs in the wind energy industry that concur with Empire's projections. Anticipated salaries range from $43,000 to $96,000 for trade workers and technicians, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

The Proposed Action would have long-term, minor beneficial impacts on employment and economic activity in the geographic analysis area, based upon anticipated short-term and modest long-term job creation, expenditures on local businesses, generation of tax revenues, and provision of grant funds. The Proposed Action would have negligible adverse impacts on demographics and housing within the geographic analysis area. As noted in Section 3.11.3.3, the growth of the overall offshore wind industry is anticipated to result in moderate beneficial impacts on employment and economics in the geographic analysis area. The Proposed Action would be part, but would not change the magnitude, of the impact.

Impacts from the Proposed Action resulting from the IPFs identified below would include beneficial, long-term impacts from increases in employment, port utilization and expansion, and vessel traffic and negligible impacts from short-term increases in noise during construction, land disturbance, and the long-term presence of offshore lighting and structures. The Proposed Action would contribute to impacts through all the IPFs. The most impactful beneficial IPFs would be increased port utilization and vessel traffic, while the most impactful adverse IPFs would be the long-term presence of offshore structures, which would affect businesses accustomed to navigating in the Lease Area. However, the Proposed Action would result in negligible incremental adverse impacts and the long-term presence of offshore structures could also have beneficial effects as a result of increased eco-tourism (e.g., people paying to charter a boat to see the wind farm, fish on the structure).

Energy generation/security: The Proposed Action would produce over 2,000 MW of electricity and a stable source of renewable energy, contributing to energy security and resiliency for the geographic analysis area. The Proposed Action would have long-term, localized, minor beneficial impacts on demographics, employment, and economics from energy generation/security.

Lighting: Lighting for vessels in transit and in the offshore work area would occur when Project construction or maintenance takes place during early-morning, dusk, or nighttime hours. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses. Therefore, lighting from the Proposed Action would have short-term, negligible impacts. Vessel lighting from other offshore wind projects would have similar impacts as those of the Proposed Action, but at different locations and times. If lighting from Proposed Action vessels occurred simultaneously, the impacts of this lighting on demographics, employment, and economics would also be short term and negligible. The permanent aviation safety lighting required for the Proposed Action's WTGs could be visible from beaches and coastal locations (i.e., City of Long Beach, Monmouth County, and Ocean County), possibly affecting employment and economics in these areas if the lighting discourages visits or vacation home rentals or purchases in coastal locations where the Proposed Action's WTG lighting is visible. Lighting from all the Proposed Action's WTGs could theoretically be visible from onshore locations. All WTGs would require mid-level lighting at the halfway point between the top of the nacelle and ground level and WTGs more than 699 feet (213 meters) above ground level would require two additional flashing red lights on the back of the nacelle (Section 2.1.2.1.2). ADLS would activate the Proposed Action's WTG lighting when aircraft approach the structure, which is expected to occur less than 0.1 percent of annual nighttime hours. Even without ADLS, the presence of aviation safety lighting on the WTGs for the Proposed Action is anticipated to have a long-term, negligible impact on demographics, employment, and economics in the geographic analysis area. Use of ADLS would reduce the already negligible impact..

Noise: The contribution of the Proposed Action to noise from survey activities, O&M, pile driving, trenching, and vessels would affect certain marine business activities associated with commercial and for-hire fishing, marine sightseeing, and recreational boating. As a result, the Proposed Action would have intermittent, short-term, negligible noise impacts on visitors, workers, and residents. As Project activities are expected to occur in developed areas and with the proposed APMs, the Proposed Action would have negligible impacts on demographics, employment, and economics as a result of noise.

Port utilization: The Proposed Action would diversify jobs and revenues in the geographic analysis area's Ocean Economy sector. In particular, the Proposed Action would enlarge and require new skills within the marine construction sector. These jobs within the Ocean Economy sector would be concentrated in Kings and Albany Counties, the locations of the proposed ports. SBMT in Kings County would be redeveloped to support the offshore wind industry as described in Section 2.1.2.4. There would be approximately 85 employees at SBMT during operations to support storage, staging, pre-assembly, and the transfer of WTG components. The offshore wind tower manufacturing facility would be developed at the Port of Albany, in Albany County. This facility would create up to 350 direct jobs in the region (Equinor 2020).

The Proposed Action could temporarily compete with the commercial fishing industry for marine workers and services during construction, potentially increasing labor and service costs and encouraging vessel owners to use services in ports not supporting offshore wind development (see Section 3.9).

Employment and economic benefits of the Proposed Action at SBMT and Port of Albany would have long-term, minor beneficial impacts. Some of the new employment may be supported by the existing workforce and would not be expected to exacerbate housing conditions in the geographic analysis area (see Appendix I). The Proposed Action would have a moderate beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

Presence of structures: Views of the offshore structures (i.e., WTGs and OSS) would be limited primarily to coastal areas of New York and New Jersey that have views of the Atlantic Ocean (i.e., Kings County, City of Long Beach, Nassau County, Suffolk County, and Monmouth County). Views of WTGs could have impacts on businesses serving the recreation and tourism industry. Considering the distance from shore and limited visibility of the offshore structures from residences, coastlines, and businesses, operation of the Proposed Action would have negligible adverse impacts on economics due to property value impacts and viewshed impacts on recreational and tourist businesses.

Traffic: The Proposed Action would generate vessel and highway traffic during construction, O&M, and decommissioning. Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. The vessel traffic generated by the Proposed Action would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction and decommissioning, and negligible beneficial impacts during operations.

Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports. While there would be potential delays from increased congestion and increased risk of damage from collisions, the Proposed Action would have negligible impacts on demographics, employment, and the economy from traffic during all Project phases. Empire would implement measures to avoid, minimize, and mitigate impacts associated with vessel traffic, including rolling construction zones (APM 212), strategic timing of construction activities (APM 213), implementation of safety zones around relevant structures and vessels in a dynamic approach (APM 221), installation of AIS on all Project vessels (APM 222), use of the surrounding TSS by Project vessels (APM 223), vessel speed restrictions, and collision avoidance measures. Any potential short-term increases in onshore traffic would be mitigated through the use of APMs and would not be expected to result in measurable adverse impacts on demographics, employment, or economics.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction on Long Island (Kings and Nassau Counties). The Proposed Action would result in localized, short-term negligible impacts as a result of disturbance of businesses near the onshore cable route and substation construction site. The Projects were sited, planned, and designed to avoid and minimize typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to those of other common construction projects, such as utility installations, road repairs, and industrial site construction. With implementation of proposed APMs (Appendix H, Table H-3), there would not be a measurable adverse impact on demographics, employment, and economics from land disturbance. Impacts on employment would be beneficial.

3.11.5.1. Impact of the Connected Action

The connected action would affect demographics, employment, and economics in the geographic analysis area through the following IPFs: noise, port utilization, presence of structures, traffic, and land disturbance. The purpose of the connected action is to upgrade SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. The connected action includes the construction of an approximately 57,000 square-foot O&M facility containing approximately 22,000 square feet of office and support space, and approximately 35,000 square feet of warehouse facilities and associated utility space with a maximum height of 32.8 feet from grade. The outside areas around the buildings would be landscaped and include associated parking. During operations, SBMT is expected to support approximately 85 employees, with roughly 80 percent being in the professional services sector. The remaining 20 percent of employees are anticipated to work within the construction sector, a major employment industry within some of the affected geographies.

Noise: The connected action would contribute temporary construction noise and noise from O&M and vessels that would affect certain marine business activities associated with marine sightseeing and recreational boating. As a result, the connected action would have negligible impacts on demographics, employment, and economics resulting from noise.

Port utilization: NYCEDC would construct improvements at SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. Upgrades would include seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing. These planned improvements at SBMT, including in-water work, are being separately reviewed and authorized by USACE and state and local agencies (NYCEDC 2021).

In the near term, SBMT would be used to support the EW 1 and EW 2 projects and it is expected to support different offshore wind developers and projects in the future. BOEM expects that SBMT would experience long-term, moderate beneficial impacts from greater economic activity and increased employment due to increased utilization of the marine terminal for WTG staging and an O&M facility, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements, and other business activity related to offshore wind.

Presence of structures: The connected action would construct a seaward bulkhead extension, new wharf and crane positions for WTG component loading and unloading, a wharf for service operation vessels and crew transfer vessels, and an O&M facility at SBMT. Considering that planned uses are consistent with the zoning of SBMT for heavy industry and the context of the SBMT site within a high- and medium-intensity developed area, BOEM expects that construction and operation of the SBMT Project would have long-term, negligible impacts on existing demographics surrounding the site and long-term, moderate beneficial impacts on employment and economics due to upgrades to the SBMT site to support the offshore wind industry in the near term and for future offshore wind projects in the New York and New Jersey region.

Traffic: The connected action would generate vessel traffic in SBMT. The proposed facility improvements would provide marine vessel access and allow the storage, staging, pre-assembly, and transfer of materials utilized in construction, installation, and O&M of offshore wind projects. Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. The vessel traffic generated by the connected action would result in increased business for marine transportation and supporting services in the geographic analysis area with minor beneficial impacts during construction and decommissioning and operations.

Vessel traffic associated with the connected action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. It is anticipated that potential increases in vessel traffic would be mitigated by environmental protection measures and that there would be no measurable adverse impact on the economy. Therefore, the connected action would have negligible impacts on demographics, employment, and economics during construction and operations as a result of vessel traffic.

Land disturbance: The connected action would construct an O&M facility at SBMT. SBMT is entirely developed with several buildings and paving throughout and is in a developed area zoned for heavy industry. No zoning changes are anticipated to be required for the connected action. Therefore, BOEM expects that land disturbance for construction and operation of planned improvements at SBMT would have negligible impacts on demographics, employment, and economics due to land disturbance. The connected action is also expected to result in minor beneficial impacts on the economy and employment during construction and operations associated with demolition of existing buildings, construction of new buildings, and increased port activity.

3.11.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, and the connected action at SBMT. In context of reasonably foreseeable environmental trends, the cumulative impacts of ongoing and planned activities, including the Proposed Action, are anticipated to be moderate beneficial for employment and economics in the geographic analysis area.

Energy generation/security: The Proposed Action’s cumulative energy security/generation impacts on demographics, employment, and economics would be notable and measurable due to increased renewable energy generation. The impacts of the Proposed Action, when combined with ongoing and planned activities, would therefore be moderate beneficial.

Lighting: The Proposed Action’s cumulative impacts on demographics, employment, and economics as a result of lighting would be negligible. Lights on 111 WTGs associated with other offshore wind projects in the geographic analysis area for recreation and tourism (in addition to 147 WTGs from the Proposed Action—a total of 258 WTGs) could also be visible, but the resulting impacts on demographics, employment, and economics are not anticipated to be measurable. Therefore, the combined lighting impacts from ongoing and planned activities including offshore wind would be negligible.

Noise: The Proposed Action’s cumulative impacts on demographics, employment, and economics as a result of noise would be negligible. The onshore construction noise activities from the Proposed Action are not anticipated to overlap in location with those of other offshore wind projects. Cumulative noise impacts on demographics, employment, and economics would be anticipated to be short term and negligible through the use of proposed environmental protection measures and because construction and operational activities would generally take place in areas already developed with commercial and industrial uses or offshore.

Port utilization: Other planned offshore wind activity would provide business activities at the same ports as the Proposed Action as well as other ports within the geographic analysis area. As noted in Section 3.11.1, port investments are ongoing and planned in response to offshore wind activity.

The Proposed Action's cumulative impacts on demographics, employment, and economics as a result of port utilization and expansion would be notable and therefore moderate beneficial. Port utilization for the offshore wind industry would contribute associated trained and skilled offshore wind workforce and would serve as an economic engine in port communities and the region as a whole.

Presence of structures: Across the New York and New Jersey lease areas, up to 1,352 WTGs and other offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses. Presence of structures would have both beneficial impacts, such as by providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as by causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income (see Sections 3.9 and 3.18). The cumulative impacts on demographics, employment, and economics due to the presence of structures would be negligible. WTGs associated with other offshore wind projects would also be visible (see Section 3.11.3.2); however, potential adverse effects on commercial fishing and recreation would not result in measurable impacts on demographics, employment, and the economy overall. Presence of structures could also result in positive benefits for commercial fishing and recreation.

Traffic: The Proposed Action combined with increased traffic congestion and collision risk from ongoing and planned activities would have unmeasurable and therefore negligible impacts on demographics, employment, and economics during all Project phases. It is anticipated that any short-term increases in traffic would be mitigated through the use of environmental protection measures and that there would not be significant disruptions to community cohesion or economic activity. Increased vessel traffic would produce demand for supporting marine services, with beneficial impacts on employment and economics during all Project phases, including minor to moderate beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations.

Land disturbance: The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for offshore wind energy projects. Cumulative impacts of the Proposed Action in combination with ongoing and planned activities would have no impact or negligible cumulative impacts on demographics, employment, and economics due to land disturbance because most activities would occur offshore or in commercially and industrially developed areas and would be mitigated through the use of environmental protection measures. Also, anticipated job creation associated with ongoing and planned offshore wind projects is notable and therefore moderate beneficial.

3.11.5.3. Conclusions

Impacts of the Proposed Action. The Proposed Action would have long-term, **negligible** to **minor beneficial** impacts on employment and economic activity in the geographic analysis area, based upon anticipated short-term and modest long-term job creation, expenditures on local businesses, generation of tax revenues, and provision of grant funds. The Proposed Action would have **negligible** adverse impacts on demographics and housing within the geographic analysis area. Impacts from the Proposed Action resulting from the IPFs identified above would include beneficial, long-term impacts from energy security/generation, port utilization and expansion, presence of structures, vessel traffic, and climate change and adverse impacts from short- and long-term increases in light, noise during construction, long-term presence of structures, vessel traffic and collisions, and land disturbance. Adverse impacts from the Proposed Action would be **negligible**.

BOEM expects that the connected action would have **negligible** impacts on demographics, employment, and economics due to noise, traffic, and land disturbance. The introduction of new facilities at SBMT for use of the marine terminal for WTG staging and an O&M facility for offshore wind projects would have **negligible** impacts on existing demographics and long-term, **minor** to **moderate beneficial** impacts on employment and economics due to the presence of structures and port utilization.

Under the Proposed Action, construction, O&M, and eventual decommissioning would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures (Appendix H). Impacts of the Proposed Action for demographics, employment, and economics are summarized as **negligible** along with **minor beneficial**.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on demographics, employment, and economics would be **negligible** to **minor** and **moderate beneficial**. See Section 3.9 for impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

3.11.6 Impacts of Alternatives B, C, D, E, F, G, and H on Demographics, Employment, and Economics

Impacts of Alternatives B, C, D, E, F, G, and H. Alternatives that make minor modifications to the WTG array (Alternatives B, E, and F), narrow the selection of submarine or onshore cable routes (Alternatives C, D, and G), or result in alternate methods of dredge and fill activities (Alternative H) would not have impacts on demographics, employment, and economics that are materially different than the impacts of the Proposed Action.

Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs defined in Empire's PDE. Therefore, the beneficial impacts on employment and the economy would be the same as described for the Proposed Action. Alternative F would optimize the production of energy, resulting in the most cost-efficient and highest annual renewable energy production, which would result in minor beneficial impacts of Alternative F compared to Alternatives B and E. Alternative B would remove six WTG positions from the northwestern end of EW 1 to reduce impacts on Cholera Bank, scenic resources, and navigation. As such, there would still be negligible impacts on economics due to property value impacts and viewshed impacts on recreational and tourist businesses. Alternative E would create a transit lane between the EW 1 and EW 2 Projects and remove seven WTG positions. Alternative F would remove three WTG positions from the northwestern end of EW 1 to further open the area to fishing and reduce impacts on Cholera Bank. Adverse economic impacts with Alternatives B, E, and F would still be expected to be negligible. See Section 3.9 for impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Under Alternatives C, D, and G, with the alternate cable routes, adverse impacts on the economy would still be expected to be negligible.

Alternative H would use an alternate method of dredge or fill activities during construction at the SBMT, requiring a permit from USACE that would reduce the discharge of dredged material. Therefore, adverse impacts on the economy would still be expected to be negligible.

Cumulative Impacts of Alternatives B, C, D, E, F, G, and H. In context of reasonably foreseeable environmental trends, the cumulative impacts resulting from individual IPFs combined with ongoing and planned activities under Alternatives B, C, D, E, F, G, and H would be similar to those of the Proposed Action: negligible or minor adverse impacts on demographics, employment, and economics along with cumulative moderate beneficial impacts due to new hiring and economic activity.

3.11.6.1. Conclusions

Impacts of Alternatives B, C, D, E, F, G, and H. Accordingly, the impacts resulting from individual IPFs associated with Alternatives B, C, D, E, F, G, and H on demographics, employment, and economics would be the same as those of the Proposed Action alone: **negligible** adverse impacts due to the IPFs discussed above, along with **negligible** to **minor beneficial** impacts due to new hiring and economic activity.

Cumulative Impacts of Alternatives B, C, D, E, F, G, and H. In context of reasonably foreseeable environmental trends, the cumulative impacts resulting from individual IPFs combined with ongoing and planned activities under Alternatives B, C, D, E, F, G, and H would be similar to those of the Proposed Action: **negligible** to **minor** adverse impacts on demographics, employment, and economics along with overall **moderate beneficial** impacts due to new hiring and economic activity.

3.11.7 Comparison of Alternatives

Alternatives B, E, and F would reduce the number of WTGs compared to the Proposed Action and still maintain negligible adverse economic impacts. Alternatives C, D, and G would also be expected to have negligible adverse impacts on the economy as a result of the alternative submarine or onshore cable routes. Similarly, Alternative H is anticipated to have negligible adverse economic impacts. Alternative H proposes an alternate method of dredge or fill during SBMT construction that would require a permit from USACE and reduce the discharge of dredged material.

In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives B, C, D, E, F, G, and H when each is combined with the impacts of ongoing and planned activities would be the same as for the Proposed Action—**negligible** to **minor** adverse impacts and **moderate beneficial** impacts.

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3.18. Recreation and Tourism

This section discusses potential impacts on recreation and tourism from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.18-1, includes an area that extends 40 miles (64.4 kilometers) around the borders of the Wind Farm Development Area. The geographic analysis area includes portions of New York, Kings, Queens, Richmond, Nassau, and Suffolk Counties in New York and Monmouth and Ocean Counties in New Jersey. Section 3.11, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the geographic analysis area.

3.18.1 Description of the Affected Environment for Recreation and Tourism

Proposed Project facilities would be within and off the coasts of New York and New Jersey. The coastal areas support ocean-based and onshore recreation and tourist activities, such as recreational and for-hire boating and fishing, guided tours, day use of parks and beaches, outdoor sports, and scenic or wildlife viewing. As indicated in Section 3.11, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of New York's and New Jersey's coastal counties. In 2019, 265.5 million people visited New York and spent about $73.6 billion, leading to a $117.6 billion total economic impact through tourism (Empire State Development n.d.). In 2019, 116 million people visited New Jersey and spent $46.4 billion, making tourism the sixth largest employer in New Jersey (Tourism Economics 2019). Annual tourism in New Jersey's coastal communities is a $16 billion industry (NJDEP 2021).

Coastal New York and New Jersey have a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, beaches, and wildlife preserves. As a result of the proximity to the Atlantic Ocean, as well as the views associated with the shoreline, the New York and New Jersey shores have been extensively developed for water-based recreation and tourism. The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors and the ability to view birds and marine life, are important community characteristics. Coastal communities provide hospitality, entertainment, and recreation for both residents and tourists.

There are several recreation areas within the geographic analysis area. Otis Pike Fire Island High Dunes Wilderness, a 7-mile stretch of undeveloped barrier island on Fire Island, is the only federally designated wilderness area within the state of New York and is the closest wilderness area in the nation to a major metropolitan area. Recreation activities within the wilderness area include hiking trails, backcountry camping opportunities, fishing, and scenic views and abundant wildlife that attract bird watchers and wildlife viewers. The Gateway National Recreation Area includes three units: the Jamacia Bay Unit (Jamacia Bay and surrounding properties in Brooklyn and Queens including the western end of the Rockaway Peninsula), the Staten Island Unit (Fort Wadsworth, Miller Field, and Great Kills), and the Sandy Hook Unit (the Sandy Hook peninsula). The Gateway National Recreation Area provides visitors green spaces and beaches alongside historic structures and cultural landscapes and provides space for recreation activities including boating, bicycle paths, bird watching, archery, camping, fishing, and guided tours.

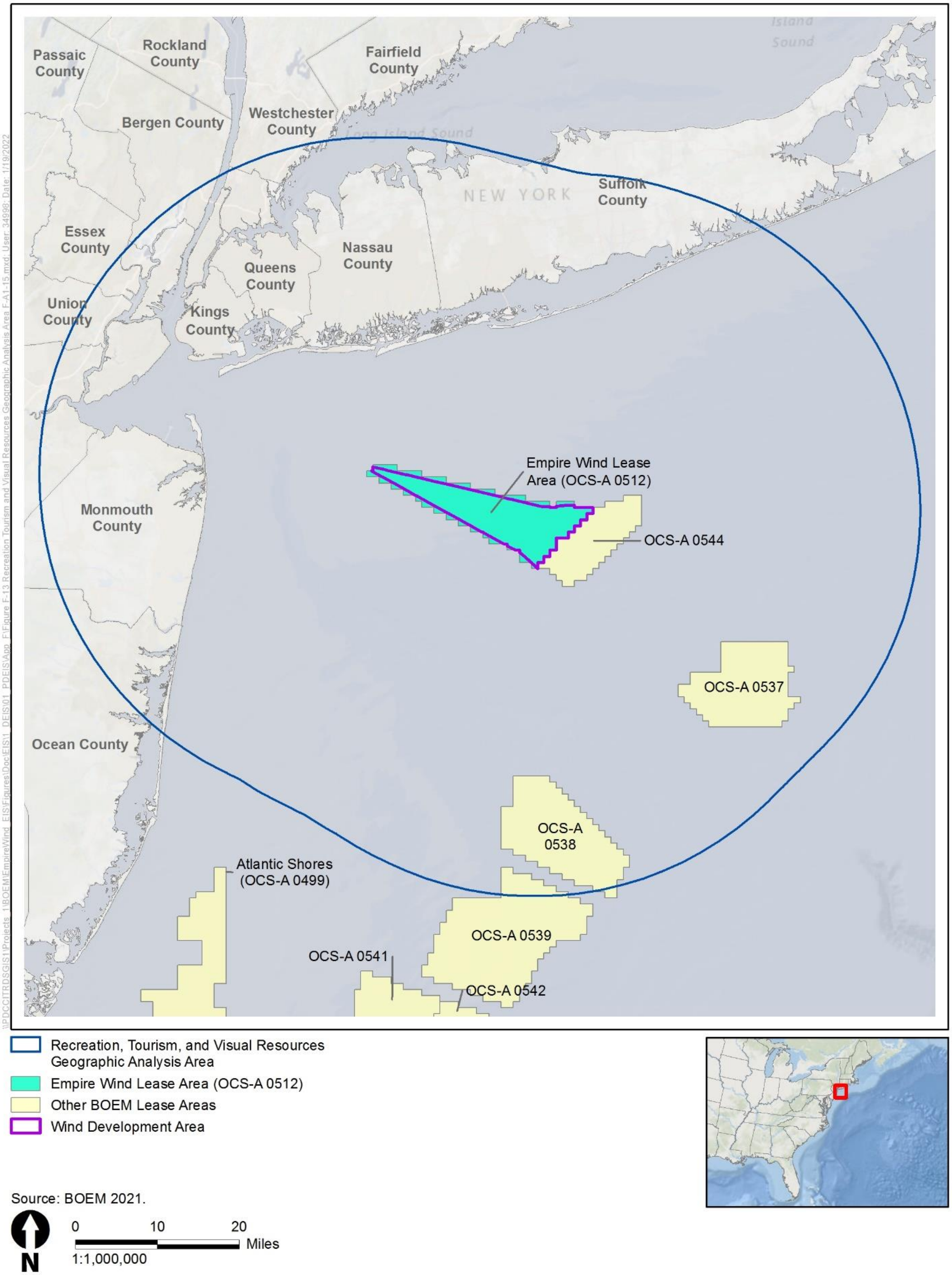

Figure 3.18-1 Recreation and Tourism Geographic Analysis Area

Water-oriented recreational activities in the geographic analysis area include recreational fishing and boating. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, fishing, shell fishing, kayaking, canoeing, and paddleboarding. Commercial businesses offer boat rentals, such as canoes, kayaks, and private charter boats for recreation, fishing, and wildlife viewing. Many of the activities make use of coastal and ocean amenities that are free for public access. Nonetheless, these features function as key drivers for many coastal businesses, particularly those within the recreation and tourism sectors. As discussed in Section 3.11, *Demographics, Employment, and Economics*, recreation and hospitality are major sectors of the local economy, supported by ocean-based recreation uses.

Offshore wildlife viewing in charter boats, such as bird and whale watching, is particularly popular off the New York and New Jersey coasts and in the New York Harbor between spring and fall due to migrations. Some bird watching does take place on shore from Jones Beach to the Fire Island National Seashore in New York and across the Gateway National Recreation Area, which includes Jamaica Bay and the Sandy Hook peninsula. Chartered bird and seal watching tours occur at New York Harbor during the winter months. Whale watching occurs at New York Harbor and throughout the New York Bight, especially during the summer months (COP Volume 2e, Section 8.11.1.1; Empire 2022). Underwater recreation, such as diving and snorkeling to see shipwrecks, reefs, canyons, and marine wildlife, happens throughout the year in New York and New Jersey, but it is most popular between May and October (COP Volume 2e, Section 8.11.1.2; Empire 2022). Surface-based marine recreational activities popular along the New York coastline, particularly during the summer, include swimming, surfing, kayaking, paddle boarding, windsurfing, and kite boarding. Most of these activities take place off Long Island, including along the Rockaways, Long Beach, Jones Beach, and Fire Island. Surfing usually occurs along Long Beach, Jones Beach Island, Cedar Beach, and Robert Moses State Park (COP Volume 2e, Section 8.11.1.3; Empire 2022).

There is a large and robust recreational fishing industry in New York and New Jersey. In 2019, there were 13.4 million recreational saltwater angler trips (i.e., charter boats, party boats, private/rental boats, and shore) in New York and 13.3 million in New Jersey, with shore fishing representing the majority (more than half) of those trips. The areas in which sport fishing take place, such as Cholera Bank and Angler’s Bank, are not within the Lease Area or within the submarine export cable siting corridors; however, fishermen may choose to travel through the Lease Area to reach the aforementioned areas. Recreational saltwater fishing takes place throughout the year but is especially prevalent from April through November, with peaks in May and June. Annual saltwater fishing tournaments also take place in the New York Bight, targeting species such as black sea bass, bluefish, striped bass, summer flounder, tautog, tuna, and shark. Recreational shell fishing occurs mainly in state waters, targeting species such as blue crabs, scallops, quahogs, Atlantic surfclam, and softshell clams (COP Volume 2e, Section 8.8.2.1; Empire 2022).

3.18.2 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.18-1.

Table 3.18-1 Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.

Impact Level	Impact Type	Definition
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the Projects.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Projects.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism.

3.18.3 Impacts of the No Action Alternative on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for recreation and tourism. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F, *Planned Activities Scenario*.

3.18.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for recreation and tourism described in Section 3.18.1, *Description of the Affected Environment for Recreation and Tourism,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area include commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvement projects, marine minerals use and ocean dredging, military use, marine transportation, and onshore development activities (see Appendix F, Section F.2). Ongoing activities would contribute to impacts on recreation and tourism through the primary IPFs of anchoring, land disturbance, lighting, cable emplacement and maintenance, noise, presence of structures, and vessel traffic.

There are no ongoing offshore wind activities within the geographic analysis area for recreation and tourism.

3.18.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Ongoing and planned non-offshore wind activities would contribute to periodic disruptions to recreation and tourism activities but are typical occurrences along the New York and New Jersey coastlines and would not substantially affect visitor use or experience. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for recreation and tourism. See Table F1-20 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for recreation and tourism.

Planned offshore wind projects in the geographic analysis area are planned within Lease Areas OCS-A 0544 (Vineyard Mid-Atlantic Offshore Wind), OCS-A 0537 (OW Ocean Winds East LLC), OCS-A 0538 (Attentive Energy LLC), and OCS-A 0539 (Bight Wind Holdings LLC). These projects are estimated to collectively install 449 WTGs, 9 OSS, and 1,889 statute miles (1,913 kilometers) of submarine export cable and interarray cable in the geographic analysis area between 2026 and 2030.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on recreation and tourism during construction, O&M, and decommissioning of the projects. BOEM expects planned offshore wind activities to affect recreation and tourism through the primary IPFs of anchoring, land disturbance, lighting, cable emplacement and maintenance, noise, presence of structures, and vessel traffic.

Anchoring: Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Development of planned offshore wind projects between 2026 and 2030 would increase the number of vessels anchored offshore. The greatest volume of anchored vessels would occur in offshore work areas during construction and installation. Vessel anchoring would also occur during O&M but at a reduced frequency. Planned offshore wind projects would add an estimated 371 acres (150 hectares) of scour protection for WTG foundations and 171 acres (69 hectares) of cable protection to the geographic analysis area, which could create resistance to anchoring for recreational boats.

Anchored vessels for constriction, O&M, and decommissioning of planned offshore wind projects would have localized, intermittent, long-term impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

Land disturbance: Planned offshore wind development would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations, which could result in localized, temporary disturbance to recreational activity or tourism-based businesses near construction sites. BOEM expects these impacts would be localized and temporary during construction, O&M, and decommissioning. The exact extent of impacts would depend on the locations of onshore infrastructure for planned offshore wind projects; however, the No Action Alternative would generally have localized, temporary, and minor impacts.

Lighting: Planned offshore wind projects would add new sources of light to onshore and offshore areas including from nighttime vessel lighting and fixed lighting at onshore substations and an estimated 449 WTGs and 9 OSS. BOEM expects that lighting at onshore substations would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be temporary for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. WTGs would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. Impacts of lighting on WTG and OSS structures would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 449 WTGs (Appendix F, Table F2-1). The installation of these WTGs affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and AMSL within the offshore wind lease areas would have long-term minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles (24.1 kilometers) from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. WTGs associated with planned offshore wind projects in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs. For example, the nearest distance between the Mid-Atlantic Offshore Wind Lease Area and the New York or New Jersey coast is over 23 miles (37 kilometers), while the OW Ocean Winds East LLC Lease Area is more than 40 miles (64.4 kilometers) from either the New York or New Jersey coast.

The New York and New Jersey shores that are within the viewshed of planned offshore wind projects have been extensively developed. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. While ambient nighttime lighting may be expected within the more developed areas of the New York and New Jersey shores, within the region's national parks, wildlife refuges, and wilderness areas, darkness and the night sky and the feelings associated with open space in a high-density area are considered fundamental resources that contribute to the visitor experience (NPS 2014). Completely natural night skies are not obtainable at these parks given the surrounding urban environment of New York City; however, many of the parks do offer relatively dark night skies where visitors can experience night skies with only dim and distant artificial lights (NPS 2014).

Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view. The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife-viewing activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would not affect recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New York and New Jersey shores and elevated areas, with less impact on the recreation and tourism industry as a whole.

Cable emplacement and maintenance: An estimated 1,189 statute miles (1,913 kilometers) of submarine export cable and interarray cable would be installed in the geographic analysis area between 2026 and 2030 for planned offshore wind projects. Recreational uses would be temporarily displaced from work zones during cable installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to trenching and associated underwater noise and turbidity near the work zone. The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Displacement of recreational activities due to cable emplacement would be temporary and limited to the construction safety zones established for safe performance of the work. Displacement of recreational uses for cable maintenance during the O&M phase of each project would be temporary and intermittent over the life of the project.

Noise: Noise from operation of construction equipment, pile driving, and vehicle or vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Construction noise could cause some boaters to avoid construction areas, although the most intense noise sources (such as pile driving) would originate within the safety zones that USCG may establish for areas of active construction, which would be off-limits to boaters. BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by construction noise (Kirkpatrick et al. 2017).BOEM expects that the impact of noise on recreation and tourism during construction would be temporary and localized. Multiple construction projects at the same time would increase the number of locations within the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSS), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction of WTGs, OSS, and submarine cables. Recreational fishing such as for tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience temporary impacts resulting from the noise generated by construction for planned offshore wind projects. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. However, planned projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing. BOEM expects that planned offshore wind construction would result in localized, temporary impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species within the geographic analysis area. As shown in Table F2-1 in Appendix F, BOEM expects that up to four offshore wind projects (not including the Proposed Action) could be under construction simultaneously in the recreation and tourism geographic analysis area. No long-term, adverse impacts are anticipated, provided that mitigation measures are implemented to prevent population-level harm to fish and marine mammal populations.

Presence of structures: The construction and installation of 449 WTGs and 9 OSS within the recreation and tourism geographic analysis area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, planned offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSS installed within offshore wind lease areas are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue.

The presence of planned offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation within the geographic analysis area. Generally, the vessels more likely to allide with WTGs or OSS would be smaller vessels moving within and near wind farm installations, such as recreational vessels. Planned offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the planned offshore wind structures on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 nm (5.5 kilometers) of the coastline within the New York Bight (COP Volume 2e, Section 8.7.1.1; Empire 2022).

The geographic analysis area would have an estimated 371 acres (150 hectares) of scour protection for WTG foundations and 171 acres (69 hectares) of cable protection, which results in an increased risk of entanglement. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Lessees would engage with both USCG and NOAA in developing a comprehensive aid to navigation plan. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Because anchoring is uncommon in water depths where the No Action Alternative WTGs would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long-term.

Planned offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The WTG and OSS structures could produce artificial reef effects. The “reef effect” refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. In a 2020 survey-based study, 11.4 percent of participants indicated that they would make a trip to tour offshore wind facilities 12.5 miles offshore (Parsons et al. 2020). The number of participants that indicated they would tour offshore wind facilities decreases as the project moves farther offshore. Of the respondents that reported they would take a trip, the majority of those reported they expect to only take a one-time trip. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.20, *Scenic and Visual Resources*, describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the viewer's experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue, and that Block Island Wind Farm's WTGs provide excellent sites for fishing and shell fishing (Smythe et al. 2018). A survey-based study found that for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).
- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (BOEM 2021a).

Additionally, a 2020 survey-based preference study to determine attitude toward offshore wind and if the presence of offshore wind turbines affects the number of trips a beachgoer makes to the beach found that developed beaches with boardwalks and beaches that were designated as local, state, or national parks had the lowest amount of reported trip cancellation (Parsons et al. 2020). Because many of New Jersey's most visited beaches, including Atlantic City, are quite developed, long-term impacts on recreation and tourism are not expected. The beachgoers at local, state, or national park beaches self-reported as more favorable toward wind power and correspondingly appeared less inclined to cancel a trip due to the presence of wind turbines.

As described under the IPF for light, the shore areas within the viewshed of the WTGs include both highly developed areas and undeveloped national parks and wilderness areas such as Otis Pike Fire Island High Dunes Wilderness. Public beaches and tourism attractions in this area are highly valued for scenic, historic, and recreational qualities, and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on the currently available studies, portions of the 449 WTGs associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernible due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

Traffic: Planned offshore wind project construction and decommissioning and, to a lesser extent, planned offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the planned offshore wind construction areas. Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of 2.8 vessel trips per day between ports and the Lease Area during construction and 1.4 vessel trips per day during operations. Between 2026 and 2030, as many as four offshore wind projects (not including the Proposed Action) could be under construction simultaneously. During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 11.2 vessel trips per day from Atlantic coast ports to worksites within the geographic analysis area, and operations would generate an average of 5.6 vessel trips per day. This level of increase in vessel traffic would represent only a modest increase compared to the background volumes of vessel traffic in and around the New York Bight, and BOEM expects that vessel traffic would have minor impacts on recreation and tourism in the geographic analysis area.

3.18.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. BOEM anticipates that the impacts of ongoing activities (including commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvement projects, marine minerals use and ocean dredging, military use, marine transportation, and onshore development activities) would have **minor** effects on recreation and tourism in the geographic analysis area because these are typical activities occurring along the New York and New Jersey coastlines and would not substantially affect visitor use or experience.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and recreation and tourism would continue to be affected by the primary IPFs of anchoring, land disturbance, lighting, cable emplacement and maintenance, noise, presence of structures, and vessel traffic. The impacts of planned non-offshore wind activities would be similar to the impacts of ongoing, non-offshore wind activities. Planned offshore wind activities would have localized, temporary, **minor** impacts on recreation and tourism related to land disturbance, cable emplacement and maintenance, noise, and traffic. Planned offshore wind activities would have localized, long-term, **minor** impacts on recreation and tourism due to anchoring and lighting, and localized, long-term, **minor** adverse and **minor beneficial** impacts on recreation and tourism due to the presence of structures, with beneficial impacts attributed to the anticipated reef effect resulting from installation of new offshore structures. BOEM expects the cumulative impacts of the No Action Alternative would result in **minor** impacts on recreation and tourism.

Planned offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and cable emplacement during construction and the presence of offshore structures during operations. Noise and cable emplacement could temporarily displace recreational uses at construction sites and affect recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational complexity, potential entanglement and loss of gear, and visual impacts from offshore structures. BOEM also anticipates that the planned offshore wind activities in the analysis area would result in **minor beneficial** cumulative impacts due to the presence of offshore structures and cable hard cover, which could provide opportunities for fishing and sightseeing due to the reef effect.

3.18.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on recreation and tourism:

- The Project layout including the number, type, height, and placement of the WTGs and OSS, and the design and visibility of lighting on the structures;
- Arrangement of WTGs and accessibility of the Wind Farm Development Area to recreational boaters; and
- The duration and time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect onshore recreation and tourism as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Duration and timing of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season. A shorter or longer duration for construction activities would decrease or increase the time that recreational uses could be displaced from construction sites.

3.18.5 Impacts of the Proposed Action on Recreation and Tourism

The Proposed Action would install 147 WTGs, two OSS, and 375 statute miles (603.5 kilometers) of submarine export cable and interarray cable in the geographic analysis area between 2023 and 2027. BOEM expects the Proposed Action to affect recreation and tourism through the primary IPFs of anchoring, land disturbance, lighting, cable emplacement and maintenance, noise, presence of structures, and vessel traffic.

Anchoring: Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning (creating space use conflicts) and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Construction of the Proposed Action between 2023 and 2027 would increase the number of vessels anchored offshore. Most construction vessels used for the Projects would maintain position using dynamic positioning, which limits the use of anchors and jack-up features. Any anchors or jack-up features would be placed within the previously cleared areas around foundations (APM 98). Empire would implement up to 1,640-foot (500-meter) safety zones around active construction sites (APM 180), which would reduce the potential for interaction between recreational and tour boats with anchored construction vessels; however, safety zones would also temporarily displace those uses from the work area. Vessel anchoring would also occur during O&M but at a reduced frequency. The Proposed Action would add an estimated 139 acres (56.3 hectares) of scour protection for WTG foundations and 23 acres (9.3 hectares) of cable protection to the geographic analysis area, which could make anchoring more difficult for recreational boats.

Anchored vessels for construction, O&M, and decommissioning of the Proposed Action would have localized, intermittent, temporary impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

Land disturbance: Construction of the Proposed Action would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations, which could result in localized, temporary disturbance to recreational activity or tourism-based businesses near construction sites. Onshore construction activities could disrupt access to public use areas and degrade the recreational experience through establishment of restricted work zones and increases in traffic, noise, and construction emissions. Empire would use ultra-low diesel fuel (APM 29) and limit unnecessary idling of diesel and gasoline engines during construction (APM 34), which would reduce noise and air emissions during construction. BOEM expects impacts of land disturbance during construction, O&M, and decommissioning would be localized and temporary.

The proposed onshore substations would be in predominantly high- and medium-intensity developed areas and construction is not expected to affect recreation or tourism in the long term. Because onshore construction would not occur within national parks or wilderness areas, construction-related impacts that would affect visitor experience, such as vibrations, noise, increases in traffic, or temporary increase in air pollution, are not expected. Empire would develop a traffic management plan to limit construction-related traffic disturbance (APM 153) and use temporary construction zones to minimize areas of road closures (APM 163), which would maintain access to recreation areas and local businesses. If tourism decreases during construction, individual businesses may be affected and could experience long-term effects. More information on potential economic impacts as a result of the Proposed Action can be found in Section 3.11.5. The selection of the Onshore Substation C location could disrupt use of a marina at the Onshore Substation C site and restrict public access to a portion of the waterfront along Reynolds Channel, which would result in long-term impacts on existing recreational uses. This impact would be localized but would be long term if shoreline access is restricted at the Onshore Substation C parcel.

Overall, BOEM expects that impacts of the Proposed Action on recreation and tourism due to land disturbance would be negligible to minor, due to the temporary nature of construction impacts and limited geographic extent of impacts related to conversion of affected properties from existing uses to a use for an electric utility.

Lighting: The Proposed Action would add new sources of light to onshore and offshore areas including from nighttime vessel lighting, and fixed lighting on 147 WTGs, two OSS, and two onshore substations. Onshore substations would be in developed areas and BOEM expects that lighting at onshore substations would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be temporary for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. WTGs would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. Impacts of lighting on WTG and OSS would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M. The installation of these WTGs affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and AMSL within the offshore wind lease areas would have long-term, minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The New York and New Jersey shores that are within the viewshed include extensively developed shores and relatively undeveloped national parks and wilderness areas. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments, except in the national parks and wilderness areas within the geographic analysis area. Visible aviation warning lighting would add a built visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view. Empire would implement an ADLS or similar system on WTGs as a base case, pending commercial availability, technical feasibility, and agency review and approval (APM 141). The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation.

As a result, although lighting on WTGs would have a long-term impact, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New York and New Jersey shores and elevated areas, with less impact on the recreation and tourism industry as a whole. Due to the distance of the Proposed Action’s WTGs and OSS from shore and potential to implement ADLS or a similar system on WTGs, BOEM expects that aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, minor impacts on recreation and tourism in the geographic analysis area. Lighting associated with vessel traffic and onshore substations would have negligible impacts on recreation and tourism.

Cable emplacement and maintenance: The Proposed Action would install 375 statute miles (603.5 kilometers) of submarine export cable and interarray cable in the geographic analysis area between 2023 and 2027. Cable emplacement would generate vessel traffic and trenching along cable routes, creating space use conflicts and resulting in short-term disturbance to species important to recreation and tourism. Recreational and tour boats traveling near the offshore cable routes would need to navigate around vessels and access-restricted areas associated with the offshore cable installation. Empire would work with USCG to communicate these zones and other work areas to the boating public via Local Notices to Mariners (APM 183 and APM 187). Space use conflicts with recreation and tourism related to offshore cable emplacement would result in localized, temporary, minor impacts.

Cable installation could also affect fish and marine mammals of interest for recreational fishing and sightseeing through dredging and resulting underwater noise and turbidity. Empire would install silt curtains in sensitive areas, based on sediment modeling, to reduce sediment transport (APM 93). Impacts of cable installation on fish and marine mammals would be localized and temporary and affected species are expected to recover upon completion of the activity, resulting in minor impacts on recreation and tourism (see Section 3.19, *Sea Turtles*, and Section 3.16, *Navigation and Vessel Traffic*).

Noise: Noise from the operation of construction equipment, pile driving, and vehicle or vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Empire would implement measures such as use of mufflers, adjustable backup alarms, and noise barriers to reduce onshore construction noise (APM 35, APM 36, APM 42).

Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Empire would comply with IMO noise standards on vessels used for nearshore and offshore work (APM 41). Construction noise could cause some boaters to avoid construction areas, although the most-intense noise sources (such as pile driving) would originate within the safety zones established for areas of active construction (APM 180), which would exclude recreational and tour boats. BOEM expects that the impact of noise on recreation and tourism during construction would be temporary and localized. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSS), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by the construction of WTGs and OSS. Recreational fishing such as for tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience temporary impacts resulting from the noise generated by construction within the Lease Area.

Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. Empire would implement measures such as seasonal pile driving closures (APM 106), ramp-up measures when pile driving is initiated (APM 107), establishment of pre-clearance and shutdown zones (APM 108 and APM 110), and noise attenuation measures (APM 112) to reduce impacts of underwater noise on marine mammals. Lower levels of noise associated with cable installation activities could also affect fish species and marine mammals in the nearshore environment. Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing.

Overall, noise generated from construction, O&M, and decommissioning of the Proposed Action alone would have localized, temporary, minor impacts on recreation and tourism.

Presence of structures: The construction and installation of 147 WTGs and two OSS within the Lease Area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, future offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSS installed within the Wind Farm Development Area are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue.

The presence of offshore wind structures would increase the complexity of navigation within the Lease Area and risk of allision (with fixed structures) or collision (with other vessels). The presence of structures within the Lease Area could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the impact on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 nm (5.5 kilometer) of the coastline within the New York Bight (COP Volume 2e, Section 8.7.1.1; Empire 2022).

The Proposed Action would install an estimated an estimated 131 acres (53 hectares) of scour protection for WTG foundations and 123 acres (49.8 hectares) of cable protection in the geographic analysis area, increasing the risk of entanglement with fishing gear. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Also, because anchoring is more common in shallower water depths, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating from the addition of scour and cable protection would be localized, continuous, and long term.

Construction of new offshore structures in the Lease Area could provide new opportunities for offshore tourism by attracting recreational fishing, wildlife sightseeing, and tours of offshore wind infrastructure. The WTG and OSS structures are expected to produce artificial reef effects. The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing, resulting in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the Lease Area. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of the Proposed Action's 147 WTGs and two OSS on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.20 describes the visual impacts from offshore wind infrastructure. During construction, viewers on the New York and New Jersey Shores would see the upper portions of tall equipment such as mobile cranes. These cranes would move from WTG to WTG as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, minor impact on recreation and tourism.

The visual contrast created by the WTGs during operations could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's values, the activity engaged in, and the purpose for visiting the area. As described in Section 3.18.3.2, studies and surveys that have evaluated the impacts of offshore wind facilities on tourism have identified variable reactions to offshore wind, with respondents having positive, neutral, or negative views of the effect that offshore wind infrastructure would have on their experience of coastal recreation (Parsons and Firestone 2018; BOEM 2021a), while a study in Europe found that established offshore wind facilities did not result in decreased tourist numbers, tourist experience, or tourist revenue (Smythe et al. 2018). The Proposed Action WTGs would be set back more than 22 miles from Gateway National Recreation Area units (see distances to KOP-2 and KOP-14 in Appendix M, Table M-5) and impacts on recreation and tourism within the recreation area are anticipated to be minor and long term.

Based on the impacts of the WTGs and OSS on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk along routes between ports and the offshore construction areas, and within the Lease Area during Project construction, O&M, and decommissioning. The Proposed Action is projected to generate an average of 2.8 vessel trips per day between ports and the Lease Area during construction, and 1.4 vessel trips per day during operations. This level of increase in vessel traffic would represent only a modest increase compared to the background volumes of vessel traffic in and around the New York Bight, and BOEM expects that vessel traffic would have long-term, minor impacts on recreation and tourism in the geographic analysis area.

Empire is considering the use of helicopters during construction and to support offshore O&M activities. Details on specific routes and frequency of trips are not known at this time; however, they have the potential to cross noise-sensitive recreational areas including Gateway National Recreation Area and Otis Park Fire Island High Dunes Wilderness. The mean existing sound level at Gateway National Recreation Area is estimated to be 47.3 dB (Wood 2015). Helicopters traveling at 500 feet are approximately 87 dB, which is loud enough to interrupt normal conversations. Depending on the number and frequency of helicopter trips, the impact of the additional noise from helicopter use could result in localized, continuous, and long-term impacts.

Non-routine activities such as response to spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. Empire would develop an emergency plan and OSRP (APM 195 and APM 202) and provide marine coordination for vessels associated with the Projects through a central coordination hub from which all Project vessel movements would be managed and third-party traffic would be monitored (APM 177). With implementation of navigation-related mitigation measures, the impacts of non-routine activities on recreation and tourism would be minor.

3.18.5.1. Impact of the Connected Action

The potential impacts of the connected action on recreation and tourism were evaluated through the following IPFs: land disturbance, lighting, and noise.

Land disturbance: Construction of the connected action would require demolition of existing structures and paving, excavation of fill to install support structures, installation of support structures, above-ground structures including three crane pads, paving for assembly roads and replacement of existing pavement, and construction of an O&M facility including utilities. The proposed construction activities could result in localized, temporary disturbance to recreation activities or tourism-based businesses near the construction site. The proposed SBMT enhancements would be in a developed area zoned for heavy manufacturing that generates noise, traffic, or pollutants; therefore, construction of the connected action would have negligible impacts on recreation and tourism due to land disturbance. Operation of the connected action is not expected to have impacts on recreation and tourism, as activities would be consistent with existing land use and zoning.

Lighting: The areas adjacent to SBMT have been extensively developed. Because of the high development density and the industrial and commercial nature of surrounding properties, existing nighttime lighting is prevalent. Permanent lighting and other utilities associated with the crane platform would be established on the wharf. Although lighting associated with the construction and operation of the connected action would have a long-term impact, the overall impact on recreation and tourism in the geographic analysis area is likely to be limited.

Noise: Noise from the operation of construction equipment and associated vehicle traffic could result in impacts on recreation and tourism in the areas surrounding SBMT by temporarily disturbing the natural sounds of the marine environment or the expected quiet of recreation areas. However, onshore construction would be limited to areas zoned for heavy industries that generate ongoing noise and traffic. Noise from constructing the connected action would have temporary but negligible impacts on recreation and tourism near SBMT. Noise from operation of the connected action is not expected to have a significant adverse effect, as the proposed increases in traffic would result in a noise increase of 3 A-weighted decibels and the crane pads are farther than 1,500 feet from the closest noise sensitive receptor (see Appendix P).

3.18.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT.

In context of reasonably foreseeable environmental trends, BOEM expects that the Proposed Action in combination with other ongoing and planned activities in the geographic analysis area would result in localized minor impacts on recreation and tourism related to anchoring and land disturbance. BOEM expects that lighting for the Proposed Action and other ongoing and planned activities would have negligible to minor impacts on recreation and tourism. The cumulative impacts of the Proposed Action related to cable emplacement would be minor on recreation and tourism due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and installation, O&M, and decommissioning of offshore export cables. Noise created as a result of the Proposed Action in combination with other ongoing and planned activities would have minor impacts on recreation and tourism due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and decommissioning. Impacts of noise on recreation and tourism during operations would be negligible and long term. The combined impacts of the presence of structures on recreation and tourism from the cumulative impacts of the Proposed Action would range from minor beneficial (related to reef effects and recreational fishing and sightseeing opportunity) to minor adverse (related to increased navigational complexity, space-use conflicts, anchoring, and gear entanglement or loss). Structures from other planned offshore wind development would generate comparable types of impacts as the Proposed Action. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts considering the Proposed Action and other ongoing and planned activities would likely be the same. In context of reasonably foreseeable environmental trends, combined vessel traffic impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action, would be temporary and minor during construction and long term and minor during operations.

3.18.5.3. Conclusions

Impacts of the Proposed Action. In summary, the impacts from individual IPFs associated with the Proposed Action alone would be **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). IPFs could disrupt recreation and tourism during construction but be localized and temporary, and recreation and tourism could be temporarily displaced to alternate areas. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area and scour and cable protection could increase the risk of gear entanglement or loss, and difficulty with anchoring. Beneficial impacts on recreation and tourism would result from the reef effect (providing additional locations for recreational for-hire fishing trips) and sightseeing attraction of offshore wind energy structures.

The connected action would have **negligible** adverse impacts on recreation and tourism from land disturbance, lighting, and noise.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities (including planned offshore wind) would be **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). Considering all IPFs together, the cumulative impact of the Proposed Action in combination with ongoing and planned activities would range from **minor** adverse to **minor beneficial**.

3.18.6 Impacts of Alternatives B, E, and F on Recreation and Tourism

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. Alternative B would remove six WTG positions closest to Cholera Bank, Alternative E would remove a row of seven WTG positions to create a separation between EW 1 and EW 2, and Alternative F would remove up to 22 WTG positions from EW 1 and optimize the layout for annual energy production. The Alternative F layout would incorporate removal of 22 WTG positions from EW 1, which would to improve access for fishing.

Further opening access to Cholera Bank and interior portions of EW 1 and creating openings within the layout or separation between EW 1 and EW 2 would all reduce space use conflicts for recreational boating, fishing, and sightseeing; risk of allision with structures; and risk of gear entanglement or loss compared to the Proposed Action. However, BOEM expects that the overall impact level would not be reduced and would be the same as that of the Proposed Action. Impacts from individual IPFs associated with Alternative B, E, or F alone would be minor adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and minor adverse to minor beneficial (related to the presence of structures).

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends in the area, the contribution of Alternative B, E, or F to the cumulative impacts on recreation and tourism would generate comparable types of impacts as those of the Proposed Action. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts considering Alternative B, E, or F and other ongoing and planned activities would likely be the same: minor adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and minor adverse to minor beneficial (related to the presence of structures). Considering all IPFs together, the cumulative impacts of Alternative B, E, or F would range from minor adverse to minor beneficial.

3.18.6.1. Conclusions

Impacts of Alternatives B, E, and F. The impacts from individual IPFs associated with Alternative B, E, or F alone or in combination with ongoing and planned activities would be **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures).

Cumulative Impacts of Alternatives B, E, and F. Considering all IPFs together, the cumulative impacts of Alternative B, E, or F in combination with ongoing and planned activities would range from **minor** adverse to **minor beneficial**.

3.18.7 Impacts of Alternatives C, D, G, and H on Recreation and Tourism

Impacts of Alternatives C, D, G, and H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, G, or H would be the same as those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), to avoid the sand borrow area (Alternative D), or to utilize a cable bridge to cross Barnums Channel (Alternative G) are already covered under the Proposed Action as part of the PDE approach and narrowing the submarine and onshore cable route options under Alternative C, D, or G would not change the analysis of any IPF. Alternative methods for dredge and fill activities under Alternative H would also have no impact on recreation and tourism.

Cumulative Impacts of Alternatives C, D, G, and H. In context of reasonably foreseeable environmental trends, the contribution of Alternative C, D, G, or H to the cumulative impacts on recreation and tourism would be the same as that described under the Proposed Action: minor adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and minor adverse to minor beneficial (related to the presence of structures). The cumulative impacts of Alternative C, D, G, or H would be the same as described under the Proposed Action: minor adverse to minor beneficial.

3.18.7.1. Conclusions

Impacts of Alternatives C, D, G, and H. Submarine and onshore cable route options analyzed under Alternatives C, D, and G are already covered as part of the PDE approach and narrowing the cable route options would not change the analysis of any IPF. Alternative methods for dredge and fill activities under Alternative H would also have no impact on recreation and tourism. The impacts from individual IPFs associated with Alternative C, D, G, or H would be **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). Considering all IPFs together, the overall impacts of Alternative C, D, G, or H would range from **minor** adverse to **minor beneficial**.

Cumulative Impacts of Alternatives C, D, G, and H. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the cumulative impacts on recreation and tourism would be the same as that described under the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures).

3.18.8 Comparison of Alternatives

Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. The overall impact level would remain the same as that of the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures).

Because Alternatives C, D, and G are already covered under the Proposed Action as part of the PDE approach and narrowing the PDE for submarine and the onshore cable installation under Alternatives C, D, or G would not change the analysis of any IPF, the impacts on recreation and tourism from these alternatives would be the same as under the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures).

In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the cumulative impacts on recreation and tourism would be the same as that of the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). Considering all the IPFs together, BOEM anticipates that the contribution of Alternative B, C, D, E, F, G, or H to the impacts from ongoing and planned activities would result in **minor** adverse to **minor beneficial** cumulative impacts on recreation and tourism in the geographic analysis area.

3.19. Sea Turtles

This section discusses existing sea turtle resources within the geographic analysis area and the potential impacts on these resources from the Proposed Action, alternatives, and ongoing and planned activities within that area. The geographic analysis area, as shown on Figure 3.19-1, includes the Northeast Shelf, Southeast Shelf, and Gulf of Mexico LMEs to capture the movement range for sea turtle species that could be affected by the Projects.

3.19.1 Description of the Affected Environment for Sea Turtles

Five species of sea turtle have been documented in U.S. waters of the northwest Atlantic Ocean, where almost all Project activities would occur: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*). All five species are listed under the ESA; hawksbill, Kemp's ridley, and leatherback sea turtles are listed as endangered, and green and loggerhead sea turtles are listed as threatened. Critical habitat has been designated for green, hawksbill, leatherback, and loggerhead sea turtles; however, critical habitat for these species is not within or in the vicinity of the Project area. Project vessels transiting routes to and from the Gulf of Mexico may travel through critical habitat for the Northwest Atlantic DPS of loggerhead sea turtles, specifically wintering habitat, breeding habitat, migratory habitat, or *Sargassum* habitat. Although hawksbill sea turtles have been documented in OCS waters of the northwest Atlantic Ocean, they are rare in this region and are considered unlikely to occur. This species occurs regularly in the Gulf of Mexico. However, only two vessel round trips from Corpus Christi are expected for the Projects, making impacts in the Gulf of Mexico unlikely. Therefore, hawksbill sea turtle will not be described further in this section. A description of the four species likely to occur in the Project area is provided below. Additional information on sea turtle species is provided in COP Volume II, Section 5.7.1 (Empire 2022).

Sea turtles generally migrate into or through the Project area as they travel between their northern-latitude feeding grounds and their nesting grounds in the southern U.S., the Gulf of Mexico, and the Caribbean. As ocean waters warm in the spring, sea turtles migrate northward to their feeding grounds in the Mid-Atlantic, typically arriving in the spring or summer and remaining through the fall. As water temperatures cool, most sea turtles begin their return migration to the south. Historically, this southward migration begins in October, and most turtles are gone by the first week in November. Some individuals may remain in the Mid-Atlantic into the winter when they could experience cold stunning (Empire 2022).

The best available information on the occurrence and distribution of sea turtles in the Project area is provided by a combination of sighting, stranding, and bycatch data, including:

- Site-specific aerial survey data collected by Empire (see Appendix P of the COP, summarized in Table 5.7-1 and Figure 5.7-3 in Volume 2b of the COP; Empire 2022)
- Protected Species Observer data collected in the Project area (summarized in Table 5.7-2 in Volume 2b of the COP; Empire 2022)
- Aerial survey data collected by NYSERDA and NYSDEC (Normandeau and APEM 2018; Tetra Tech and LGL 2019, 2020; Tetra Tech and Smultea Sciences 2018; Tetra Tech and LGL 2019, 2020)
- Sighting data retrieved from the Ocean Biodiversity Information System (Halpin et al. 2009; Roberts et al. 2016a, 2016b, 2017, 2018, 2020)
- Data from NOAA's Atlantic Marine Assessment Program for Protected Species surveys (NEFSC and SEFSC 2018, 2020)
- Other regional data (CETAP 1981; Kenney and Vigness-Raposa 2010; Kraus et al. 2016; NMFS 2019)

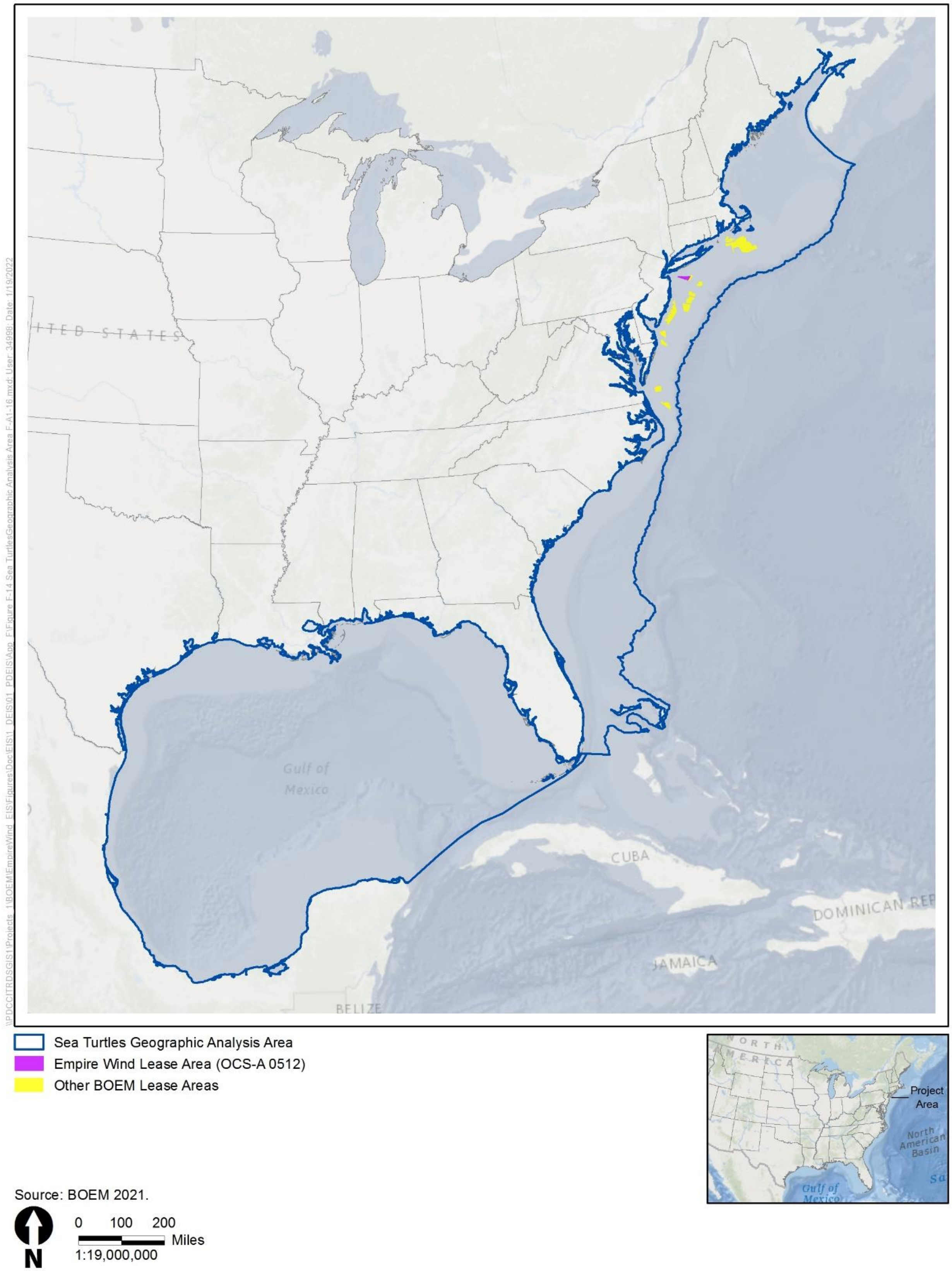

Figure 3.19-1 Sea Turtles Geographic Analysis Area

These data are summarized on Figure 5.7-2 in Volume 2b of the COP (Empire 2022). Species occurrence is summarized in Table 3.19-1 and described in the following paragraphs.

Green sea turtle: Green sea turtles found in the Project area most likely belong to the North Atlantic DPS, although Project vessels transiting through the South Atlantic and Gulf of Mexico may encounter individuals from both the North Atlantic and South Atlantic DPSs (Bass and Witzell 2000; Foley et al. 2007). This species inhabits tropical and subtropical waters around the globe. In the U.S., green sea turtles occur from Texas to Maine, as well as the Caribbean. Late juveniles and adults are typically found in nearshore waters of shallow coastal habitats (NMFS 2021a). No green sea turtle nesting has been documented on the New York coast. The adult diet is largely herbivorous, composed primarily of algae and seagrasses with occasional sponges and invertebrates (NMFS 2021a). Although they have the potential to occur year-round, green sea turtles generally occur seasonally in the Project area with the highest densities observed between June and November. Green sea turtles have been sighted in the vicinity of the Project area in relatively low numbers compared to the other three species. Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 23 of Appendix M-2 of the COP (Empire 2022). Green sea turtles have a density of 0.00 animal per 100 km^2 in all four seasons. There is no population estimate for the North Atlantic DPS of green sea turtles. However, nester abundance for this DPS is estimated at 167,424 (Seminoff et al. 2015). All major nesting populations in this DPS have shown long-term increases in abundance (Seminoff et al. 2015). Nester abundance for the South Atlantic DPS is estimated at 63,332, although many nesting sites have insufficient data to estimate abundance (Seminoff et al. 2015). Long-term data are lacking to evaluate trends for this DPS. A detailed species description for green sea turtles is provided in Section 5.7.1.2 of Volume 2b of the COP (Empire 2022).

Table 3.19-1 Sea Turtles Likely to Occur in the Project Area

Common Name	Scientific Name	DPS/ Population	ESA Status	Relative Occurrence in the Project Area	Seasonal Occurrence in the Project Area
Green	*Chelonia mydas*	North Atlantic	Threatened	Regular	June to November
Kemp's ridley	*Lepidochelys kempii*	-	Endangered	Common	June to November
Leatherback	*Dermochelys coriacea*	Northwest Atlantic	Endangered	Common	June to November
Loggerhead	*Caretta caretta*	Northwest Atlantic	Threatened	Common	June to November

Kemp's ridley sea turtle: All Kemp's ridley sea turtles, including those found in the Project area, belong to a single population. This species primarily inhabits the Gulf of Mexico, although large juveniles and adults travel along the U.S. Atlantic coast. At these life stages, Kemp's ridley sea turtles occupy nearshore habitats in subtropical to warm temperate waters, including sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters. A single Kemp's ridley nest was documented on Queen's Beach, New York in 2018. However, this nest was outside the known nesting range for the species, which is essentially limited to the beaches of the western Gulf of Mexico (NMFS and USFWS 2015). The diet of Kemp's ridley sea turtles is composed of crabs, mollusks, shrimp, fish, and vegetation (Ernst et al. 1994). Kemp's ridley sea turtles could occur in the Project area year-round, but they are mainly in the region during the summer and fall. Annual density of Kemp's ridley sea turtles is provided on Figure 5.7-4 in Volume 2b of the COP (Empire 2022). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 23 of Appendix M-2 of the COP (Empire 2022). Kemp's ridley sea turtles have seasonal densities of 0.001 animal per 100 km^2 for spring, 0.010 animal per 100 km^2 for summer, 0.002 animal per 100 km^2 for fall, and 0.000 animal per 100 km^2 for winter. In 2012, the population of individuals age 2 and up was estimated at 248,307 turtles (NMFS and USFWS 2015 citing Gallaway et al. 2013). Since 2009, there has been a decline in nest abundance for this population (NMFS and USFWS 2015). A detailed species description for Kemp's ridley sea turtles is provided in Section 5.7.1.2 of Volume 2b of the COP (Empire 2022).

Leatherback sea turtle: Leatherback sea turtles that occur in the Project area belong to the Northwest Atlantic population identified in the 2020 status review for the species (NMFS and USFWS 2020); however, this population has not been identified as a DPS or listed separately under the ESA at this time. This species is found in the Atlantic, Pacific, and Indian Oceans (NMFS 2021b). Leatherback sea turtles can be found throughout the western North Atlantic Ocean as far north as Nova Scotia, Newfoundland, and Labrador (Ernst et al. 1994). While early life stages prefer oceanic waters, adult leatherback sea turtles are generally found in mid-ocean, continental shelf, and nearshore waters (NMFS and USFWS 1992). This species does not nest along the New York coast. Leatherback sea turtle diets are composed almost exclusively of jellyfish, salps, and other gelatinous prey (Bjorndal 1997). This species displays a marked migration pattern, entering the Mid-Atlantic in spring and remaining through the summer months (Shoop and Kenney 1992). However, leatherback sea turtles could occur in the Project area throughout the year. Annual density of leatherback sea turtles is provided on Figure 5.7-6 in Volume 2b of the COP (Empire 2022). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 23 of Appendix M-2 of the COP (Empire 2022). Leatherback sea turtles have a seasonal density of 0.000 animal per 100 km^2 for spring, 0.003 animal per 100 km^2 for summer, 0.008 animal per 100 km^2 for fall, and 0.000 animal per 100 km^2 for winter. The best available estimate of nesting female abundance for the Northwest Atlantic population is 20,659 females. This population is currently exhibiting an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020). A detailed species description for leatherback sea turtles is provided in Section 5.7.1.2 of Volume 2b of the COP (Empire 2022).

Loggerhead sea turtle: Loggerhead sea turtles found in the Project area belong to the Northwest Atlantic DPS. This species inhabits nearshore and offshore habitats throughout the globe (Dodd 1988). Loggerhead sea turtles occur throughout the Northwest Atlantic as far north as Newfoundland (NMFS 2021c). This species does not nest along the New York coast. Juvenile loggerhead sea turtles have omnivorous diets, consuming crabs, mollusks, jellyfish, and vegetation. Adults are carnivores, consuming primarily benthic invertebrates (Dodd 1988). Although they have the potential to occur year-round, loggerhead sea turtles generally occur seasonally in the Project area during summer and fall with the highest densities observed in the summer months. Annual density of loggerhead sea turtles is provided on Figure 5.7-2 in Volume 2b of the COP (Empire 2022). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 23 of Appendix M-2 of the COP (Empire 2022). Loggerhead sea turtles have a seasonal density of 0.003 animal per 100 km^2 for spring, 0.268 animals per 100 km^2 for summer, 0.002 animal per 100 km^2 for fall, and 0.000 animal per 100 km^2 for winter. The most recent population estimate for the Northwest Atlantic continental shelf, calculated in 2010, is 588,000 juvenile and adult loggerhead sea turtles (NEFSC and SEFSC 2011). The recovery units for the Northwest Atlantic DPS have shown no trend or an increasing trend in nest abundance; however, these recovery units have not met their recovery criteria for annual increases in nest abundance (Bolten et al. 2019). A detailed species description for loggerhead sea turtles is provided in Section 5.7.1.2 of Volume 2b of the COP (Empire 2022).

All four sea turtle species in the geographic analysis area are subject to regional, pre-existing threats. These threats include fisheries bycatch, loss or degradation of nesting and foraging habitat, entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Green, Kemp's ridley, and loggerhead sea turtles are also susceptible to cold stunning.

Although sea turtles possess auditory organs that are adapted for underwater hearing, hearing abilities for these species are not well studied but have been reported to be limited to low frequencies, typically below 1,600 Hz. The documented hearing range for each of the four sea turtle species is provided in Table 3.19-2.

Table 3.19-2 Sea Turtle Hearing Ranges

Species	Hearing Range (Hertz)		Source
	Minimum	Maximum	
Green	50	1,600	Dow Piniak et al. 2012a
Kemp's ridley	100	500	Bartol and Ketten 2006
Leatherback	50	1,200	Dow Piniak et al. 2012b
Loggerhead	50–100	800–1,120	Martin et al. 2012

3.19.2 Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-3.

Table 3.19-3 Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for sea turtles. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.19.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles, described in Section 3.19.1, *Description of the Affected Environment for Sea Turtles*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind and offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles are generally associated with coastal and offshore development, marine transport, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect sea turtles through accidental releases (see Table F1-23 in Appendix F for a summary of accidental releases anticipated), which can have physiological effects on sea turtles; EMF and light, which can result in behavioral changes in sea turtles; new cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on sea turtles; the presence of structures, which can result in behavioral changes in sea turtles, effects on prey species, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. Global climate change is an ongoing risk for sea turtle species in the geographic analysis area. Warming and sea level rise could affect sea turtles through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, increased erosion and sediment deposition, and development of protective measures (e.g., seawalls and barriers); ocean acidification may also affect sea turtles (Hawkes et al. 2009). Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on sea turtles, including changes to sea turtle distribution, habitat use, migratory patterns, nesting periods, nestling sex ratios, nesting habitat quality or availability, prey distribution or abundance, and foraging habitat availability (Fuentes and Abbs 2010; Janzen 1994; Newson et al. 2009; Witt et al. 2010).

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and vessel traffic that are described in detail in Section 3.19.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

See Table F1-21 for a summary of potential impacts associated with ongoing non-offshore wind and offshore activities by IPF for sea turtles.

3.19.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities (see Section F.2 in Appendix F for a complete description of planned activities). BOEM expects planned activities other than offshore wind to affect sea turtles through several primary IPFs, including accidental releases, EMF, light, new cable emplacement and maintenance, port utilization, noise, and the presence of structures. See Table F1-21 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for sea turtles.

The sections below summarize the potential impacts of other ongoing and planned offshore wind activities on sea turtles during construction, O&M, and decommissioning of the projects. Other ongoing and planned offshore wind activities in the geographic analysis area for sea turtles include the construction, O&M, and decommissioning of 30 offshore wind projects.

BOEM expects ongoing and planned offshore wind activities to affect sea turtles through the following primary IPFs.

Accidental releases: Ongoing and planned offshore wind activities may increase accidental releases of fuels, fluids, hazardous materials, and trash and debris due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning.

Ongoing and planned offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels, fluids, and hazardous materials. There would also be a low risk of fuel, fluid, and hazardous materials leaks from any of the 2,884 WTGs (Table F2-1 in Appendix F) anticipated in the geographic analysis area (including ongoing and planned projects but not including the Proposed Action). The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 14.3 million gallons (Table F2-3 in Appendix F). OSS and ESPs are expected to hold an additional 10.8 million gallons of fuels, fluids, and hazardous materials (Table F2-3 in Appendix F). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Sea turtle exposure to oil spills through aquatic contact or inhalation of fumes can result in death (Shigenaka et al. 2010) or sublethal effects, including but not limited to adrenal effects, dehydration, hematological effects, increased disease incidence, hepatological effects, poor body condition, dermal effects, and skeletomuscular effects (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Such sublethal effects would affect individual fitness but are not expected to affect sea turtle populations. In addition to direct effects on sea turtles, accidental releases can indirectly affect sea turtles through impacts on prey species (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction, operation, and decommissioning of offshore wind facilities. All sea turtle species are known to ingest trash and debris, including plastic fragments, tar, paper, polystyrene foam, hooks, lines, and net fragments (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Tomás et al. 2002). Such ingestion can occur accidentally or intentionally when individuals mistake the debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Tomás et al. 2002). Ingestion of trash and debris can result in death or sublethal effects, including but not limited to dietary dilution, chemical contamination, depressed immune system, poor body condition, reduced growth rates, reduced fecundity, and reduced reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). These sublethal effects would affect individual fitness, but mortality and sublethal effects associated with ingestion of trash and debris are not expected to have population-level effects. BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released during planned offshore wind activities would likely be miniscule compared to trash releases associated with ongoing activities, including land-based activities and commercial and recreational fishing.

EMF: Ongoing and planned offshore wind activities would install up to 10,306 miles (16,586 kilometers) of export and interarray cables, increasing the production of EMF and heat in the geographic analysis area. EMF and heat effects would be reduced by cable burial to an appropriate depth and shielding, if necessary. Cables are also expected to be separated by a minimum distance of 330 feet, avoiding additive EMF and heat effects from adjacent cables.

Sea turtles are capable of detecting magnetic fields, and behavioral responses to such fields have been documented. The threshold for behavioral responses varies somewhat among species. Loggerhead sea turtles have exhibited responses to field intensities ranging from 0.0047 to 4,000 microteslas, and green sea turtles have responded to field intensities ranging from 29.3 to 200 microteslas (Normandeau et al. 2011); other species are expected to have similar thresholds due to similar anatomical features, behaviors, and life history characteristics. Juvenile and adult sea turtles may detect EMFs associated with ongoing and planned activities when foraging on benthic prey or resting on the bottom in relatively close proximity to cables. There are no data on EMF impacts on sea turtles associated with underwater cables. Migratory disruptions have been documented in sea turtles with magnets attached to their heads (Luschi et al. 2007), but evidence that EMF associated with planned offshore wind activities would likely result in some deviations from direct migration routes is lacking (Snoek et al. 2016). Any deviations are expected to be minor (Normandeau et al. 2011), and any increased energy expenditure due to these deviations would not be biologically significant.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters (Taormina et al. 2018). There are no data on cable heat effects on sea turtles (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms that serve as prey for sea turtles that forage in the benthos. Based on the narrowness of cable corridors and expected weakness of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths, thermal effects would not occur at the surface of the seabed where sea turtles would forage. Therefore, any effects on sea turtle prey availability would be too small to be detected or meaningfully measured.

Gear utilization: Ongoing and planned offshore wind activities are expected to include monitoring surveys in the project areas. Sea turtles could be affected by these surveys through survey vessel traffic and interactions with survey gear. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs.

Additional impacts on sea turtles could result from interactions with mobile (e.g., trawl, dredge) or fixed (e.g., trap, hydrophone) survey gear. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in fisheries utilizing bottom trawls are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; NRC 1990). Although sea turtles are capable of extended dive durations, entanglement and forcible submersion in fishing gear leads to rapid oxygen consumption (Lutcavage and Lutz 1997). Based on available research, restricting tow times to 30 minutes or less is expected to prevent sea turtle morality in trawl nets (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates trawl surveys for offshore wind project monitoring would be limited to tow times of 20 minutes, indicating that this activity poses a negligible risk of mortality. Additional mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear. Tows for clam dredge surveys would have a very short duration of 120 seconds, and the survey vessels would be subject to mitigation measures similar to those for the trawl survey. Therefore, effects of dredge surveys on sea turtles would be insignificant or discountable.

The vertical buoy and anchor lines associated with monitoring surveys using fixed gear, such as fish traps or baited remote underwater video, could pose a risk of entanglement for sea turtles. While there is a theoretical risk of sea turtle entanglement in trap and pot gear, particularly for leatherback sea turtles (NMFS 2016), the likelihood of entanglement would be discountable given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. BOEM also anticipates mitigation measures would be in place to reduce sea turtle interactions during fisheries surveys. Sea turtle prey species (e.g., crabs, whelks, fish) may be collected as bycatch in trap gear. However, all bycatch is expected to be returned to the water and would still be available as prey for sea turtles regardless of their condition, particularly for loggerhead sea turtles, which are known to forage for live prey and scavenge dead organisms. Given the non-extractive nature of fixed-gear surveys, any effects on sea turtles from the collection of potential sea turtle prey would be so small that it cannot be meaningfully measured, detected, or evaluated. Therefore, indirect effects on sea turtles due to collection of potential prey items would be insignificant. Hydrophone mooring lines for passive acoustic monitoring studies pose a theoretical entanglement risk to sea turtles, similar to trap and pot surveys. However, BOEM anticipates that monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement. Therefore, passive acoustic studies are expected to pose a discountable risk of entanglement to sea turtles.

Monitoring surveys are expected to occur at short-term, regular intervals over the duration of the monitoring program. Although the potential extent and number of animals potentially exposed cannot be determined without project-specific information, impacts of gear utilization on sea turtles are expected to be negligible given the negligible risk of mortality, the discountable risk of entanglement, and the insignificant effect on sea turtle prey availability.

Lighting: Vessels and offshore structures associated with planned offshore wind activity will produce light at night. Lighting on vessels and offshore structures could elicit attraction, avoidance, or other behavioral responses in sea turtles. In laboratory experiments, juvenile loggerhead sea turtles consistently oriented toward lightsticks of various colors and types used by pelagic longline fisheries (Wang et al. 2019), indicating that hard-shelled sea turtle species expected to occur in the vicinity of the Projects (i.e., green, Kemp’s ridley, and loggerhead) could be attracted to offshore light sources. In contrast, juvenile leatherback sea turtles failed to orient toward or oriented away from lights in laboratory experiments (Gless et al. 2008), indicating that this species may not be attracted to offshore lighting. Any behavioral responses to offshore lighting are expected to be localized and temporary.

Under the planned activities scenario described in Appendix F, 2,884 WTGs and 68 OSS/ESPs would be constructed between 2023 and 2030 (Tables F2-1 and F2-2 in Appendix F). These offshore structures would have yellow flashing navigational lighting and red flashing FAA hazard lights, in accordance with

BOEM's (2021c) lighting and marking guidelines. Following these guidelines, direct lighting would be avoided, and indirect lighting of the water surface would be minimized to the greatest extent practicable. As described in the previous paragraph, offshore lighting may attract juvenile green, Kemp's ridley, and loggerhead sea turtles, based on laboratory experiments. The flashing lights on offshore structures associated with planned offshore wind activities are unlikely to disorient juvenile or adult sea turtles, as they do not present a continuous light source (Orr et al. 2013). There is no evidence that lighting on oil and gas platforms in the Gulf of Mexico, which may have considerably more lighting than offshore WTGs, has had any effect on sea turtles over decades of operation (BOEM 2019a). Therefore, lighting on offshore structures associated with planned offshore wind activities is not expected to have detectable effects on sea turtles.

Cable emplacement and maintenance: Ongoing and planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement and maintenance activities disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations. Cable emplacement associated with ongoing and planned offshore wind activities (not including the Proposed Action) is expected to disturb more than 36,125 acres of seabed (Table F2-2 in Appendix F) between 2023 and 2030. This acreage could be reduced if open-access offshore transmission systems are built, as have been proposed. However, such projects are not considered reasonably foreseeable at this time. During cable installation, sediment plumes would be present for up to 6 hours at a time until the activity is completed and suspended sediment settles back to the seabed; areas subject to cumulative increases in suspended sediment from simultaneous activities would be limited because the occurrence of concurrent cable installation operations is expected to be limited. The increases in suspended sediment associated with new cable emplacement and maintenance would be short term and localized to the cable corridor. There are no data on the physiological effects of suspended sediment on sea turtles. However, elevated suspended sediment may cause sea turtles to alter their normal movements and behaviors, as sea turtles would be expected to avoid the area of elevated suspended sediment. Such alterations are expected to be too small to be detected (NMFS 2020a). No effects are anticipated if sea turtles swim through the area of elevated suspended sediment. Suspended sediment is most likely to affect sea turtles if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to sea turtles swimming through the area of elevated suspended sediment or avoiding the area (NMFS 2020a). In addition to direct effects on sea turtle behavior, suspended sediment can indirectly affect sea turtles through impacts on prey species, including benthic mollusks, crustaceans, sponges, and sea pens. Elevated suspended sediment concentrations are shown to have adverse effects on benthic communities when they exceed 390 mg/L (NMFS 2020a citing EPA 1986). See Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, for a discussion of impacts on prey species.

Any dredging required prior to cable emplacement could have additional impacts on sea turtles due to impingement, entrainment, or capture in certain types of dredges. Mechanical dredging is not expected to capture, injure, or kill sea turtles (NMFS 2020b). Hopper dredges may strike, impinge, or entrain sea turtles, which may result in injury or mortality (Ramirez et al. 2017 citing Dickerson et al. 1990; Ramirez et al. 2017 citing Dickerson et al. 1991; Ramirez et al. 2017 citing Reine et al. 1998; Ramirez et al. 2017 citing Richardson 1990). The sea turtle species most often affected by dredge interactions is loggerhead sea turtles, followed by green sea turtles, then Kemp's ridley sea turtles (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and sea turtles is expected to be lower in the offshore environment where dredging for offshore wind cables would most likely occur (Michel et al. 2013; NMFS 2020b). The risk of injury or mortality of individual sea turtles due to dredging associated with planned offshore wind activities is considered low, and population-level effects are unlikely to occur.

Noise: Ongoing and planned offshore wind activities would generate anthropogenic noise from aircraft, G&G surveys, offshore wind turbines, pile driving, cable laying, and vessels. These noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Helicopters may be used to transport crew during construction or operation of offshore wind facilities. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit stress or behavioral responses (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of WTG inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area; these responses are not expected to be biologically significant.

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities. Site assessment and characterization activities are expected to occur intermittently over a 2- to 10-year period at locations spread throughout much of the geographic analysis area. Although schedules for many planned offshore wind activities are still being developed, it would be possible to avoid overlapping noise impacts on sea turtles by scheduling site assessment and characterization activities to avoid conducting simultaneous G&G surveys in proximity to each other. Such surveys can generate high-intensity, impulsive noise that has the potential to affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. TTS or PTS could occur if sea turtles are close to survey activities. However, TTS and PTS are considered unlikely, as sea turtles are expected to avoid survey activities and survey vessels would travel quickly (NSF and USGS 2011). BOEM has concluded that underwater noise associated with G&G surveys for offshore wind activities would likely result in temporary displacement and behavioral effects or biologically insignificant physiological effects (BOEM 2019a) and has developed Project Design Criteria and BMPs for offshore wind data collection activities (e.g., G&G surveys) to minimize impacts on protected species (BOEM 2021b) that lessees will be required to follow. Any resulting impacts on individual sea turtles are not expected to result in stock or population-level effects.

Operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. Monitoring data indicate that SPL_{RMS} produced by operating turbines generally range from 110 to 125 dB in the 10-Hz to 8-kilohertz frequency range (Tougaard et al. 2020). Noise levels produced by WTGs are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Kraus et al. 2016; Thomsen et al. 2015). At Block Island Wind Farm, turbine noise reaches ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Additionally, studies suggest that sea turtles acclimate to repetitive underwater noise in the absence of an accompanying threat (Bartol and Bartol 2011; Hazel et al. 2007; Navy 2018). Therefore, no noise impacts on sea turtles are anticipated from operating WTGs.

Construction of ongoing and planned offshore wind projects will generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 4 to 6 hours at a time as 2,884 WTGs and 68 OSS/ESPs are constructed between 2023 and 2030 (Tables F2-1 and F2-2 in Appendix F). The intense, impulsive noise associated with pile driving can cause behavioral or physiological effects. Potential behavioral effects of pile driving noise include altered dive patterns, short-term disturbance, startle responses, and short-term displacement (NSF and USGS 2011; Samuel et al. 2005). Potential physiological effects include temporary stress response and, close to the pile-driving activity, TTS or PTS. Behavioral effects and most physiological effects are expected to be of short duration and localized to the ensonified area. PTS could permanently limit an individual's ability to locate prey, detect predators, or find mates and could therefore have long-term effects on individual fitness. BOEM expects that sea turtles would be displaced for 6 to 14 hours per day during foundation installation, depending on the type of turbine foundation. Therefore, any disruptions to foraging or other normal behaviors would be temporary and increased energy expenditures associated with this displacement are expected to be small. It is possible that pile driving could displace animals into areas with lower habitat quality or higher risk (e.g., vessel collision or fisheries interaction). Multiple construction activities within the same calendar year could potentially affect migration, foraging, breeding, and individual fitness. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction; such impacts could be long term and of high intensity and high exposure level. For example, individuals repeatedly exposed to pile driving over a significant period of time (e.g., a season, a year, or a life stage) may incur energetic costs associated with avoidance movements that would be sufficient to cause long-term effects on individual fitness (Navy 2018). However, habituation may occur in sea turtles (Hazel et al. 2007), potentially reducing avoidance and reducing the impacts of repeated exposures.

Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Modeling based on noise data collected during cable laying operation in Europe estimates that underwater noise levels would exceed 120 dB in a 98,842-acre area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the dynamic nature of the ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on sea turtles.

Vessels generate low-frequency (10 to 100 Hz) (MMS 2007), non-impulsive noise that could affect sea turtles. Vessel noise overlaps with the hearing range of sea turtles and may elicit behavioral responses, including startle responses and changes in diving patterns, or a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). Vessel activity associated with planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities (BOEM 2019b). This increase in vessel activity could cause repeated, intermittent impacts on sea turtles resulting from short-term, localized behavioral responses, which would dissipate once the vessel leaves the area. BOEM considers these behavioral effects to be unlikely given the patchy distribution of sea turtles in the geographic analysis area, and, therefore, no stock or population-level effects would be expected.

Port utilization: The increased size of vessels and increased volume of vessel traffic associated with planned offshore wind activities will likely result in port expansion within the geographic analysis area. At least two proposed offshore wind projects are considering port expansion, and other ports along the East Coast may be upgraded to accommodate the development of offshore wind projects. Increased port utilization and expansion results in increased noise associated with vessels or pile driving for port expansion and increased suspended sediment concentrations during port expansion activities, including dredging and pile driving. The impacts of vessel noise on sea turtles are expected to be short term and localized, as previously described for the noise IPF in this section. Impacts on water quality associated with increased suspended sediment would also be temporary and localized, as previously described for the new cable emplacement and maintenance IPF in this section. Additionally, the area affected by benthic disturbance would be small compared to available foraging habitat.

Increased port utilization may require dredging at ports or within navigation channels to accommodate the large ships required to carry WTG components. In addition to benthic disturbance and increased suspended sediment concentrations, dredging can affect sea turtles through impingement, entrainment, or capture in the dredges, as described for the new cable emplacement and maintenance IPF in this section. These impacts would be localized to nearshore habitats, and typical mitigation measures (e.g., timing restrictions) are expected to minimize risk to sea turtles. Therefore, risks of injury or mortality are considered low and population-level effects are unlikely to occur.

Presence of structures: An estimated 2,884 WTGs and 68 OSS/ESPs could be built in the geographic analysis area for planned and ongoing offshore wind activities. These structures would occupy open-water, pelagic habitat and would provide presently unavailable hard structure within the water column. Approximately 4,259 acres of hard scour protection would be installed around the WTG foundations, and an additional 2,646 acres of hard protection would be installed around the export and interarray cables (Table F2-2 in Appendix F). The rock and concrete material used for scour protection and cable protection represents presently unavailable benthic hard structure on the seabed. The installation of WTGs and OSS/ESPs and hard protection could result in hydrodynamic changes; obstructions that cause loss of fish gear resulting in entanglement or ingestion by sea turtles; habitat conversion from open-water pelagic and benthic soft substrates to structurally complex, mid-water and benthic hard bottom; new areas of prey aggregation; avoidance or displacement; and behavioral disruption.

The presence of WTGs and OSS/ESPs could alter local hydrodynamic patterns at a fine scale. Water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), effects are expected to dissipate within 300 to 400 feet. Although effects from individual structures are highly localized, the presence of an estimated 2,877 WTGs and 68 OSS/ESPs associated with ongoing and planned offshore wind activities (not including the Proposed Action) could result in regional impacts on wind wave energy, mixing regimes, and upwelling (van Berkel et al. 2020). These localized and regional alterations to hydrodynamics could have impacts on sea turtle prey species. Fine-scale effects on water flow could have localized impacts on prey distribution and abundance. Regional hydrodynamic effects could affect prey species at a broader scale. Effects on surface currents could influence patterns of larval distribution (Johnson et al. 2021) and seasonal mixing regimes could influence primary productivity, both of which could in turn affect the distribution of fish and invertebrates on the OCS (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). Hydrodynamic alterations due to the presence of WTGs could increase primary productivity in the vicinity of the structures (Carpenter et al. 2016; Schultze et al. 2020). However, such an increase would be highly localized and the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles.

In-water structures associated with ongoing and planned activities may serve as artificial reefs, resulting in increased recreational fishing activity in the vicinity of the structures. An increase in recreational fishing activity increases the risk of sea turtles becoming entangled in or ingesting lost fishing gear, which could injure or kill sea turtles. Specifically, entanglement and hooking can cause abrasions, loss of limbs, or increased drag resulting in reduced swimming efficiency and decreased ability to forage or avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Between 2016 and 2018, 186 sea turtles were observed to have been hooked or entangled by recreational fishing gear. Although recreational fishermen would be expected to disperse effort across many WTG foundations to avoid overcrowding, risk of entanglement and ingestion of fishing gear could increase as fishermen and sea turtles are attracted to the structures.

Although the artificial reef effect could increase risk of interactions with recreational fishing gear, this effect could also benefit sea turtles due to prey aggregation. In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (Causon and Gill 2018; Taormina et al. 2018), essentially creating artificial reefs. The aggregation of prey at artificial reefs can result in increased foraging opportunities for sea turtles. In the Gulf of Mexico, green, Kemp’s ridley, leatherback, and loggerhead sea turtles have been documented in the presence of offshore oil and gas platforms (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976; Rosman et al. 1987), indicating that sea turtles are likely to use habitat created by in-water structures in the geographic analysis area. However, increased foraging opportunities are not expected to be biologically significant given the broad geographic range used by sea turtles on their annual foraging migrations compared to the localized scale of artificial reef effects.

Although sea turtle prey may be aggregated through the reef effect, it may also aggregate sea turtle predators. In field surveys of artificial and natural reefs off North Carolina conducted by Paxton et al. (2020), higher densities of large, reef-associated predators, specifically transient predators, were observed on artificial reefs than natural reefs. The aggregation of transient predators (e.g., sharks, barracuda, jacks, mackerel) at artificial reefs was associated with greater vertical relief (Paxton et al. 2020), indicating that the vertical structure provided WTG foundations may attract relatively high densities of sharks. The attraction of both sea turtles and their predators to offshore wind structures may increase predation risk for sea turtles. Although the potential for increased predation risk associated with the presence of structures may affect individual sea turtles, it is not expected to result in population-level effects given the localized scale of artificial reef effects compared to the geographic range of sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of offshore wind farms. Assuming fishing vessels are displaced to adjacent areas, risk of interaction with fishing vessels would not be greater than current risk given the patchy distribution of sea turtles. Presence of structures could potentially lead to a shift in gear types due to displacement. If displacement leads to an overall shift from mobile to fixed gear types, there could be an increased number of vertical lines in the water, increasing the risk of sea turtle interactions with fishing gear.

Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although 2,884 WTG and 68 OSS/ESP structures are anticipated (2,952 total structures), spacing would be sufficient to allow sea turtles to utilize habitat between and around structures for foraging, resting, and migrating. Although migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in sea turtle migratory patterns.

Traffic: Planned offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning.

Vessel strikes are an increasing concern for sea turtles. The percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem (NMFS and USFWS 2007). Sea turtles are expected to be most vulnerable to vessel strikes in coastal foraging areas and may not be able to avoid collisions when vessel speeds exceed 2 knots (Hazel et al. 2007). Average vessel speeds in the geographic analysis area may exceed 10 knots. Increased vessel traffic may result in sea turtle injury or mortality. Vessel activity associated with planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities. This increase in traffic would only be a small, incremental increase in overall traffic in the geographic analysis area (see Section 3.16, *Navigation and Vessel Traffic*).

The risk of vessel strike from offshore wind vessels would be dependent on the density of sea turtles in each project area, as well as the stage of the project, time of year, number of vessels utilized for each project, and speed of each vessel. Collision risk is expected to be greatest when offshore wind vessels transit between the offshore wind lease areas and ports utilized by each project, as vessel speeds would be highest and turtles are expected to be most susceptible to strike in coastal foraging areas. The increased collision risk associated with this incremental increase in vessel traffic may result in injury or mortality of individual sea turtles. The risk would be greatest for species with the highest densities in a given project area. The increased risk of vessel strike would not be expected to have stock or population-level impacts on sea turtles given their low densities in the geographic analysis area and patchy distribution. Additionally, BOEM expects minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for sea turtles.

3.19.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, sea turtles would continue to be affected by existing environmental trends and ongoing activities.

The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in **negligible** to **minor** adverse impacts on sea turtles. Adverse impacts would result mainly from vessel traffic. BOEM anticipates that adverse impacts associated with ongoing activities, especially those associated with the traffic and noise IPFs, would be **minor**. Other adverse impacts associated with ongoing activities would be **negligible**, particularly those impacts associated with the EMF, accidental releases, and lighting IPFs. Overall, BOEM anticipates that adverse impacts associated with ongoing activities would be **minor**.

Cumulative Impacts of the No Action Alternative. For the No Action Alternative, BOEM expects that ongoing and planned activities would result in continuing temporary to permanent impacts on sea turtles. Considering all IPFs together, ongoing activities, planned activities other than offshore wind, and planned offshore wind activities would result in **minor** impacts, largely due to pile-driving noise and the presence of structures, with some **minor beneficial** impacts possible. Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for sea turtles. These effects would be localized and are not expected to affect individual fitness.

3.19.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on sea turtles:

- Foundation types used for WTGs and OSS;
- The number of foundations installed; and
- The size of foundations installed.

Variability of the Project design exists as described in Appendix E. Below is a summary of potential variances in impacts:

- WTG foundation number: the number of WTG foundations installed affects the duration of pile driving. The more WTG foundations, the longer the duration of pile driving would be.
- WTG foundation size: the size of the pile affects the amount of noise produced during pile driving and thus the size of the ensonified area. Generally, a larger pile would result in a larger ensonified area.

Although variation is expected in the design parameters, the impact assessments in Sections 3.19.5 through 3.19.8 evaluate impacts associated with the maximum-case scenario for sea turtles identified in Appendix E.

3.19.5 Impacts of the Proposed Action on Sea Turtles

As described in Section 2.1.1, the Proposed Action includes the construction of up to 147 WTGs and two OSS and the installation of up to 299 miles (260 nm) of interarray cables and 76 miles (66 nm) of export cables between 2023 and 2027. The Proposed Action also includes 35 years of O&M over a 35-year commercial lifespan and decommissioning activities at the end of commercial life. BOEM expects the Proposed Action to affect sea turtles through the following primary IPFs.

Accidental releases: The Proposed Action may increase accidental releases of fuels, fluids, hazardous materials, and trash and debris during construction, operation, and decommissioning. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste (APM 121), further reducing the likelihood of an accidental release. Empire has developed an OSRP (see COP Appendix F) with measures to avoid accidental releases and a protocol to respond to such a release (APM 103). APM 121 and the OSRP (APM 103), described in Appendix H, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.3.2. Therefore, accidental releases are considered unlikely. BOEM is proposing additional mitigation measures for the Projects (Appendix H, Table H-1). These additional BOEM-proposed measures include marine debris awareness training for vessel operators, employees, and contractors engaged in offshore activities for the Projects. This additional measure would be expected to further reduce the risk of an accidental release but is not expected to change the impact determinations presented in Section 3.19.5.3.

EMF: During operation, the Proposed Action would result in the production of EMFs and heat. EMFs could cause migratory deviations, and heat has the potential to affect benthic species, which serve as prey for some sea turtle species, as described in Section 3.19.3.2. Empire would bury cables to a minimum depth of 6 feet (1.8 meters) wherever possible (APM 101). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. APM 101, described in Appendix H, is included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.5.3. Cable burial and surface protection, where necessary, would minimize EMF and heat exposure. Any potential impacts on sea turtles from EMFs and heat associated with the Proposed Action are expected to be too small to be measured.

Gear utilization: Monitoring surveys for the Proposed Action may include otter trawling, trap sampling, video and still imaging, Sediment Profile and Plan View Imaging, and grab sampling. As described in Section 3.19.3.2, mobile gear surveys (e.g., trawl surveys) have the potential to capture sea turtles, and fixed-gear surveys with vertical lines (e.g., trap surveys) have the potential to entangle sea turtles. Trawl surveys for the Proposed Action would be limited to avoid mortality of sea turtles if incidentally captured (Epperly et al. 2002; Sasso and Epperly 2006); BOEM anticipates capture probability in otter trawls to be low and expects incidentally caught turtles to resume normal behavior upon release. Therefore, the risk to sea turtles from otter trawl surveys would be negligible. The likelihood of entanglement in trap surveys for the Proposed Action would be discountable given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. Additionally, trap surveys would be required to utilize mitigation measures to further reduce entanglement risk (e.g., ropeless gear, biodegradable components).

Sea turtles could also be affected by these surveys through survey vessel traffic. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs.

In addition to direct effects on sea turtles, monitoring surveys may indirectly affect these species through capture of prey items. However, biological monitoring for the Projects is expected to be non-extractive, returning captured organisms at the end of each sampling event. Therefore, indirect effects on sea turtles due to collection of potential prey items would be insignificant, as described in Section 3.19.3.2.

Monitoring survey sampling events are expected to be short term, occurring at fixed intervals over the duration of the monitoring program. Impacts of gear utilization for the Proposed Action on sea turtles are expected to be negligible given the negligible risk of mortality, the discountable risk of entanglement, and the insignificant effect on sea turtle prey availability.

Lighting: Vessels and offshore structures associated with the Proposed Action would have deck and safety lighting. The incremental contribution associated with the Proposed Action would be lighting of up to 147 WTGs and two OSS, a small fraction of the light sources anticipated under the No Action Alternative. As discussed in Section 3.19.3.2, light may elicit temporary, localized behavioral impacts in sea turtles, including attraction or avoidance. Empire would light WTGs and OSS in compliance with FAA and USCG standards and BOEM best practices (APM 168 and APM 219) and would avoid intentionally illuminating the water surface (APM 91). Empire has additionally proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures associated with the Proposed Action (APM 88). APMs 88, 91, 168, and 219, described in Appendix H, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.5.3. Given the APMs in place, light associated with the Proposed Action is not expected to have an effect on sea turtles.

Cable emplacement and maintenance: The Proposed Action would involve the placement and maintenance of 375 miles (326 nm) of export and interarray cables. The incremental contribution of the Proposed Action is a 1,895-acre area of seabed disturbance for the emplacement of export and interarray cables. As described in Section 3.19.3.2, cable emplacement and maintenance activities disturb bottom sediment, temporarily increasing suspended sediment concentrations, which could result in behavioral effects on sea turtles or effects on sea turtle prey species. Empire has sited cable routes to avoid sensitive benthic habitats, including eelgrass beds, where feasible (APM 122), minimizing impacts on unique sea turtle foraging habitats. APM 122, described in Appendix H, is included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.5.3. New cable emplacement is expected to affect only a small percentage of foraging habitat available to sea turtles, and any effects on sea turtles or their prey species would be localized and short term. Recolonization and recovery of prey species is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little time as 100 days (Dernie et al. 2003). Given the short-term and localized nature of impacts and the available sea turtle habitat in the geographic analysis area, impacts of new cable emplacement and maintenance on sea turtles are expected to be too small to be measured.

Noise: Underwater anthropogenic noise sources associated with the Proposed Action would include operating WTGs, pile driving during construction, cable laying during construction, vessels, and potentially helicopters and drilling during construction. As described in Section 3.19.3.2, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. Underwater sound propagation modeling for drilling, impact pile driving, and vibratory pile driving was conducted in support of the COP (see Appendices M-1 and M-2 of the COP; Empire 2022). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Helicopters may be used to support construction or operation of the Proposed Action. As described in Section 3.19.3.2, aircraft traveling at relatively low altitude has the potential to elicit stress or behavioral responses in sea turtles. BOEM assumes helicopters transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of WTG inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

Drilling could occur if pile driving is not possible for the entire piling installation. However, the probability of such an action is considered low. Modeling results indicate that if drilling were required, sea turtles would have to be within less than 328 feet (100 meters) of the pile to experience auditory injury or behavioral effects (COP Appendix M-1; Empire 2022).

HRG surveys would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. As described in Section 3.19.3.2, G&G survey noise could affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. However, HRG survey equipment produces less-intense noise, operates in smaller areas than other G&G survey equipment (e.g., seismic air guns), and is unlikely to result in injury given that sea turtles are expected to avoid survey activities and vessels would travel quickly (NSF and USGS 2011). HRG surveys will be required to follow the Project Design Criteria and BMPs for offshore wind data collection activities (BOEM 2021b). Additionally, any G&G surveys conducted for the Proposed Action would comply with a Project-specific Letter of Authorization, which would include measures to minimize HRG survey impacts on marine mammals that would also benefit sea turtles (i.e., use of ramp-up procedures).

As discussed in Section 3.19.3.2, operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. However, maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Therefore, no noise impacts on sea turtles are anticipated from operating WTGs.

The loudest source of underwater noise associated with the Proposed Action would be pile driving during construction, specifically impact pile driving. As noted above, underwater sound propagation modeling for vibratory and impact pile driving was conducted in support of the COP (see Appendices M-1 and M-2, respectively, of the COP; Empire 2022). Modeling results indicated that the extent of the ensonified area associated with vibratory pile driving for the Projects is relatively small (distance from the pile generally less than 328 feet [100 meters]) compared to the ensonified area produced during impact pile driving. Therefore, this impact evaluation focuses on impact pile driving.

For a typical installation of 31.5-foot (9.6-meter) monopiles (COP Volume 2, Appendix M-2, Tables I-47 through I-50: Empire 2022), impact pile driving sound levels could exceed recommended sea turtle injury thresholds within up to 1.1 miles (1.71 kilometers) during the summer months without sound mitigation. Assuming 10 dB of noise attenuation due to noise mitigating technology, which is the level of attenuation generally achievable by a single noise abatement system (Bellman et al. 2020) and required for mitigation in the Proposed Action’s Letter of Authorization, impact pile driving levels could exceed recommended sea turtle injury thresholds at distances up to 1,148 feet (350 meters) during summer months. Without mitigation, sound levels could exceed recommended sea turtle behavioral thresholds within up to 1.4 miles (2.31 kilometers) of pile driving. Assuming 10 dB of noise attenuation due to noise-mitigating technology, recommended sea turtle behavioral thresholds could be exceeded within up to 2,526 feet (770 meters) of pile driving. Because it is possible that some monopiles (up to 17) will be more difficult to install, modeling was also conducted for 31.5-foot (9.6-meter) monopiles under a difficult-to-drive scenario (COP Volume 2, Appendix M-2, Tables I-51 through I-54; Empire 2022). Under this scenario, sea turtles that remain within up to 1.8 miles (2.84 kilometers) of pile driving in the summer months could experience PTS without noise mitigation. Assuming 10 dB of noise attenuation, sea turtles that remain within up to 2,559 feet (780 meters) of pile driving could experience PTS. Without noise mitigation, recommended sea turtle behavioral thresholds could be exceeded within up to 2.3 miles (3.73 kilometers) of pile driving during summer months. Assuming 10 dB of noise attenuation, radial distances to recommended behavioral thresholds could be reduced to 1.0 mile (1.59 kilometers).

For 36.1-foot (11-meter) monopiles, impact pile driving sound levels in summer months could exceed recommended sea turtle injury thresholds within up to 1.0 mile (1.58 kilometers), without sound mitigation. Assuming 10 dB of noise attenuation, the distance to the recommended sea turtle injury thresholds could be reduced to 984 feet (300 meters) of pile driving. Without mitigation, sound levels could exceed recommended sea turtle behavioral thresholds within up to 1.5 miles (2.45 kilometers) of pile driving. Assuming the use of 10 dB of noise attenuation due to noise-mitigation technology, the distance to recommended sea turtle behavioral thresholds could be reduced to 2,756 feet (840 meters) from the source of pile driving.

Average numbers of sea turtles predicted to receive sound levels above behavioral and PTS exposure criteria were modeled assuming a maximum-case 2-year construction scenario of two monopiles and three pin piles being installed per day, with 96 monopiles and 24 pin piles being installed in Year 1 and 51 monopiles and no pin piles being installed in Year 2 (COP Volume 2, Appendix M-2, Tables 10, 14, I-17, and I-18; Empire 2022) (Table 3.19-4). Without noise mitigation, up to five Kemp's ridley sea turtles, three leatherback sea turtles, and 12 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds. Assuming 10 dB of noise attenuation, no sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds. Without noise mitigation, up to one green sea turtle, 33 Kemp's ridley sea turtles, 18 leatherback sea turtles, and 538 loggerhead sea turtles are expected to be exposed to sounds levels exceeding recommended behavioral thresholds. Assuming 10 dB of noise attenuation, up to eight Kemp's ridley sea turtles, one leatherback sea turtle, and 96 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended behavioral thresholds.

Table 3.19-4 Mean Number of Sea Turtles Predicted to Receive Sound Levels Above Injury and Behavioral Thresholds over 2-Year Construction Period

Species	Injury (L_E)		Behavior (L_p)	
	Attenuation (dB)		Attenuation (dB)	
	0	10	0	10
Green turtle	0	0	1	0
Kemp's ridley turtle	5	0	33	8
Leatherback turtle	3	0	18	1
Loggerhead turtle	12	0	538	96

Source: COP Volume 2, Appendix M-2, Tables I-17 and I-18; Empire 2022.
L_E = sound exposure level (decibel re 1 µPa square second); L_p = root-mean-square sound pressure (decibel re 1 µPa)

As described in Section 3.19.3.2, pile driving can result in behavioral and physiological effects on sea turtles. Empire has proposed measures to avoid, minimize, and mitigate impacts of pile driving noise on sea turtles (Appendix H, Attachment H-1), including utilization of protected species observers to monitor and enforce appropriate monitoring and exclusion zones (APM 108, APM 109, APM 110, APM 111), soft-start procedures (APM 107), noise-reducing technologies (APM 112), and seasonal pile driving restrictions (APM 106) with no pile driving occurring between July and October when sea turtle densities in the Project area are generally highest. APMs 106 through 112, described in Appendix H, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.5.3. With these measures in place, no significant injuries to sea turtles are expected. Temporary behavioral and physiological effects are expected to occur, but no stock or population-level effects are anticipated. BOEM is proposing additional mitigation measures for the Projects (Appendix H, Table H-1). These additional BOEM-proposed measures include preparation and implementation of a pile driving monitoring plan providing for sound attenuation and monitoring of sea turtles during pile driving, sound field verification to determine the appropriate size of monitoring and exclusion zones, minimum size requirements for exclusion zones, extended monitoring duration for sea turtles in the monitoring zone, and protected species observer coverage requirements. Furthermore, the Project-specific Letter of

Authorization would include mitigation measures for marine mammals that would also benefit sea turtles (i.e., time-of-day restrictions, use of soft-start procedures, and use of noise mitigation techniques that achieve a 10-dB attenuation). The additional measures would be expected to further minimize pile-driving noise effects on sea turtles but are not expected to change the impact determinations presented in Section 3.19.5.3.

As described in Section 3.19.3.2, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. The incremental contribution of the Proposed Action is noise-producing activities associated with an additional 326 nm of export and interarray cables. The incremental impacts of the Proposed Action are not expected to exceed noise impacts of cable-laying activities under the No Action Alternative, which are not expected to result in adverse effects on sea turtles.

As described in Section 3.19.3.2, vessels associated with the Proposed Action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in sea turtles. It is estimated that up to 18 vessels could be utilized during construction of each phase of the Proposed Action. Additional vessels would be used during operation and decommissioning. Effects of vessel noise on individual sea turtles are expected to be temporary and localized.

Presence of structures: The Proposed Action would include construction of up to 147 WTGs and two OSS and installation of up to 254 acres of hard scour protection around the WTG foundations and export and interarray cables. As described in Section 3.19.3.2, the installation of WTGs and OSS and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of WTGs and OSS could alter local hydrodynamic patterns at a fine scale, which could have localized impacts on prey distribution and abundance. However, these localized impacts may not translate to impacts on sea turtle prey species.

The presence of structures may have an artificial reef effect, resulting in increased recreational fishing activity in the vicinity of the WTGs and OSS. An increase in fishing activity would increase risk of entanglement or ingestion of lost fishing gear, which can lead to sea turtle injury or death. Any increase in interactions with fishing gear is not expected to be detectable. The artificial reef effect could also result in beneficial impacts on sea turtles due to prey aggregation. The aggregation of prey species would increase sea turtle foraging opportunities around offshore wind facility structures, potentially leading to increased habitat use around the WTGs. However, the artificial reef effect could also attract sea turtle predators (i.e., sharks) (Paxton et al. 2020). Predator attraction may result in increased risk of predation for sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. However, the habitat quality for sea turtles does not greatly vary within and around the Lease Area. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Risk of interaction with fishing vessels is not expected to be greater than current risk, but gear shifts that result in an increased number of vertical lines in the water would increase the risk of sea turtle interactions with fishing gear. Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in sea turtle migratory patterns.

Traffic: The Proposed Action would result in increased vessel traffic due to vessels transiting to and from the Project area during construction, operation, and decommissioning. As described in Section 3.19.3.2, vessel strikes are an increasing concern for sea turtles and could result in injury or death of individual sea turtles. Risk of injury or death would be highest for loggerheads, which have the highest density in the Project area. Vessel strike is most likely to occur when Project vessels are transiting to and from the Project area. Empire expects 18 vessels to be used during each phase of construction, and the number of vessels transiting the Project area during operation is expected to be lower. This increase in traffic would only be a small, incremental increase in overall traffic in the geographic analysis area. Empire has proposed the use of dedicated lookouts to reduce the risk of collisions with marine mammals and sea turtles (APM 123) and site-specific training on vessel strike avoidance measures for all crew members (APM 120). Empire has proposed additional measures to avoid, minimize, and mitigate impacts associated with vessel traffic on marine mammals, including vessel speed restrictions and collision avoidance measures (APMs 113 and 115), which would also benefit sea turtles. These APMs, described in Appendix H, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.19.5.3. Given the small, incremental increase in vessel traffic compared to existing traffic and the measures that would be taken to avoid, minimize, and mitigate vessel traffic impacts, the increased collision risk associated with the incremental increase in vessel traffic due to Project vessels would not be expected to have stock or population-level impacts on sea turtles. BOEM is proposing additional mitigation measures for the Projects (Appendix H, Table H-1). These additional BOEM-proposed measures include minimum separation distances and vessel speed and heading changes to avoid sea turtle strikes. These additional measures would be expected to further minimize vessel traffic effects on sea turtles but are not expected to change the impact determinations presented in Section 3.19.5.3.

3.19.5.1. Impact of the Connected Action

Infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders) that may affect sea turtles. Some upland activities included in the improvements also have the potential to affect sea turtles. These improvements at SBMT are not being undertaken by Empire but are considered a connected action for the Projects and are therefore evaluated in this section. BOEM expects the connected action to affect sea turtles through the following primary IPFs.

Lighting: The connected action would lead to increased artificial light in the Project area. The number of lamp poles would be kept to a minimum, and changes in lighting of the water surface are expected to be negligible relative to the high levels of artificial light in Upper New York Bay. Given the small change in water surface lighting and the unlikely presence of sea turtles in the Project area for the connected action, light at SBMT is not expected to have an effect on sea turtles.

Noise: Underwater anthropogenic noise sources associated with the connected action would include pile driving during construction and vessels during construction and operation. As described in Section 3.19.3.2, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

The connected action would include installation of 36-inch (0.9-meter) steel pipe piles and steel sheet piles. Pipe piles would be installed using a vibratory hammer for the majority of installation. An impact hammer would be used to drive the final 10 to 15 feet (3 to 4.5 meters). Sheet piles would be installed entirely using a vibratory hammer. To evaluate pile driving impacts, the NMFS Greater Atlantic Regional

Fisheries Office Acoustics Tool[1] was used to calculate distances to recommended regulatory thresholds for sea turtles. Noise levels associated with pile driving for the connected action would not exceed recommended injury thresholds for sea turtles (AECOM 2021). Noise levels may exceed recommended behavioral thresholds for sea turtles up to approximately 131 to 151 feet (40 to 46 meters) from impact pile driving. For vibratory pile driving, sea turtles may experience behavioral effects within up to approximately 33 feet (10 meters) of the pile. Given the small distances to behavioral thresholds and unlikely sea turtle presence in the Project area for the connected action, pile-driving noise impacts would be extremely unlikely to occur.

As described in Section 3.19.3.2, vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in sea turtles. During construction, less than one vessel per day is expected to be used. During operation, up to nine vessels may transit to and from SBMT per week. Any effects of vessel noise on individual sea turtles are expected to be temporary and localized. Based on the small volume of vessel traffic associated with the connected action, vessel noise impacts would be extremely unlikely to occur.

Port utilization: In-water activities for the SBMT improvements include dredging and dredged material management, which may affect sea turtles through physical interactions with the dredge and increased suspended sediments, as described in Section 3.19.3.2. Habitat disturbance and modification associated with dredging may also affect benthic prey species.

Dredging for the connected action could affect sea turtles through physical interactions (i.e., impingement, entrainment, or capture). Dredging at SBMT would utilize a clamshell dredge with an environmental bucket. As noted in Section 3.19.3.2, mechanical dredging, including the use of a clamshell dredge, is not expected to capture, injure, or kill sea turtles (NMFS 2020b). Additionally, turbidity curtains would be used for a large proportion of the dredge area, excluding sea turtles from most active dredging areas. Therefore, effects of physical interactions with the dredge are not expected to occur.

Dredging for the connected action would result in temporary increases in suspended sediment concentrations in the associated Project area. As described in Section 3.19.3.2, increased suspended sediment concentrations could result in behavioral effects on sea turtles or on sea turtle prey species. Any behavioral effects would be too small to be detected (NMFS 2020a), and no effects are anticipated if sea turtles swim through the area of elevated suspended sediment. Turbidity curtains would be used for a large proportion of the dredge area, minimizing water quality impacts and excluding sea turtles from most active dredging areas. Additionally, BMPs to reduce turbidity (e.g., slow bucket withdrawal) would be used. Increased suspended sediment concentrations could also affect prey species. However, any effects on sea turtles or their prey species would be localized and short term, as described in Section 3.19.3.2. Given the localized and temporary or short-term nature of the effects, the use of turbidity curtains, and the unlikely presence of sea turtles, any effects of increased suspended sediments on sea turtles would be discountable.

Habitat disturbance and modification associated with dredging could result in short-term reductions in foraging habitat or short-term effects on prey availability for some sea turtle species. Benthic communities would be expected to recover within 1 year of disturbance (NMFS 2017). Dredging may increase water depths by up to 21 feet (6.4 meters), which is not expected to have a substantial impact on benthic community composition following recolonization of the dredge area. Dredging is not expected to alter the sediment composition compared to the existing substrate in the dredge area. Given there would be no change in sediment composition, subsequent changes in benthic community composition would not

[1] Available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic.

be expected. However, the surface sediments following dredging may contain increased concentrations of contaminants, which may affect recolonizing benthic invertebrates. Although habitat disturbance and modification may result in reductions in foraging habitat availability or prey availability, these reductions would be short term, and there would be no changes in the benthic community composition. Contaminants in the sediment could affect the recolonized benthic community. However, sea turtle foraging in the Project area for the connected action is extremely unlikely and the affected area would be very small relative to available sea turtle foraging habitat. Therefore, any effects on sea turtles due to habitat disturbance and modification would be discountable.

Traffic: The connected action would result in increased vessel traffic during construction of the infrastructure improvements and during operation of SBMT as an offshore wind hub. As described in Section 3.19.3.2, vessel strikes could result in injury or death of sea turtles.

Only a small number of vessels would be used for construction of the connected action. All construction vessels would have a large below-water envelope but would be operating at slow speeds. Less than one vessel visit per day is expected during construction. Additionally, sea turtles are not generally found in the Project area for the connected action and would be excluded from a large portion of this Project area by turbidity curtains deployed to minimize impacts on water quality during construction. Based on the low volume of traffic, unlikely sea turtle presence in the Project area for the connected action, and sea turtle exclusion by turbidity curtains, vessel strikes associated with construction traffic would be extremely unlikely to occur.

During operation, approximately nine vessel trips (i.e., 18 one-way trips) are expected each week. This increase in vessel traffic represents less than a 0.2-percent increase compared to existing vessel traffic utilizing the Port of New York (i.e., 5,355 vessels per week). Additionally, a majority of vessel traffic at SBMT (i.e., seven of nine weekly vessels) would operate at slow speeds and would have large envelopes, displacing a large volume of water and repelling aquatic fauna in proximity to the vessel. Therefore, vessel strike risk would be minimal for these vessels. Given the very small increase in vessel traffic compared to existing traffic levels and the slow speeds of the majority of vessels utilizing SBMT, vessel strike risk for sea turtles during operation of the connected action would be discountable.

3.19.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities. The connected action would improve the SBMT facility to support offshore wind activities, increase the water depth for berthing larger vessels, and generate vessel traffic during use of the facility for staging of offshore wind turbine components. Ongoing and planned offshore wind activities in the geographic analysis area for sea turtles include the construction, O&M, and decommissioning of 30 planned offshore wind projects.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of accidental releases from ongoing and planned activities on sea turtles would likely be negligible. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely and impacts from small-scale releases would be localized and short term. Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 11,646 miles (18,742 kilometers) of buried cable to the geographic analysis area, producing

EMF in the immediate vicinity of each cable during operation (Table F2-1), of which the Proposed Action represents less than 4 percent. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of EMF and heat from ongoing and planned activities in the geographic analysis area would be negligible given the small area that would be affected by the Projects.

The 149 structures for the Proposed Action represent only 4.8 percent of the 3,101 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to light on the OCS associated with ongoing and planned activities would be negligible given the large volume of existing vessel traffic and the relatively small number of offshore structures anticipated for the Proposed Action.

The 1,913 acres of seabed disturbance, including anchoring disturbance, associated with the proposed Projects represents only 1 percent of the 188,839 acres of seabed expected to be disturbed on the OCS due to ongoing and planned offshore wind farms, including the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of new cable emplacement and maintenance from ongoing and planned activities would be negligible.

Planned offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 structures for the Proposed Action represent only 4.8 percent of the 3,101 offshore wind structures anticipated on the OCS for ongoing and planned offshore wind farms, including the Proposed Action, although some foundations at other planned wind farms may be installed without impact pile driving. Project vessels would represent only a small fraction of the large volume of existing traffic in the geographic analysis area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to noise impacts on sea turtles from ongoing and planned activities would be negligible given the magnitude of ongoing and planned activities.

The 149 structures for the Proposed Action represent only 4.8 percent of the 3,101 offshore wind structures anticipated on the OCS for ongoing and planned offshore wind farms, including the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts on sea turtles due to the presence of structures from ongoing and planned activities would be negligible.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of vessel traffic from ongoing and planned activities would be negligible given the large volume of existing vessel traffic in the geographic analysis area.

3.19.5.3. Conclusions

Impacts of the Proposed Action. Construction, operation, and decommissioning of the Proposed Action would result in **negligible** to **minor** adverse impacts on sea turtles and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise. Beneficial impacts could result from the presence of structures. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts associated with accidental releases, EMF, light, new cable emplacement and maintenance, aircraft noise, G&G survey noise, WTG noise, cable-laying noise, disturbed hydrodynamic patterns associated with the presence of structures, entanglement or ingestion of fishing gear associated with the presence of structures, avoidance or displacement associated with the presence of structures, and behavioral disruptions associated with the presence of structures would be **negligible**. These impacts are expected to be unlikely to occur and localized, temporary, or too small to be measured.

Adverse impacts associated with pile-driving noise, vessel noise, displacement into higher-risk areas associated with the presence of structures, and vessel traffic would be **minor**. These impacts are generally expected to be localized and temporary, although some may be long term. Adverse effects on individual sea turtles may occur due to these impacts, but no stock or population-level effects are anticipated.

Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for sea turtles. These effects would be localized and are not expected to affect individual fitness.

BOEM expects that the connected action alone would have **negligible** impacts on sea turtles due to light, noise, port utilization, and vessel traffic. These impacts would be unlikely to occur and, if they did occur, would be localized, temporary or short term, or too small to be measured.

An assessment of the impacts of the Proposed Action on ESA-listed sea turtles and sea turtle critical habitat will be provided in the Projects' BA. Based on this assessment, BOEM determined that the Proposed Action was not likely to adversely affect hawksbill sea turtle, given that impacts associated with the limited number of vessel transits in the Gulf of Mexico would be extremely unlikely to occur. The Proposed Action may affect and is likely to adversely affect green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. BOEM also concluded that vessel transits through loggerhead sea turtle critical habitat would not affect any essential physical and biological features. Therefore, the Proposed Action is expected to have no effect on designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtle.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action and the connected action to the impacts of individual IPFs on sea turtles from ongoing and planned activities would range from **negligible** to **minor** adverse and would also include **minor beneficial** impacts. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including the Proposed Action, would result in **minor** impacts on sea turtles. BOEM made this determination because the anticipated impact would be detectable and measurable, but these impacts would not result in population-level impacts. The main drivers for this impact rating are impact pile-driving noise, vessel noise, the presence of structures, and vessel traffic. The Proposed Action would contribute to the overall impact rating primarily through impact pile-driving noise, vessel noise, and the presence of structures.

3.19.6 Impacts of Alternatives B, E, and F on Sea Turtles

Impacts of Alternatives B, E and F. Alternatives B, E, and F would alter the turbine array layout but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternatives B, E, and F would be the same as those described under the Proposed Action because the same number of WTGs would be constructed throughout the Lease Area. While the WTGs may move to a different position in the Lease Area under Alternatives B, E, and F, impacts on sea turtles would not materially change compared to the Proposed Action. All other offshore and onshore Project components of Alternatives B, E, and F would be the same as under the Proposed Action. Measures discussed in Appendix H would provide the same degree of minimization of impacts on sea turtles if implemented for any of these alternatives.

Cumulative Impacts of Alternatives B, E and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, E, and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative B, E, or F would be the same level as described under the Proposed Action.

3.19.6.1. Conclusions

Impacts of Alternatives B, E, and F. Given that impacts on sea turtles are not expected to be measurably different compared to impacts under the Proposed Action, the impacts associated with these alternatives would not change the anticipated impact rating. Therefore, BOEM anticipates that impacts under Alternatives B, E, and F would have **negligible** to **minor** adverse impacts with potential **minor beneficial** impacts.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, E, and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative B, E, or F would be the same level as described under the Proposed Action.

3.19.7 Impacts of Alternative C, D, and G on Sea Turtles

Impacts of Alternatives C, D, and G. Alternatives C-1, C-2, D, and G would include variations in the export cable routes for the Projects. Alternatives C-1 and C-2 would allow BOEM to select a specific export cable route for EW 1. Alternative C-1 would pass through the anchorage area in Gravesend Bay. Alternative C-2 is an alternative route along the Ambrose Navigation Channel to avoid the anchorage area in Gravesend Bay. Under Alternative D, the export cable route for EW 1 would avoid the sand borrow area offshore of Long Island. Under Alternative G, the onshore cable route for EW 2 would use a cable bridge to cross Barnums Channel. Alternative export cable routes would not change or reduce impacts on sea turtles. Therefore, the impacts of Alternatives C-1, C-2, D, and G would not differ from the impacts anticipated under the Proposed Action. Measures discussed in Appendix H would provide the same degree of minimization of impacts on sea turtles if implemented for any of these alternatives.

Cumulative Impacts of Alternatives C, D, and G. Cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action.

3.19.7.1. Conclusions

Impacts of Alternatives C, D, and G. Given that impacts on sea turtles are not expected to differ from those under the Proposed Action, BOEM anticipates that impacts under Alternatives C-1, C-2, D, and G would have **negligible** to **minor** adverse impacts with potential **minor beneficial** impacts.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the contribution of Alternatives C, D, and G to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative C, D, or G would be the same level as described under the Proposed Action.

3.19.8 Impacts of Alternative H on Sea Turtles

Impacts of Alternative H. Alternative H would utilize a method of dredge or fill activities for construction of the EW 1 landfall that would reduce the discharge of dredged material. Dredging would be conducted using a mechanical clamshell dredge, which sea turtles are expected to avoid (NMFS 2018), or similar method. Dredged sediments would be dewatered on site to reduce turbidity effects. Under Alternative H, effects of suspended sediments would be minimized and effects of physical interactions with the dredge would be minimized or avoided, compared to other dredging methods. Although impacts would be reduced, BOEM anticipates this reduction would not be sufficient to reduce the overall impact determination because of the relatively small portion of the Project area encompassed by Alternative H. Measures discussed in Appendix H would provide the same degree of minimization of impacts on sea turtles if implemented for this alternative.

Cumulative Impacts of Alternative H. Cumulative impacts of Alternative H would be the same as described for the Proposed Action.

3.19.8.1. Conclusions

Impacts of Alternative H. Given that impact determinations for sea turtles are not expected to differ from those under the Proposed Action, BOEM anticipates that impacts under Alternative H would have **negligible** to **minor** adverse impacts with potential **minor beneficial** impacts.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative H would be the same level as described under the Proposed Action.

3.19.9 Proposed Mitigation Measures

BOEM has proposed measures to minimize impacts on sea turtles (Appendix H). If one or more of the measures analyzed are adopted by BOEM, some adverse impacts would be further reduced.

- **Marine debris awareness training:** Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
- **Pile-Driving Monitoring Plan, Alternative Monitoring Plan, protected species observer coverage, sound field verification, shutdown zones, and monitoring zones for sea turtles:** The development of an Alternative Monitoring Plan, protected species observer coverage, shutdown zones, and monitoring zones for sea turtles would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. The development of a Pile-Driving Monitoring Plan and sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of these measures would decrease risk to sea turtles during impact pile driving or increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
- **Geophysical surveys:** Compliance with Project Design Criteria and BMPs for Protected Species would minimize risk to sea turtles during HRG surveys. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination of negligible for HRG activities.
- **Operational Sound Field Verification Plan:** The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG noise do not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination of negligible for WTG noise.
- **Sampling gear, gear identification, lost survey gear, survey training, sea turtle disentanglement, sea turtle identification and data collection, sea turtle handling and resuscitation guidelines, and take notification:** The regular hauling of sampling gear, survey staff training, sea turtle disentanglement, and handling and resuscitation guidelines would reduce risk of entanglement or effects of entanglement in fisheries survey gear. Gear identification and lost survey gear would

improve accountability in the case of gear loss. Sea turtle identification and data collection and take notification would improve accountability for documenting take associated with fisheries surveys. While adoption of these measures would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.

- **Periodic underwater surveys, and reporting of monofilament and other fishing gear around WTG foundations:** Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures.
- **Look out for sea turtles and reporting:** Measures to minimize vessel interactions would reduce the risk of vessel strike. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for vessel traffic.
- **Monthly/annual reporting requirements and meeting requirements for sea turtle take documentation:** Reporting requirements and meeting requirements to document take would improve accountability for documenting take associated with the Proposed Action. While adoption of these measures would improve accountability, it would not alter the overall impact determination of minor for the Proposed Action.

3.19.10 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, G, and H would have the same overall **negligible** to **minor** adverse impacts and **minor beneficial** impacts on sea turtles as described under the Proposed Action. Alternatives B would result in fewer impacts on Cholera Bank, an important fishing area, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternative E, which creates a 1-nm setback between EW 1 and EW 2 by the removal of up to seven WTG positions, and Alternative F would improve access for fishing; however, the resultant increase in vessel traffic through the Project area could increase the occurrence of vessel noise, vessel strikes, accidental releases of fuels/fluids/hazardous materials and trash and debris, permitted discharges, and the risk of fishing gear entanglement and loss within the Project area. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. Alternative G would involve changes to only the onshore portion of the EW 2 export cable route; therefore, the impact of Alternative G on sea turtles would be the same as that of the Proposed Action. Alternative H would reduce effects of dredge and fill activities for construction of the EW 1 landfall but would not measurably reduce impacts on sea turtles compared to the Proposed Action.

3.22. Wetlands

This section discusses potential impacts on wetlands from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area. The wetlands geographic analysis area, as shown on Figure 3.22-1, includes all subwatersheds that intersect the Onshore Project area. See Section 3.21 for a discussion of impacts on water quality.

3.22.1 Description of the Affected Environment for Wetlands

The National Wetlands Inventory (NWI) and NYSDEC wetland data were used to determine the potential presence of wetlands. A preliminary reconnaissance of the onshore portion of EW 1 was conducted in December 2018 to verify the presence of mapped wetland identified by the NWI and NYSDEC wetland data and to assess potential presence of unmapped wetlands. The EW 2 Project components were not under consideration at the time of the preliminary reconnaissance; therefore, the analysis of EW 2 was conducted based on NWI and NYSDEC wetland data. In order to confirm the extent and presence of regulated wetlands, Empire will conduct a wetland delineation to identify the wetlands under jurisdiction of USACE and NYSDEC. Authorization from USACE and NYSDEC is required prior to dredge or fill of jurisdictional wetlands. CWA Section 404 requires that all appropriate and practicable steps be taken first to avoid and minimize impacts on jurisdictional wetlands; for unavoidable impacts, compensatory mitigation is required to replace the loss of wetlands.

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3(c)(16)). Under the New York State code of regulations (6 CRR-NY 661.4), tidal wetlands are more broadly defined in that vegetation is not a requirement to be considered wetland. Wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. New York's coastal wetlands, including the wetlands in the geographic analysis area, protect coastal water quality by acting as a sink for land-derived nutrients and contaminants, constitute an important component of coastal food webs, provide valuable wildlife habitat, and protect upland and shoreline areas from flooding and erosion.

The acreage of NWI wetland communities present within the geographic analysis area is shown in Table 3.22-1.

Table 3.22-1 NWI Wetland Communities in the Geographic Analysis Area

Wetland Community	Acres	Percent of Total
Estuarine and Marine Wetland	6,493	96
Freshwater Emergent Wetland	204	3
Freshwater Forested/Shrub Wetland	72	1
Total	**6,769**	**100.0%**

Source: USFWS 2021.

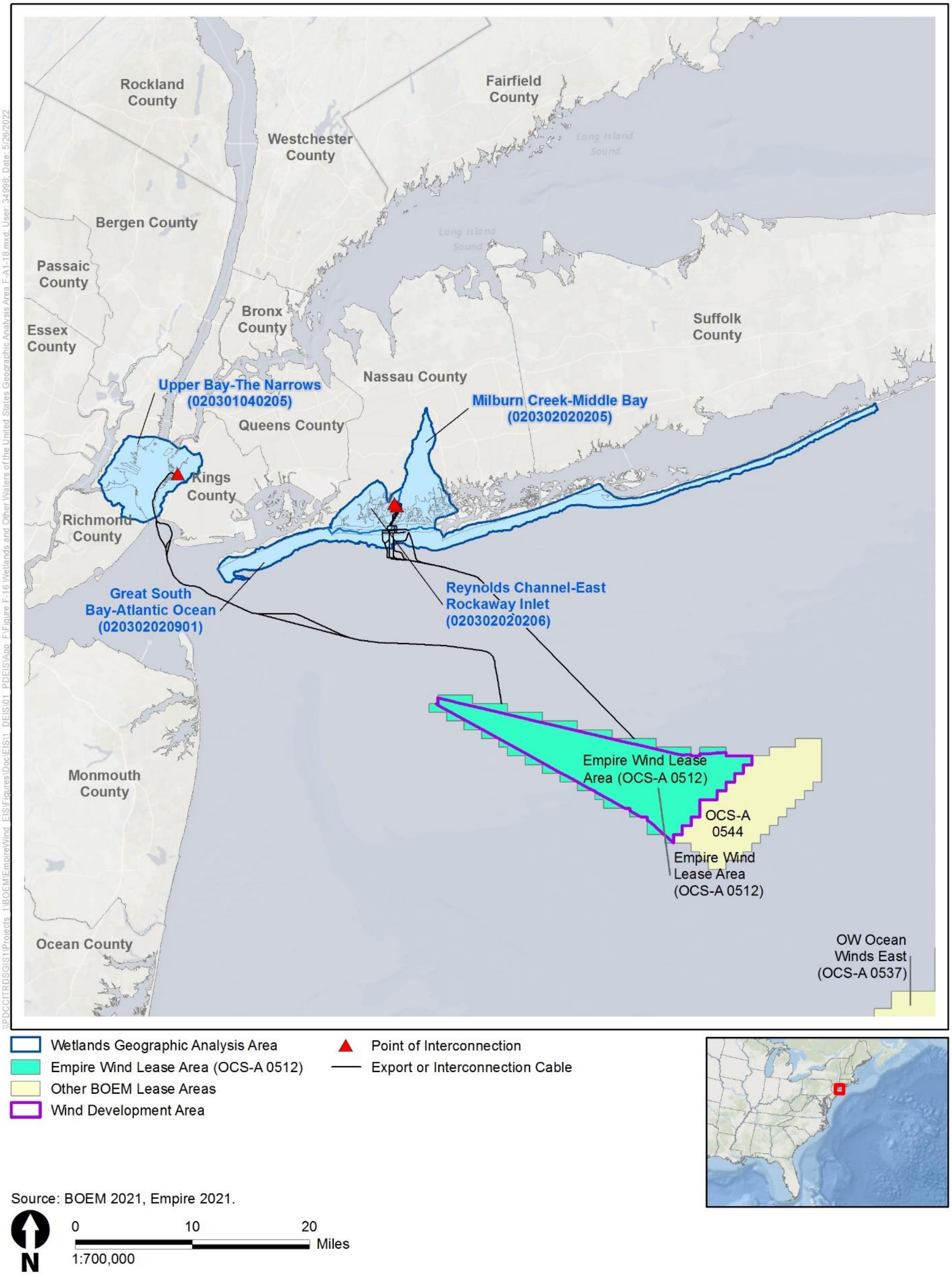

Figure 3.22-1 Wetlands Geographic Analysis Area

EW 1

The EW 1 submarine export cable route would extend across the New York Bight into Lower New York Bay, up the Narrows, and into Upper New York Bay before it makes landfall. The Upper Bay-the Narrows subwatershed (hydrologic unit code [HUC] 020301040205) encompasses the submarine export cable's approach/landfall and the EW 1 substation and the location under consideration for the O&M facility. The EW 1 interconnection cable route, onshore substation, and O&M facility site are situated above the bank of the Upper Bay. The Upper Bay, in the vicinity of the onshore portions of the Projects, is classified by the NWI as an excavated subtidal estuarine system with an unconsolidated bottom and by NYSDEC wetland data as a littoral zone; the NWI classification is not considered wetland because it is a deepwater habitat that lacks vegetation. NWI mapping indicates that a small portion of the Upper Bay would overlap the interconnection cable route, the onshore substation, and the O&M facility. NYSDEC mapping indicates that the littoral zone of the Upper Bay would partially overlap the onshore substation. However, based on observations during the preliminary site reconnaissance, the bank is mainly composed of industrial properties with bulkheaded marine terminals and the Upper Bay terminates at the bulkhead. It is anticipated that any 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). 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 facility due to the developed nature of the area and lack of wetland resources identified (Empire 2022).

EW 2

The EW 2 submarine export cable routes would extend across the New York Bight before they make landfall. The Great South Bay-Atlantic Ocean subwatershed (HUC 020302020901) encompasses the submarine export cables' approaches/landfalls and a portion of the onshore export cable routes on Long Beach Barrier Island. The Reynolds Channel-East Rockaway Inlet (HUC 020302020206) and Milburn Creek-Middle Bay subwatershed (HUC 020302020205) encompass the remaining EW 2 onshore Project elements, with all three substation locations and the interconnection location in the Reynolds Channel-East Rockaway Inlet (HUC 020302020206). Four export cable landfall options (Landfalls A, B, C, and E) are currently under review for EW 2. The NWI does not map any wetlands in the Landfall A, B, and C footprints, but does map 1.59 acres of estuarine and marine deepwater in Landfall C footprint. The estuarine and marine deepwater classification is not considered wetland because it is a deepwater habitat and lacks vegetation. NYSDEC wetland data do not map any wetlands in the Landfall A, B, C, or E footprints. There are also small areas of estuarine and marine wetland (less than 0.01 acre) within the LB-A and LB-G cable corridors, but these wetland areas would be outside of the actual cable disturbance area because these cable segments would be placed in already disturbed road rights-of-way.

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. These routes would travel along existing roads and the Long Island Rail Road right-of-way in areas dominated by high-intensity development with no mapped wetlands crossed (see COP Volume 2, Figure 5.2-5 and Table 5.2-3; Empire 2022). At the Reynolds Channel crossing options, the NWI maps the channel as estuarine and marine deepwater and estuarine and marine wetland (on the south side of the channel) in the cable crossing corridor and NYSDEC maps the channel as a littoral zone and coastal shoals, bars, and mudflat in the cable crossing corridor. The NWI estuarine and marine deepwater habitats are not considered wetland because they are deepwater habitats that lack vegetation. It should be noted that the NWI does not map any wetlands in the cable crossing corridor at the western Reynolds Channel crossing option; the estuarine and marine wetland is within the eastern cable crossing corridor option.

Based on a review of aerial imagery, the banks of Reynolds Channel are highly modified, with the southern bank consisting of a mix of riprap and natural shoreline that quickly transitions to industrial properties, and the north bank consisting of bulkheading and docks associated with an active marina. After crossing the Reynolds Channel into Island Park, a total of eight cable route segments under review would traverse Island Park to the onshore substation. These cable route segments travel along existing roads in areas dominated by high- and medium-intensity development (see COP Volume 2, Figure 5.1-5; Empire 2022). The NWI identifies estuarine and marine wetland at cable segment IP-C's crossing corridor of Barnums Channel. The NWI identifies estuarine and marine wetland at cable segment IP-F's crossing corridor of Barnums Channel where the cable would be placed on a constructed above-water cable bridge. The NWI identifies palustrine emergent/scrub-shrub, palustrine emergent, and estuarine and marine wetland at cable segment IP-G's crossing corridor of Barnums Channel where the cable would be placed on an above-water cable bridge (similar to IP-F) or attached to the existing Long Beach Road bridge. In addition, cable segment IP-E (only needed if IP-G is constructed) would cross NWI-mapped estuarine and marine deepwater and riverine waters, and NYSDEC-mapped littoral zone waters associated with a channel that runs under Daly Boulevard through a bridge or large culvert that spans the distance of the road corridor (approximately 175 feet). The IP-E cable segment would be placed just off the road and above the bridge/large culvert and, therefore, would avoid these resources.

No wetlands are mapped by the NWI or NYSDEC at the Onshore Substation A site. NWI and NYSDEC data indicate that Reynolds Channel would extend into the EW 2 Onshore Substation C site by a maximum of 40 feet (12 meters); however, a review of aerial imagery indicates that historical alterations to the shoreline, including bulkheading, have resulted in a more artificial and linear bank than portrayed by NWI and NYSDEC mapped boundaries. The result of these shoreline alterations is that the current bank of Reynolds Channel appears to approximately align with the boundary of the EW 2 Onshore Substation C site (Empire 2022).

3.22.2 Impact Level Definitions for Wetlands

As described in Section 3.3, this EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of impact levels are provided in Table 3.22-2. There are no beneficial impacts on wetlands.

Table 3.22-2 Impact Level Definitions for Wetlands

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on wetlands would be so small as to be unmeasurable and impacts would not result in a detectable change in wetland quality and function.
Minor	Adverse	Impacts on wetlands would be minimized and would be relatively small and localized. If impacts occur, wetlands would completely recover.
Moderate	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation required to offset impacts on wetland functions and values and would have a high probability of success.
Major	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation required to offset impacts on wetland functions and values would have a marginal or unknown probability of success.

3.22.3 Impacts of the No Action Alternative on Wetlands

When analyzing the impacts of the No Action Alternative on wetlands, BOEM considered the impacts of ongoing activities, including non-offshore wind and ongoing offshore wind activities, on the baseline conditions for wetlands. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.22.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.22.1, *Description of the Affected Environment for Wetlands*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore activities within the geographic analysis area that may contribute to impacts on wetlands are associated with onshore construction and development activities. These activities and associated impacts are expected to continue and have the potential to affect wetlands through temporary and permanent loss of wetlands, which can affect the functions wetlands provide (e.g., water quality improvement) in the watershed. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects to compensate for lost wetlands.

There are no ongoing offshore wind activities within the geographic analysis area for wetlands.

3.22.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect wetlands primarily include onshore development activities (see Appendix F, Section F.2.13 for descriptions). These activities could permanently (e.g., permanent fill placement) and temporarily (e.g., temporary fill placement or vegetation clearing) affect wetlands or areas near wetlands. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects to compensate for lost wetlands. See Table F1-24 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for wetlands.

Impacts on wetlands from planned offshore wind projects may occur if onshore activity from these projects overlaps with the geographic analysis area. BOEM is not currently aware of any planned offshore wind projects other than the Proposed Action that would overlap the geographic analysis area for wetlands. However, there is potential for planned offshore wind projects to site landfalls and onshore infrastructure within the same subwatersheds that are intersected by Proposed Action onshore infrastructure. If any planned offshore wind activities occur within the highly urbanized landscape of the geographic analysis area, BOEM expect that impacts would be similar to those under the Proposed Action (Section 3.22.5), including impacts related to land disturbance.

BOEM expects planned offshore wind activities to affect wetlands through the following primary IPF.

Land disturbance: The locations of onshore components for planned offshore wind projects are not known at this time. However, given the proximity to Long Island, export cables from other lease areas (particularly lease areas in the New York Bight) could landfall within the geographic analysis area. Construction of onshore components (e.g., export cables, onshore substation) for planned offshore wind projects is anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands, causing adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use) and water quality and flood/storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland's ability to impede and retain stormwater and floodwater. On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions.

Temporary wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands. The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component.

Given that the geographic analysis area is within urbanized landscapes in the New York metropolitan area and onshore project components associated with planned offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), BOEM anticipates wetland impacts to be minor. In addition, BOEM expects planned offshore wind projects would be designed to avoid wetlands to the extent feasible, and would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. This would include compliance with the New York State Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Construction Activities and implementation of sediment controls and a SWPPP to avoid and minimize water quality impacts during onshore construction. Any in-wetland work would require a CWA Section 404 permit from USACE and a Section 401 Water Quality Certification from NYSDEC, as well as authorization from NYSDEC under the Tidal Wetlands Act. If impacts would not be avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands.

3.22.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, wetlands would continue to be affected by existing environmental trends and ongoing activities. Land disturbance from onshore construction periodically would cause temporary and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. Therefore, the No Action Alternative would result in **minor** impacts on wetlands.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. Planned activities could cause impacts that would be similar to the impacts of the Proposed Action. Currently, there are no planned offshore wind activities proposed in the geographic analysis area. If any were to occur, they would have some potential to result in temporary disturbance and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects that would allow wetlands to recover to the extent possible. Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates the No Action Alternative would result in **minor** cumulative impacts in the geographic analysis area, primarily through land disturbance.

3.22.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in similar or lesser impacts than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on wetlands:

- The onshore export cable routing variants within the Onshore Project area

An onshore export cable route with less wetlands within or adjacent to the right-of-way would have less potential for direct and indirect impacts on wetlands.

3.22.5 Impacts of the Proposed Action on Wetlands

The Proposed Action could affect wetlands through the following primary IPF.

Land disturbance: Based on NWI data, there is little actual wetland within most of the affected area of the onshore Project components due to the developed nature of the Onshore Project area and the siting of onshore components in mostly previously disturbed areas (e.g., existing road rights-of-way). NYSDEC data do not map any wetlands within the footprints of the EW 1 onshore Project components. No NWI wetlands are mapped within the footprints of the EW 1 or EW 2 onshore substations, the O&M facility, or landfalls. While there would be NWI-mapped deepwater habitats crossed by the EW 2 onshore cable routes, there are only a few areas where wetlands are present (Table 3.22-3). Most of the wetland area is related to nearshore and adjacent areas to Reynolds Channel and Barnums Channel. As previously stated, there are small areas of estuarine and marine wetland (less than 0.01 acre) within the LB-A and LB-G cable corridors, but these wetland areas would be outside of the actual cable disturbance area because these segments would be placed in already disturbed road rights-of-way. The areas of NYSDEC-mapped wetlands within the onshore Project footprint and cable corridors are listed in Appendix I, Section I.3, *Wetlands*, Table I-25.

Table 3.22-3 NWI Wetland Communities Potentially Affected by the EW 2 Project

Route Feature	Wetland Community	Acres
LB-A	Estuarine and Marine Wetland	<0.01
LB-G	Estuarine and Marine Wetland	<0.01
Reynolds Channel Crossing	Estuarine and Marine Wetland	0.39
IP-C[1]	Estuarine and Marine Wetland	0.12
IP-F[1]	Estuarine and Marine Wetland	0.30
IP-G[1]	Palustrine emergent/scrub-shrub	7.20
	Estuarine and Marine Wetland	5.21
	Palustrine emergent	0.27
	Total	**13.64**

Source: Empire 2022.
Note: The table presents wetland areas within the cable corridor that could be susceptible to potential impacts and not necessarily the area of wetland that would actually be affected during construction and operations. For example, segment IP-C could cross Barnums Channel via open trench or trenchless (e.g., HDD) methods, which would have very different impacts on wetlands.
[1] Includes Barnums Channel crossing.

Empire is evaluating both open cut and HDD methods to cross Reynolds Channel. If HDD is used, then the wetland would likely be avoided and there would be no direct impact on the wetland from cable installation. If open cut is employed at the Reynolds Channel crossing, then up to 0.39 acre of the wetland would be affected. Similarly, for the IP-C Barnums Channel crossing, if HDD is employed then wetland impacts would be avoided, and if trenching is employed then there would be a small area of wetland temporarily affected (up to 0.12 acre). With either method, impacts would be short term and BOEM does not anticipate any long-term or permanent impacts on the wetlands or their functions, and the total temporary impact of 0.51 acre would represent less than 0.01 percent of this wetland type in the geographic analysis area. The IP-F cable segment that crosses Barnums Channel would consist of a cable bridge over the channel that would use up to two support columns (pile caps) within the channel to support the truss system that would hold the cables above the waters. These supports would include up to three 1.5-foot (0.5-meter) diameter steel pipe piles per pile cap, for a total of six steel pipe piles within the channel. The IP-G cable corridor crossing of Barnums Channel has over 12 acres of wetland in the crossing corridor. Any crossing solution (whether open cut, HDD, or cable bridge) would result in a greater potential for impacts on wetlands compared to the IP-C and IP-F crossings. Empire assessed several crossing methods of Barnums Channel along the IP-G cable corridor and determined that HDD was not practicable as a crossing method, and that trenching and a cable bridge would be feasible. Details of Empire's alternatives analysis for the Barnums Channel crossing are presented in Appendix O, *Alternatives Analysis for Corps Permit Application*.

The installation of permanent support columns in Barnums Channel to support a cable bridge would constitute a permanent impact on the channel. If access is required through wetlands during construction at EW 2, Empire would install temporary matting to protect vegetation root systems, reduce compaction, and minimize ruts (COP Volume 2f, Table 9-1, APM 65; Empire 2022). Temporary workspaces would be restored to pre-construction conditions to the extent possible. Revegetation monitoring at EW 2 would be conducted consistent with a landscaping restoration plan, which will be provided for agency review and approval, as applicable, within wetlands and adjacent areas that were temporarily disturbed during Project construction to ensure that functionality is restored in these areas (COP Volume 2f, Table 9-1, APM 73; Empire 2022).

Excavation, soil stockpile, and grading may increase the potential for erosion and sedimentation to wetlands down gradient, which could affect wetland water quality. Empire would develop and implement a SWPPP that would use erosion and sedimentation controls and BMPs to avoid and minimize these impacts during onshore construction (COP Volume 2f, Table 9-1, APMs 60, 61, 71, 75; Empire 2022). Additionally, during onshore construction, dewatering may be required. If dewatering is needed, Empire would develop a site-specific dewatering plan to protect nearby wetlands in accordance with a Project-specific SWPPP, approved by the applicable agencies, as necessary (COP Volume 2f, Table 9-1, APM 62; Empire 2022). Dewatering activities would be temporary and water drawdown would be minimal. In addition to the aforementioned measures to avoid and minimize wetland impacts, Empire has committed to implementing various other APMs to reduce wetland impacts (COP Volume 2f, Table 9-1, APMs 58, 59, 63, 64, 66-70, 72, 74; Empire 2022). Therefore, potential adverse impacts on wetlands from construction activities would be short term and localized.

All earth disturbances from construction activities would be conducted in compliance with the New York State Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Construction Activities and implementation of sediment controls and a SWPPP to avoid and minimize water quality impacts during onshore construction. If ground-based delineations identify wetlands within the footprint of an onshore facility, permanent wetland impacts would require a CWA Section 404 permit from USACE and a Section 401 Water Quality Certification from NYSDEC, as well as authorization from NYSDEC under the Tidal Wetlands Act. If permanent impacts would not be avoided or minimized, mitigation would be anticipated to compensate for lost wetlands. Empire would comply with all requirements of any issued permits.

BOEM would not expect normal O&M activities to involve further wetland alteration. The onshore cable route and associated facilities generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to affect wetlands. In the event of a fault or failure, impacts would be expected to be short term and negligible. Decommissioning of the onshore Project components would have similar impacts as construction.

3.22.5.1. Impact of the Connected Action

As described in Section 3.22.3.1, the NWI and field reconnaissance did not identify any emergent, vegetated wetlands around the EW 1 Onshore Project area, including the SBMT where the connected action activities would occur. However, NYSDEC littoral zone wetlands and an area of SAV do exist in the vicinity of the connected action. The connected action would affect wetlands through the following IPFs: discharges and presence of structures.

Discharges: Localized increases in total suspended sediment resulting in localized turbidity would be expected during dredging and during installation of the bulkheads and piles. While there are no emergent, vegetated wetlands within the Project site, there is an area of SAV approximately 700 feet downstream of the site near the shoreline between the 40^{th} Street and 42^{nd} Street piers, and NYSDEC littoral zone tidal wetlands are present on site. BMPs used during construction would minimize total suspended sediment increases in the water column. These measures include use of turbidity curtains during dredging in the basins, use of an environmental bucket, and slow withdrawal of the bucket through the water column. Pile driving would result in minimal and localized increases in turbidity (i.e., 5 to 10 mg/L above ambient within 300 feet of the activity) that would not be expected to reach the area of SAV to the south. Because the SAV is in a relatively protected location between two piers and the Project would use BMPs during construction to minimize sediment resuspension, the Project would not be expected to result in significant impacts on wetlands or SAV. Turbidity associated with the Project activities would be minimal and temporary in nature and would result in localized, short-term, and minor impacts on NYSDEC littoral zone tidal wetlands, as resuspended sediments would dissipate relatively quickly with the tidal currents.

Presence of structures: NYSDEC littoral zone tidal wetlands are primarily located along the riprap slopes on the northern and southern faces of the 35^{th} Street Pier and at the end of the interpier basin between the 35^{th} and 39^{th} Street Piers. These areas are currently covered by a layer of bedding stone and riprap armor stone, which would remain in place with the connected action. Installation of piles associated with the proposed wharves would result in the loss of less than 0.01 acre of these littoral zone tidal wetlands, and the installation of deck surfaces atop these piles would result in shading of 0.07 acre over the same tidal wetlands. Impacts on NYSDEC littoral zone tidal wetlands would be minor.

Agency-proposed mitigation measures: Mitigation proposed in Appendix H would require NYCEDC to mitigate for impacts on mapped tidal littoral zone wetlands from fill and shading in consultation with New York State agencies (Table H-1).

3.22.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on wetlands through the primary IPF of land disturbance. The connected action could affect wetlands through discharges and presence of structures (shading). The construction, O&M, and decommissioning of onshore infrastructure for offshore wind activities in the geographic analysis area would also contribute to the primary IPF of land disturbance. Temporary disturbance and permanent loss of wetland may occur as a result of offshore wind development. BOEM is not aware of any planned offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for wetlands. If wetland alteration or loss is anticipated, it would likely be minimal, the overall scale of impacts is expected to be small, and any activities that would result in these impacts would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts.

The cumulative impact on wetlands would likely be minor, mostly driven by land disturbance. In context of reasonably foreseeable environmental trends, the impacts on wetlands under the Proposed Action may add to the impacts of ongoing and planned land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss, although a significant portion of the geographic analysis area is highly urbanized and developed with few wetlands. The future extent of land disturbance from ongoing activities and planned non-offshore wind activities over the next 35 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action.

If a planned project were to overlap the geographic analysis area or even be co-located (partly or completely) within the same right-of-way corridor that the Proposed Action would use, then the impacts of those planned projects on wetlands would be of the same type as those of the Proposed Action alone; the degree of impacts may increase, although the location and timing of planned activities would influence this. For example, repeated construction in a single right-of-way corridor would be expected to have less impact on wetlands than construction in an equivalent area of undisturbed wetland. All earth disturbances from construction activities would be conducted in compliance with the New York State Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Construction Activities and implementation of sediment controls and a SWPPP to avoid and minimize water quality impacts during onshore construction. Any work in wetlands would require a CWA Section 404 permit from USACE and a Section 401 Water Quality Certification from NYSDEC, as well as authorization from NYSDEC under the Tidal Wetlands Act; any wetlands permanently lost would require compensatory mitigation. Therefore, in context of reasonably foreseeable environmental trends, combined land disturbance impacts on wetlands from ongoing and planned activities, including the Proposed Action, would likely be minimal.

3.22.5.3. Conclusions

Impacts of the Proposed Action. The activities associated with the proposed Projects may affect wetlands through short-term disturbance from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action would likely have **negligible** to **minor** impacts on wetlands. The connected action activities would have no effect (i.e., **negligibl**e) on emergent, vegetated wetlands due to the lack of that type of wetlands in the area where activities are proposed and minor effects on NYSDEC littoral zone wetlands and SAV.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on wetlands in the geographic analysis area would be **minor**. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on wetlands would be undetectable. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts on wetlands from onshore construction activities in and adjacent to these resources. Measurable impacts would be small and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

3.22.6 Impacts of Alternatives B, E, and F on Wetlands

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. The impacts on wetlands of Alternatives B, E, and F would be the same as those of the Proposed Action because these alternatives would differ only with respect to offshore components, and offshore components of the proposed Projects have no potential impacts on wetlands. The impacts resulting from the land disturbance IPF associated with onshore construction under Alternatives B, E, and F on wetlands are expected to be minimal and would be the same as those of the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. The cumulative impacts on wetlands would be minor for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on wetlands would be the same as those described for the Proposed Action for the reason described above.

3.22.6.1. Conclusions

Impacts of Alternatives B, E, and F. As discussed above, the expected **negligible** to **minor** impacts associated with the Proposed Action would not change under Alternatives B, E, and F because the alternatives would only differ in offshore components, and offshore components would not contribute to impacts on wetlands; the same construction, O&M, and decommissioning activities would still occur.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on wetlands would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives B, E, or F, BOEM anticipates that cumulative impacts of Alternatives B, E, and F would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, E, and F would be **minor**.

3.22.7 Impacts of Alternative C on Wetlands

Impacts of Alternative C. Wetland impacts under Alternative C would be the same as those of the Proposed Action because submarine export cable route options that would traverse Gravesend Anchorage (Alternative C-1) or the Ambrose Navigation Channel (Alternative C-2) have no potential impacts on wetlands. The impacts resulting from the land disturbance IPF associated with onshore construction under Alternative C on wetlands would be the same as those of the Proposed Action.

Cumulative Impacts of Alternative C. The cumulative impacts on wetlands would be minor for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on wetlands would be the same as those described for the Proposed Action.

3.22.7.1. Conclusions

Impacts of Alternative C. As discussed above, the expected **negligible** to **minor** impacts associated with the Proposed Action would not change under Alternative C because the alternative would only differ in offshore components, and offshore components would not contribute to impacts on wetlands; the same construction, O&M, and decommissioning activities would still occur.

Cumulative Impacts on Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on wetlands would be undetectable. Because the impacts of the Proposed Action would not change under Alternative C, BOEM anticipates that cumulative impacts of Alternative C would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative C would be **minor**.

3.22.8 Impacts of Alternative D on Wetlands

Impacts of Alternative D. The impacts resulting from the land disturbance IPF associated with construction and installation, O&M, and decommissioning of the Projects under Alternative D would be the same those described under the Proposed Action. Landfall and onshore export cable route options to avoid the sand borrow area (Alternative D) are already covered under the Proposed Action as part of the PDE approach, and narrowing the landfall and onshore export cable route options under Alternative D would not materially change the analyses of the land disturbance IPF. All other onshore Project components would be the same as under the Proposed Action and selection of a submarine export cable route option to avoid the sand borrow area (Alternative D) would not affect wetlands.

Cumulative Impacts of Alternative D. The cumulative impacts on wetlands would be minor for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on wetlands would be the same as those described for the Proposed Action.

3.22.8.1. Conclusions

Impacts of Alternative D. As discussed above, the expected **negligible** to **minor** impacts associated with the Proposed Action would not change under Alternative D.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on wetlands would be undetectable. Because the impacts of the Proposed Action would not change under Alternative D, BOEM anticipates that cumulative impacts of Alternative D would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative D would be **minor**.

3.22.9 Impacts of Alternative G on Wetlands

Impacts of Alternative G. Under Alternative G, the Barnums Channel cable crossing would be limited to cable segment IP-F, which would consist of an elevated cable bridge across Barnums Channel adjacent to the Long Island Rail Road railway bridge in order to avoid tidal wetlands. Analysis completed for Empire’s USACE permit application determined that crossing Barnums Channel with a cable bridge adjacent to the Long Island Rail Road railway bridge would reduce impacts within the tidal channel itself compared to other EW 2 route options for the Barnums Channel crossing or alternate construction methods (details of Empire’s alternatives analysis for the Barnums Channel crossing are presented in Appendix O, *Alternatives Analysis for Corps Permit Application*). The IP-F cable bridge crossing would require installation of support footings within the channel; however, this would occur along a corridor already containing both the railroad bridge and another utility bridge on the eastern side of the railroad crossing. Because the northern and southern sides of the crossing comprise an existing parking lot and a tank farm, respectively, impacts on wetlands and natural habitats on either side of the crossing would be avoided. Compared to the Proposed Action’s IP-C crossing option, segment IP-F would have less wetland impact because IP-C could be constructed using the open trench method across Barnums Channel under the PDE, which could directly affect the estuarine and marine wetland at the crossing. Compared to the Proposed Action’s IP-G crossing of Barnums Channel, segment IP-F is anticipated to have less impact on wetlands. Although IP-G could also cross Barnums Channel with an elevated cable, either via attachment to the existing Long Beach Road bridge or a newly constructed elevated cable bridge (similar to segment IP-F), there are greater areas of wetland along the IP-G cable corridor around Barnums Channel compared to the IP-F cable corridor (see Table 3.22-3). Therefore, the IP-G cable crossing presents a greater potential for wetlands to be affected during construction and operations.

Cumulative Impacts of Alternative G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative G to the cumulative impacts on wetlands would be less than the Proposed Action because, under the PDE approach of the Proposed Action, other crossing options for Barnums Channel could result in greater potential impacts on tidal wetlands. The impacts under Alternative G would still be undetectable, like those of the Proposed Action. Even though there would be less potential impact on tidal wetlands, BOEM does not anticipate the overall impact on wetlands for Alternative G to differ substantially from those of the Proposed Action. Therefore, BOEM anticipates that cumulative impacts of Alternative G would be the same as described for the Proposed Action: minor.

3.22.9.1. Conclusions

Impacts of Alternative G. Wetland impacts under Alternative G would be reduced compared to those of the Proposed Action, which includes other crossing options of Barnums Channel that could result in greater wetland impacts. The expected **negligible** to **minor** impacts associated with the Proposed Action would not change under Alternative G because while impacts on wetlands would be minimized, wetland impacts would still occur at the Barnums Channel crossing. BOEM expects that wetland impacts would be small and localized and would not result in a detectable change in wetland quality or function.

Cumulative Impacts of Alternative G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative G to the cumulative impacts on wetlands would be the same as those of the Proposed Action. Offshore wind projects would contribute to wetland impacts in the geographic analysis area but the overall scale of impacts is expected to be small, and compliance with mitigation measures and regulations would minimize these impacts. Because the impacts of the Proposed Action would not substantially change under Alternative G, BOEM anticipates the cumulative impacts of Alternative G would be the same as the Proposed Action. Therefore, the cumulative impacts of Alternative G would be **minor**.

3.22.10 Impacts of Alternative H on Wetlands

Impacts of Alternative H. The impacts resulting from the land disturbance IPF associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be the same those described under the Proposed Action. An alternate method of dredge and fill activity at the SBMT would not change the analysis of the IPF. All other offshore and onshore Project components of Alternative H would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. The cumulative impacts on wetlands would be minor for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on wetlands would be the same as those described for the Proposed Action.

3.22.10.1. Conclusions

Impacts of Alternative H. As discussed above, the expected **negligible** to **minor** impacts associated with the Proposed Action would not change under Alternative H.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on wetlands would be undetectable. Because the impacts of the Proposed Action would not change under Alternative H, BOEM anticipates that cumulative impacts of Alternative H would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative H would be **minor**.

3.22.11 Comparison of Alternatives

The **negligible** to **minor** impacts on wetlands under the Proposed Action would be the same under Alternatives B, E, and F because these alternatives would differ only with respect to offshore components, and offshore components of the proposed Projects have no potential impacts on wetlands and are outside of the wetlands geographic analysis area.

Alternative C or D would not change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach and the specific cable route options that would be constructed under Alternative C or D have no potential impacts on wetlands. Therefore, the impact level on wetlands would not change: **negligible** to **minor**.

Alternative G would not change the analysis compared to the Proposed Action because while impacts on wetlands would be minimized, permanent wetland impacts are still not anticipated and short-term wetland impacts are still likely to occur at inland crossings. BOEM expects that wetland impacts would be small and localized and would not result in a detectable change in wetland quality or function. Therefore, the impact level on wetlands would not change: **negligible** to **minor**.

Under Alternative H, an alternative method of dredge and fill activity would occur around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action, and any potential indirect effects on wetlands in the vicinity would be temporary. Therefore, the overall impact level on wetlands would not change: **negligible** to **minor**.

Appendix H. Mitigation and Monitoring

This Draft EIS assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, O&M, and conceptual decommissioning of the Projects proposed by Empire in its COP. As part of the Projects, Empire has committed to implement APMs to avoid, reduce, mitigate, or monitor impacts on the resources discussed in Chapter 3 of the Draft EIS.[1] Empire's APMs are part of the Proposed Action, and implementation of APMs is considered in the impact analysis for the Proposed Action and each action alternative. Attachment H-1 describes the APMs included in Empire's MMPA Letter of Authorization Application. Empire's APMs to reduce impacts on other resources are described in Attachment H-2 of this appendix. Attachment H-3 describes Empire's Proposed Bird and Bat Monitoring Framework and Attachment H-4 contains Empire's Fisheries and Benthic Monitoring Plan.

BOEM may select alternatives and require additional mitigation or monitoring measures to further protect and monitor these resources. Additional mitigation and monitoring measures may result from reviews under several environmental statutes (CAA, ESA, MSA, MMPA, and NHPA) as discussed in Appendix A of the Draft EIS. Additional mitigation measures identified by BOEM, as well as those that may result from reviews under these statutes, are shown in Table H-1. Please note that not all of these mitigation measures are within BOEM's statutory and regulatory authority but could be adopted and imposed by other governmental entities. Table H-1 provides descriptions of these mitigation or monitoring measures, as well as those that BOEM has identified for analysis in the Draft EIS. Note that the BOEM-proposed measures provided in Table H-1 are written in a form intended to match as closely as possible the text contemplated for inclusion in a letter of approval to Empire if the Projects are approved. Therefore, the draft measures themselves endeavor to use concrete and readily enforceable language even though they are only proposals at this stage and thus fundamentally conditional.

If BOEM decides to approve the COP, the ROD would state which of the mitigation and monitoring measures identified by BOEM in Table H-1 have been adopted, and if not, why they were not. As such, the ROD would inform terms and conditions of COP approval and would compel compliance with or execution of identified mitigation and monitoring measures (40 CFR 1505.3). Empire would be required to certify compliance with certain terms and conditions, as required under 30 CFR 585.633(b). Furthermore, BOEM would periodically review the activities conducted under the approved COP. The frequency and extent of the review would be based on the significance of any changes in available information and on onshore or offshore conditions affecting, or affected by, the activities conducted under the COP.

Monitoring measures may be required to evaluate the effectiveness of a mitigation measure or to identify if resources are responding as predicted to impacts from the Proposed Action. Monitoring programs would be developed in coordination among BOEM and agencies with jurisdiction over the resource to be monitored. The information generated by monitoring may be used to (1) adapt how a mitigation measure identified in the COP or ROD is being implemented, (2) revise or develop new mitigation or monitoring measures required under the COP in accordance with 30 CFR 585.634(b), (3) develop measures for future projects, or (4) contribute to regional efforts for better understanding of the impacts and benefits resulting from offshore wind energy projects in the Atlantic (e.g., potential cumulative impact assessment tool). Unless specified, the proposed mitigation measures described below would not change the impact ratings on the affected resource, as described in Chapter 3 of the Draft EIS, but would further reduce expected impacts or inform the development of additional mitigation measures if required.

[1] APMs that commit to an action that is already required by law (e.g., use of ultra-low sulfur diesel fuel) are not considered mitigation measures.

Table H-1 Potential Agency-Proposed Mitigation and Monitoring Measures Analyzed

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
BOEM OCS Study 2020-039 – Radar Systems Mitigations to Operations					

1	O&M	Mitigation for ARSR-4 and ASR-8/9 radars	Empire Wind will enter into a mitigation agreement with DOD for impacts on ARSR-4 and for ASR-8/9 radars. Possible mitigation measures might include the following:
			• Passive aircraft tracking using ADS-B or signal/transponder
			• Increasing aircraft altitude near radar
			• Sensitivity time control (range-dependent attenuation)
			• Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates)
			• Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals)
			• Modification mitigations for ARSR-4 and for ASR-8/9 systems:
			  ○ Utilizing the dual beams of the radar simultaneously
			  ○ In-fill radars
				Other Uses – Radar	BOEM and BSEE

2	O&M	Mitigation for oceanographic high frequency radars	Empire Wind will enter into a mitigation agreement with NOAA, to mitigate operational impacts on oceanographic high-frequency radars. Possible mitigation measures might include the following:
			• Data sharing from turbine operators to include the following:
			  ○ Sharing real-time telemetry of surface currents and other oceanographic data measured at locations in the Projects with radar operators into the public domain
			  ○ Sharing time-series of blade rotation rates, nacelle bearing angles, and other information about the operational state of each of the Projects' turbines with radar operators to aid interference mitigation
			• Wind farm curtailment/curtailment agreement
			• Signal processing enhancements
			• Antenna modifications
				Other Uses – Radar	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
3	O&M	Mitigation for NEXRAD weather radar systems	Empire Wind will enter into a mitigation agreement with NOAA, to mitigate operational impacts to NEXRAD weather radar systems. Possible mitigation measures might include the following: • Wind farm curtailment/curtailment agreement • Employing adaptive clutter filters • Changing the radar scan strategy to pass over areas with wind turbines • Using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine • Curtailment	Other Uses – Radar	BOEM and BSEE
DoD-proposed Measures					
1	O&M	Mitigation for radar impacts to NORAD's air defense mission	Empire will notify the North American Aerospace Defense Command (NORAD) 30 to 60 days prior to Project completion and again when the Projects are complete and operational for Radar Adverse Impact Management scheduling.	Other Uses – Radar	BOEM, BSEE, and DOD
2	O&M	Mitigation for radar impacts to NORAD's air defense mission	Empire will contribute funds in the amount of $80,000 per impacted radar toward the execution of the Radar Adverse Impact Management.	Other Uses – Radar	BOEM, BSEE, and DOD
3	O&M	Mitigation for radar impacts to NORAD's air defense mission	Empire will implement curtailment for National Security or Defense Purposes as described in the leasing agreement.	Other Uses – Radar	BOEM, BSEE, and DOD
NHPA Section 106 Mitigation Measures					
1	C	Avoid or mitigate impacts on identified archaeological resources	Empire must avoid any identified archaeological resource or TCP or, if Empire cannot avoid the resource, it must perform additional investigations for the purpose of determining eligibility for listing in the NRHP. Of those resources determined eligible, BOEM would conduct additional consultation to determine the appropriate minimization or mitigation measures under 36 CFR 800.6. If Empire determines it cannot avoid an archaeological resource or TCP after the ROD has been issued, additional Section 106 consultation will be required.	Cultural Resources	BOEM, BSEE, USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
2	C	Unanticipated discovery plan	Empire will develop and implement archaeological monitoring and unanticipated discoveries plans for terrestrial and submerged archaeology, which include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and unanticipated discovery procedures and contacts, to reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction.	Cultural Resources	BOEM, BSEE, USACE
3	Prior to C	Historic Properties Treatment Plans	BOEM, with the assistance of Empire, will develop and implement one or multiple Historic Property Treatment Plans in consultation with consulting parties who have demonstrated interest in specific historic properties.	Cultural Resources	BOEM, BSEE, USACE
BOEM-proposed Mitigation and Monitoring Measures in the NMFS BA					
1	PrC, C, O&M, D	Marine debris awareness training	The Lessee must ensure that vessel operators, employees, and contractors engaged in offshore activities under the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			• Recordkeeping and the availability of records for inspection by DOI. By January 31 of each year, the Lessee must submit to DOI an annual report that describes its marine trash and debris awareness training process, number of people trained, estimated related costs; and certifies that the training process has been followed for the previous calendar year. The Lessee must send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).		
2	C, O&M	PAM Plan	BOEM and USACE will require Empire to prepare a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan must be submitted to BOEM and BSEE at OSWsubmittals@bsee.gov for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
3	C	Pile Driving Monitoring Plan	BOEM will require Empire to prepare and submit a *Pile Driving Monitoring Plan* to NMFS and BSEE OSWsubmittals@BSEE.gov for review and concurrence at least 90 days before start of pile driving. The plan will detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan will also describe how BOEM and Empire will determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Empire will obtain NMFS' concurrence with this plan prior to starting any pile driving.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
4	C	PSO coverage	BOEM, BSEE, and USACE will ensure that PSO coverage is sufficient to reliably detect whales and sea turtles at the surface in clearance and shutdown zones so that Empire can execute any pile driving delays or shutdown requirements. If, at any point before or during construction, the PSO coverage that is included by Empire as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			within the clearance and shutdown zones, additional PSOs or platforms will be deployed. Determinations prior to construction will be based on review of the *Pile Driving Monitoring Plan* before construction begins. Determinations during construction will be based on review of the weekly pile driving reports and other information, as appropriate.		
5	C	Sound field verification	BOEM, BSEE, and USACE will require Empire to ensure that PSO coverage is sufficient to reliably monitor the clearance or shutdown zones if they are expanded due to the verification of sound fields from Project activities. Additional observers will be deployed on additional platforms for every 1,500 meters that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
6	C	Shutdown zones	BOEM, BSEE, and USACE may reduce shutdown zones for ESA-listed sei, fin, or sperm whales based upon sound field verification of a minimum of 3 piles. However, the shutdown zone for sei, fin, and sperm whales will not be reduced to less than 1,000 m, or less than 500 m for ESA-listed sea turtles. The clearance or shutdown zones for NARWs will not be reduced regardless of the results of sound field verification of a minimum of three piles.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
7	C	Monitoring zone for sea turtles	To ensure that any “take” is documented, BOEM, BSEE, and USACE will require Empire to monitor and record all observations of ESA-listed sea turtles over the full extent of any area where noise may exceed 175 dB rms during any pile driving activities and for 30 minutes following the cessation of pile driving activities.	Sea Turtles	BOEM, BSEE, and USACE
8	PrC, C, O&M, D	Look out for sea turtles and reporting	a. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, Empire must have a trained lookout posted on all vessel transits during all phases of the Projects to observe for sea turtles. The trained lookout must communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented.	Sea Turtles	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			b. For all vessels operating south of the Virginia/North Carolina border, year-round (reflecting year-round sea turtle presence), Empire must have a trained lookout posted on all vessel transits during all phases of the Projects to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented. c. The trained lookout will review https://seaturtlesightings.org/ before each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators or captains and lookouts on duty that day. d. The trained lookout will maintain a vigilant watch and monitor a 500-m Vessel Strike Avoidance Zone at all times to maintain this minimum separation distance between the vessel and ESA-listed sea turtle species. Alternative monitoring technology, such as night vision and thermal cameras, will be available to ensure effective watch at night and in any other low visibility conditions. If the trained lookout is a vessel crew member, lookout will be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts will receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. e. If a sea turtle is sighted within 100 m or less of the operating vessel's forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m between the vessel and the sea turtle at which time the vessel may resume normal operations. If a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			f. Vessel captains or operators must avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. If operational safety precludes avoiding such areas, vessels must slow to 4 knots when transiting. g. All vessel crew members must be briefed on identification of sea turtles, applicable regulations, and best practices for avoiding vessel collisions with sea turtles. Reference materials for identification of sea turtles must be available aboard all Project vessels. The requirement and process for reporting sea turtles (including live, entangled, and dead individuals) must be clearly communicated, including posting in highly visible locations aboard all Project vessels. This communication must clearly convey that sea turtle observations are to be reported to the designated vessel contact (such as the lookout or the vessel captain) and provide a communication channel and process for crew members to do so. h. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout is not required so long as the PSO or trained lookout maintains watch for both whales and sea turtles. i. Vessel transits to and from the Wind Farm Area that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 100 m avoidance measure. j. Reporting for survey vessels will include documentation of dates of sampling gear deployment and retrieval to ensure compliance with BA Measure #9, *Sampling Gear*. k. Exceptions to the requirements of this mitigation measure (Look out for sea turtles and reporting) are allowed only if the safety of the vessel or crew necessitates deviation from the requirements on an emergency basis. Any such exceptions must be reported to NMFS and BSEE within 24 hours after they occur.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
9	C, O&M	Sampling gear	All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
10	C, O&M	Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project survey must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, 3 additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape. No variation from these marking requirements may be made without notification and approval from NMFS.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
11	C, O&M	Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost gear must be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWsubmittals@bsee.gov) within 24 hours after the gear is documented as missing or lost. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
12	C, O&M	Survey training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed NEFOP observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures must be available on board each survey vessel. Empire must prepare a training plan that addresses how these survey requirements will be met and must submit that plan to NMFS in advance of any trawl or trap surveys.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
13	C, O&M	Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) must have adequate disentanglement equipment onboard, such as a (i.e., knife and boathook) onboard. Any disentanglement must occur consistent with the Northeast Atlantic Coast STDN	ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).		
14	C, O&M	Sea turtle/Atlantic sturgeon identification and data collection	Any sea turtles or Atlantic sturgeon caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Biological data collection, sample collection, and tagging activities must be conducted as outlined below. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation. a. The Sturgeon and Sea Turtle Take Standard Operating Procedures must be followed (https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). b. Survey vessels must have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader). This reader must be used to scan any captured sea turtles and sturgeon for tags, and any tags found must be recorded on the take reporting form (see below). c. Genetic samples must be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This must be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dam-migration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips must be sent to a NMFS-approved laboratory capable of performing genetic analysis and assignment to DPS of origin. Empire must cover all reasonable costs of	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			the genetic analysis. Arrangements for shipping and analysis must be made before samples are submitted and confirmed in writing to NMFS within 60 days of the receipt of the Project BiOp with ITS. Results of genetic analyses, including assigned DPS of origin must be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms must be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?nullhttps://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. d. All captured sea turtles and Atlantic sturgeon must be documented with required measurements and photographs. The animal's condition and any marks or injuries must be described. This information must be entered as part of the record for each incidental take. Particularly, a NMFS Take Report Form must be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described in the take notification measure below.		
15	PrC, C, O&M	Sea turtle/Atlantic sturgeon handling and resuscitation guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: a. Priority must be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			being used. Handling times for these species must be minimized, and if possible, kept to 15 minutes or less to limit the amount of stress placed on the animals. b. All survey vessels must have onboard copies of the sea turtle handling and resuscitation requirements (found at 50 CFR 223.206(d)(1)) before begging any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures must be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during survey activities. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff must immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If survey staff are unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG must be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours and managed in accordance with handling instructions provided by the Hotline before transfer to a rehabilitation facility. d. Survey staff must attempt resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). e. If appropriate cold storage facilities are available on the survey vessel, any dead sea turtle or Atlantic sturgeon must be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore unless		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			NMFS indicates that storage is unnecessary, or storage is not safe. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey must ultimately be released according to established protocols including safety considerations.		
16	C, O&M	Take notification	GARFO PRD must be notified as soon as possible of all observed takes of sea turtles, and Atlantic sturgeon occurring as a result of any fisheries survey. Specifically: a. GARFO PRD must be notified within 24 hours of any interaction with a sea turtle or sturgeon (nmfs.gar.incidental-take@noaa.gov). The report will include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the e-mail will transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports must be submitted as soon as possible; late reports must be submitted with an explanation for the delay. b. At the end of each survey season, a report must be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report will also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			must be comprehensive of all activities, regardless of whether ESA-listed species were observed.		
17	C, O&M	Monthly/annual reporting requirements	Empire must implement the following reporting requirements to document the amount or extent of take that occurs during all phases of the Proposed Action: a. All reports must be sent to: NMFS at nmfs.gar.incidental-take@noaa.gov and BSEE at OSWsubmittals@bsee.gov. b. During the construction phase and for the first year of operations, Empire must compile and submit monthly reports summarizing all Project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. c. Beginning in year 2 of operations, Empire must compile and submit annual reports that summarize all Project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS
18	O&M	Meeting requirements for sea turtle take documentation	BOEM, BSEE, and NMFS will meet twice in the first year of operations in person or virtually to review sea turtle observation records and review any incidental take. These meetings will be held in September (to review observations through August of that year) and December (to review observations from September to November) and will consider the best available information on sea turtle presence, distribution, and abundance; Project vessel activity; and estimated total number of sea turtle vessel strikes in the action area that are attributable to Project operations. The agencies will meet annually following the first year of operations unless NMFS, BSEE, and BOEM agree to a different frequency.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
19	C, O&M, D	Geophysical Surveys	Empire must comply with all the Project Design Criteria and Best Management Practices for Protected Species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf that implement the integrated requirements for threatened and endangered species in the June 29, 2021, programmatic consultation under the ESA, revised November 22, 2021.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
20	PrC, C, O&M	PAM Monitoring	Empire must deploy three (3) moored or autonomous PAM devices to continuously record ambient noise and marine mammals in each of the EW1 and EW2 project areas before construction, during all construction activities, the remainder of the calendar in which construction ends, and for at least 3 additional calendar years of operation following construction. The archival recorders must at a minimum be capable of detecting and storing acoustic data on anthropogenic noise sources (such as vessel noise, pile driving, and WTG operation) and marine mammal vocalizations. Empire must submit both raw and processed data with detection results to BOEM at renewable_reporting@boem.gov, BSEE OSWSubmittals@bsee.gov, and NMFS nmfs.pacmdata@noaa.gov within 120 calendar days following recorder collection and annually within 120 calendar days of the anniversary of the initial recorder deployments. Empire must consider currently available recommendations for designing underwater acoustic monitoring, including standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind. The PAM Plan must include proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the required use of PAM for monitoring. Empire may deploy the PAM buoys outside of the lease area in coordination with the Regional Wildlife Science Entity, if PAM buoys will be present within the lease area for the required periods of time. No later than 90 calendar days before the first buoy deployment, Empire must submit its PAM Plan to BOEM	Marine Mammals	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			renewable_reporting@boem.gov, BSEE OSWSubmittals@bsee.gov, and NMFS at nmfs.gar.incidental-take@noaa.gov. BOEM will review the PAM Plan and provide comments, if any, on the plan within 45 calendar days, but no later than 90 after it is submitted. Empire must resolve all comments on the PAM Plan to BOEM's satisfaction before implementation of the plan. If BOEM does not provide comments on the PAM Plan within 90 calendar days of its submittal, Empire may conclude that BOEM has concurred with the PAM Plan.		
21	PrC, C, O&M, D	Data Collection BA BMPs	BOEM will ensure that all Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Empire Wind project as applicable.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
22	C	Alternative Monitoring Plan (AMP) for pile driving	Empire must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. Empire must submit an AMP to BOEM and BSEE for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring technologies such as night vision, thermal, and infrared technologies, or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below to DOI's satisfaction. The AMP must address daytime conditions when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as one hour after civil sunrise to 1.5 hours before civil sunset. If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, Empire must follow the shutdown procedures	Marine Mammals, Sea Turtles	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			outlined in the Protected Species Mitigation Monitoring Plan. Empire must notify BOEM of any shutdown occurrence during pile driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM. The AMP must include, but is not limited to the following information: • Identification of night vision devices, such as mounted thermal or IR camera systems, hand-held or wearable NVDs, and IR spotlights, if proposed for use to detect protected marine mammal and sea turtle species. • The AMP must demonstrate, through empirical evidence, the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. • Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available). • Reporting procedures, contacts and timeframes. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP		
23	O&M	Periodic underwater surveys, reporting of monofilament	Empire must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least ten different WTGs in each EW1 and EW2 project area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Empire must conduct surveys	Marine Mammals, Sea Turtles	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		and other fishing gear around WTG foundations	by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris. Empire must report the results of the surveys to BOEM at renewable_reporting@boem.gov and BSEE at marinedebris@bsee.gov in an annual report, submitted by April 30 for the preceding calendar year. Annual reports must be submitted in Microsoft Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic and/or video documentation of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place). Required data and reports may be archived, analyzed, published, and disseminated by BOEM.		
24	PrC, C, O&M, D	PDC minimize vessel interactions with listed species (from HRG Programmatic)	All vessels associated with survey activities (transiting [i.e., travelling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. • If any ESA-listed marine mammal is sighted within 500 m of the forward path of a vessel, the vessel operator must steer a course away from the whale at <10 knots (18.5 km/hr) until the minimum separation distance has been established. Vessels may also shift to idle if feasible. • If any ESA-listed marine mammal is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 meters. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m.	Marine Mammals	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
25	O&M	Operational Sound Field Verification Plan	Empire must develop an *Operational Sound Field Verification Plan* to determine the operational noises emitted from the Offshore Wind Area. The plan must be reviewed and approved by BOEM and NMFS.	ESA-listed Fish, Marine Mammals, and Sea Turtles	BOEM, BSEE, and NMFS
BOEM-proposed Bird and Bat Mitigation Measures					
1	O&M	Adaptive mitigation for birds and bats	If the reported post-construction bat monitoring results (generated as part of Empire's *Bird and Bat Monitoring Framework* (Attachment H-3) indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Empire must make recommendations for new mitigation measures or monitoring methods.	Birds and Bats	BOEM, USFWS, BSEE
2	C, O&M	Annual reporting	Annual Bird and Bat Mortality Reporting during construction and operation, and decommissioning. The Lessee must submit an annual report covering each calendar year, due by January 31 of the following year, documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must be submitted to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) and USFWS. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with Federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory. Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state.	Birds and Bats	BOEM, USFWS, BSEE
Other Agency-proposed Mitigation Measures					
1	C	LOA Requirements	The measures required by the final MMPA LOA for Incidental Take Regulations would be incorporated into COP approval. NMFS published receipt of an application for regulations and Letter of Authorization under the MMPA on September 9, 2022 (87 FR 55409) and is currently accepting comments until October	Marine Mammals	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			11, 2022. NMFS is currently accepting comments from the public to provide information, suggestions, and comments on Empire's application and has not yet proposed rulemaking on this action.[2]		
2	C	Hydraulic Dredge Intake	All hydraulic dredge intakes should be covered with a mesh screen or screening device that is properly installed and maintained to minimize potential for impingement or entrainment of fish species. The screening device on the dredge intake should prevent the passage of any material greater than 1.25" in diameter, with a maximum opening of 1.25" x 6". Water intakes should be positioned at an appropriate depth to avoid or minimize the entrainment of eggs and larvae. Intake velocity should be limited to less than 0.5 ft/sec.	Benthic Resources; Finfish, Invertebrates, EFH	BOEM, BSEE, USACE
3	Pre-C, C, O&M, D	Anchoring Plan	Empire will develop and comply with an anchoring plan to reduce impacts on benthic habitats associated with the Proposed Action. This plan should specifically delineate areas of complex habitat around each turbine and cable locations, and identify areas restricted from anchoring. Anchor chains should include midline buoys to minimize impacts to benthic habitats from anchor sweep where feasible. The habitat maps and inshore maps delineating sensitive benthic habitat adjacent to the landfall and O&M facility should be provided to all cable construction and support vessels to ensure no anchoring of vessels be done within or immediately adjacent to these habitats.	Benthic Resources, EFH	BOEM, BSEE, USACE
4	Pre-C	Cable Burial Risk Assessment	Empire will develop a draft Cable Burial Risk Assessment for maritime stakeholder review prior to BOEM rendering a decision on the Fabrication and Installation Report/Facility Design Report (FIR/FDR). Empire will document how maritime stakeholder comments were addressed and transmit the comments and responses to BOEM, USACE, and USCG.	Navigation	BOEM, BSEE, USACE
5	C	Avoid Sand Ridges and Troughs	Empire will avoid perpendicular crossings of sand ridges and troughs for the submarine export cables and inter-array cables.	Benthic Resources, EFH	Best practice

[2] See Table H-2 for Empire’s proposed Mitigation, Monitoring, and Reporting Measures in the MMPA Letter of Authorization.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
6	Pre-C, C, O&M, D	Mariner Communication and Outreach Plan	Empire will develop and implement a Mariner Communication and Outreach Plan that covers all project phases from pre-construction to decommissioning and that facilitates coordination with all mariners, including the commercial shipping industry, commercial and for-hire fishing industries, and other recreational users. The Mariner Communication and Outreach Plan will include the following components: a. During Project design, routinely coordinating in-water construction activities and phasing to avoid and minimize disruptions; b. At least 90 days prior to commencing in-water construction activities in any construction season, consultation with stakeholders on an approximate schedule of activities and existing uses within the Project area. Make good faith efforts to accommodate those existing uses. The results of these good faith consultations will be summarized in a report and submitted to the federal agency(ies) prior to the start of each construction season; c. Following COP approval, notice of proposed changes which have the potential to impact fishing or maritime resources or activities; d. Notices to commence construction activities, conduct maintenance activities, and commence decommissioning; e. Status reports during construction with specific information on construction activities and locations for upcoming activities in the next 1-2 weeks; f. Post-construction notice of: (i) all cable protection measure locations (including protection type and charted location); (ii) any areas where the identified burial depth is less than target burial depth; and (iii) other obstructions to navigation created by the Project; g. During operations, notice of locations where cables have shifted outside the cable area identified in Electronic Navigation Charts; and	Navigation	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			h. Post all notices described above to the Project website with information on how to opt-in for alerts.		
7	C, O&M, D	Fishing Gear and Anchor Strike Incident Reporting	Empire will report fishing gear and anchor strike incidents that fall below or are not captured by the regulatory thresholds outlined in 30 CFR §§ 585.832 and 585.833. Reports will be filed annually during construction and decommissioning, and every 5 years during operations.	Commercial Fishing	BOEM, USACE, USCG
8	C	Sand Wave Leveling and Boulder Clearance	Sand wave leveling and boulder clearance should be limited to the extent practicable. Best efforts should be made to microsite to avoid these areas.	Benthic Resources; EFH	Best practice
9	Pre-C, C, O&M	Cable Maintenance Plan	Empire will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, addresses repeat exposures, and establishes a process for identifying when cable burial depths reach unacceptable risk levels.	Navigation	BOEM, BSEE, USACE
10	C	Cable Separation Distance	Empire will install export cables as close to each other as possible within the proposed cable corridor, not to exceed the approximately 2-3x water depth is required for the cable repair bight. The final corridor width should be as narrow as possible to minimize overall impacts.	Other Uses	Best practice
11	Pre-C	Cable Installation Plan	Empire’s Cable Installation Plan or Cable Burial Risk Assessment will: 1. depict precise planned locations and burial depths of the entire cable system; 2. detail how cable installation and operation will be managed to ensure disruption to harbor uses is minimized along the cable routes; 3. evaluate impacts to anchorage area capacity during construction and operations and identify mitigation measures where appropriate. Mooring buoys should be considered as alternative berthing options to offset permanently reduced operational or anchorage capacity (e.g., Gravesend Bay); and	Navigation	BOEM, BSEE, USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			4. evaluate the need for additional mitigation measures, including deeper burial depth to mitigate risks to ocean users, including crossing the Ambrose to Nantucket Traffic Lane.		
12	C, O&M	Cable Alert System	Empire will install a cable alert system that alerts vessels to the presence of cables, which could shift over time both horizontally and vertically. Such a system would be prudent in high traffic areas (e.g., navigation channels, crossing TSS, near offshore anchorage).	Navigation	BOEM, BSEE, USACE
13	C	Consolidate EW 2 Landfall(s)	Empire will consolidate EW 2 cable landfall(s) to one location for all cables, to the extent practicable, to minimize community and environmental impacts.	Multiple	Best practice
14	C, O&M	Compensation for gear loss and damage	The lessee shall implement a gear loss and damage compensation program consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment.	Commercial Fisheries and For-Hire Recreational Fishing	BOEM and BSEE
15	O&M	Compensation for lost fishing income	The lessee shall implement a compensation program for lost income for commercial and recreational fishermen and other eligible fishing interests for construction and operations consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment.	Commercial Fisheries and For-Hire Recreational Fishing	BOEM and BSEE
16	C, O&M	Navigational Safety Adaptation Fund	Empire will establish an adaptation fund to equip vessel operators with necessary safety training and equipment, including suitable marine vessel radar, where appropriate.	Navigation	BOEM and BSEE
17	O&M	Mobile gear friendly cable protection measures	Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure chiefly ensures that seafloor cable protection does not introduce new hangs for mobile fishing gear. Thus, the cable protection measures should be trawl-friendly with tapered/sloped edges. If cable protection is necessary in "nontrawlable" habitat, such as rocky habitat, then Empire must ensure that all materials consist of natural or engineered stone that does not inhibit epibenthic growth, to the extent technically and economically feasible. The materials	Commercial Fisheries and For-Hire Recreational Fishing; Benthic Resources; EFH	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	Anticipated Enforcing Agency
			selected for protective purposes should mirror the natural environment and perform similar habitat functions.		
18	C, O&M	High-frequency radar mitigation	Empire must develop a mitigation plan, to be reviewed and coordinated with the NOAA IOOS Surface Currents Program Manager, for purposes of implementing measures that correct for wind turbine interference. Measures would include sharing real-time telemetry of surface currents, waves, and other oceanographic data with the Surface Currents Program into the public domain, measured at locations in the Project confirmed by the Surface Currents Program and its high-frequency radar operators as sufficient to allow NOAA IOOS mission objectives to be met.	Other Uses	BOEM and BSEE
Agency-proposed Mitigation Measures for the Connected Action					
1	C	Wetland Mitigation	NYCEDC will mitigate for impacts to mapped tidal littoral zone wetlands from fill and shading associated with the Connected Action, as required in consultation with NYS agencies.	Wetlands	NYSDEC

ATTACHMENT H-1
MITIGATION, MONITORING, AND REPORTING MEASURES IN EMPIRE'S LETTER OF AUTHORIZATION APPLICATION

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Table H-2 Proposed Mitigation, Monitoring, and Reporting Measures in the MMPA Letter of Authorization Application, also included in the Proposed Action for Consultation with NMFS as a Co-Action Agency under the ESA for Threatened and Endangered Marine Mammals[3]

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
LOA-1: Vessel strike avoidance procedures	C, O&M, D	Vessel operators and crew must maintain a vigilant watch for cetaceans and pinnipeds by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to the following, except under extraordinary circumstances when complying with these measures would put the safety of the vessel or the crew at risk: • Vessel operators and crew will maintain vigilant watch for cetaceans and pinnipeds, and slow down or stop their vessel to avoid striking these protected species; • All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions in any SMA, DMA or visually triggered Slow Zone; • All vessel operators will reduce vessel speed to 10 knots (18.5 km/hr) or less when any large whale, any mother/calf pairs, whale or dolphin pods, or larger assemblages of cetaceans are observed near (within 100 m [330 ft]) an underway vessel; • All vessels will maintain a separation distance of 500 m (1,640 ft) or greater from any sighted NARW; • If underway, vessels must steer a course away from any sighted NARW at 10 knots (18.5 km/hr) or less until the 500 m (1,640 ft) minimum separation distance has been established. If a NARW is sighted in a vessel's path, or within 100 m (330 ft) of an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be	Marine Mammals	BOEM, BSEE, and NMFS

[3] NMFS published receipt of an application for regulations and Letter of Authorization under the MMPA on September 9, 2022 (87 *Federal Register* 55409) and is currently accepting comments until October 11, 2022.

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		engaged until the NARW has moved outside of the vessel's path and beyond 100 m. If stationary, the vessel must not engage engines until the NARW has moved beyond 100 m; • All vessels will maintain a separation distance of 100 m (330 ft) or greater of any sighted whales. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside the vessel's path and beyond 100 m. If a survey vessel is stationary, the vessel will not engage engines until the whale has moved out of the vessel's path and beyond 100 m; • All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted small cetacean. Any underway vessel must remain parallel to a sighted small cetacean's course whenever possible and avoid excessive speed or abrupt changes in direction. Vessels may not adjust course and speed until the small cetaceans have moved beyond 50 m and/or the beam of the underway vessel; • All vessels underway will not divert or alter course in order to approach any whale, small cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and • All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped. Vessel operators will use all available sources of information of NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and monitoring of Coast Guard VHF Channel 16 to receive notifications of right whale detections to plan vessel routes to minimize the potential for co-occurrence with right whales. As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet		

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.		
LOA-2: Foundation installation – Seasonal pile driving restrictions	C	Impact pile driving of foundations will not occur from January 1 through April 30. In addition, pile driving will not occur from December 1 through December 31, unless unanticipated delays due to weather or technical issues arise that necessitate extending pile driving into December in which case Empire would notify NMFS and BOEM in writing by September 1 that circumstances are expected to necessitate pile driving in December.	Marine Mammals	BOEM, BSEE, and NMFS
LOA-3: Foundation installation – Pile driving weather and time restrictions	C	Impact pile driving will commence only during daylight hours no earlier than one hour after (civil) sunrise. Impact pile driving will not be initiated later than 1.5 hours before (civil) sunset. Pile driving may continue after dark when the installation of the same pile began during daylight (1.5 hours before [civil] sunset), when clearance zones were fully visible for at least 30 minutes and must proceed for human safety or installation feasibility reasons. Impact pile driving will not be initiated in times of low visibility when the visual clearance zones cannot be visually monitored, as determined by the lead PSO on duty.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
LOA-4: Foundation installation – Visual monitoring	C	During impact pile driving visual monitoring will occur as follows: • A minimum of two PSOs must be on active duty at the impact pile driving vessel/platform from 60 minutes before, during, and for 30 minutes after all pile installation activity; and • A minimum of two PSOs must be on active duty on a dedicated PSO vessel from 60 minutes before, during, and for 30 minutes after all monopile installation activity, or, an alternate monitoring technology (e.g., UAS) that has been demonstrated as having greater visual monitoring capability compared to two PSOs on a dedicated PSO vessel and is approved by NMFS, will be employed from 60 minutes before, during, and for 30 minutes after all monopile installation activity. If a dedicated PSO vessel is selected, the vessel must be located at the best vantage point to observe and document marine mammal sightings in proximity to the Clearance/Shutdown zones.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
LOA-5: Foundation installation – Pre-start clearance	C	For impact pile driving, the Applicant will implement a 60-minute pre-start clearance period of the Clearance zones prior to the initiation of soft-start to ensure no marine mammals are in the vicinity of the pile. During this period the Clearance zones will be monitored by both PSOs and PAM. Pile driving will not be initiated if any marine mammal is observed within its respective Clearance zone. If a marine mammal is observed within a Clearance zone during the pre-start clearance period, impact pile driving may not begin until the animal(s) has been observed exiting its respective zone, or, until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). In addition, impact pile driving will be delayed upon a confirmed PAM detection of a NARW, if the PAM detection is confirmed to have been located within the 5 km NARW PAM Clearance zone. Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a NARW. Impact pile driving will not be initiated if the clearance zones cannot be adequately monitored (i.e., if they are obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period prior to the commencement of soft start, as determined by the Lead PSO. If light is insufficient, the Lead PSO will call for a delay until the Clearance zone is visible in all directions. If a soft start has been initiated before the onset of inclement weather, pile driving activities may continue through these periods if deemed necessary to ensure human safety and/or the integrity of the Project.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
LOA-6: Foundation installation – Clearance and shutdown zones	C	Clearance and Shutdown zones will be established (see Table 42 of the LOA application (Empire Wind 2022) and continuously monitored during impact pile driving to minimize impacts to marine mammals. These zones will be monitored as described under LOA-4 and mitigation enacted as described under LOA-9.	Marine Mammals	BOEM, BSEE, and NMFS
LOA-7: Foundation installation – Passive	C	PAM will occur during all impact pile driving and will supplement the visual monitoring program. During impact pile driving, PAM will begin 60 minutes prior to the initiation of soft-start, throughout foundation installation, and for 30 minutes after impact pile driving	Marine Mammals	BOEM, BSEE, and NMFS

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
acoustic monitoring		has been completed. PAM will be conducted by a dedicated, qualified, and NMFS-approved PAM operator. The PAM operator will monitor the hydrophone signals in real time both aurally (using headphones) and visually (via the monitor screen displays). The PAM operator will communicate detections of any marine mammals to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measures (i.e., delay or shutdown of pile driving). PAM detection alone (i.e., in the absence of visual confirmation by a PSO of a marine mammal within a relevant Clearance/Shutdown zone) will not trigger mitigation measures (i.e., delay or shutdown of pile driving), with the exception of a confirmed PAM detection of a NARW within the relevant zone. The real-time PAM system will be designed and established such that detection capability extends to 5 km from the pile driving location, for all monopile installations. Real-time PAM will begin at least 60 minutes before pile driving begins. The real-time PAM system will be configured to ensure that the PAM operator is able to review acoustic detections within approximately 15 minutes of the original detection, in order to verify whether a NARW has been detected. Any possible NARW vocalization will be reported as a detection if the vocalization is determined by the PAM operator to be within the Clearance/Shutdown zones.		
LOA-8: Foundation installation – Soft start	C	A soft start refers to initiating the pile driving process at reduced hammer energy to provide marine mammals a warning and an opportunity to vacate the area prior to pile driving at full hammer energy. Soft start will occur at the beginning of the driving of each pile and at any time following the cessation of impact pile driving of 30 minutes or longer. The soft start requires an initial 30 minutes using a reduced hammer energy for pile driving.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
LOA-9: Foundation installation – Shut down and power down	C	The Clearance and Shutdown zones around the pile driving activities will be maintained by PSOs for the presence of marine mammals before, during, and after impact pile driving activity. If a marine mammal is observed entering or within the respective zones after pile driving has commenced, a shutdown of impact pile driving will occur when practicable as determined by the lead	Marine Mammals	BOEM, BSEE, and NMFS

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		engineer on duty, who must evaluate the following to determine whether shutdown is safe and practicable: • Use of site-specific soil data and real-time hammer log information to judge whether a stoppage would risk causing piling refusal at re-start of piling; • Confirmation that pile penetration is deep enough to secure pile stability in the interim situation, taking into account weather statistics for the relevant season and the current weather forecast; and • Determination by the lead engineer on duty will be made for each pile as the installation progresses and not for the site as a whole. If a shutdown is called for but the lead engineer determines shutdown is not practicable due to an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy (power down) will be implemented, when the lead engineer determines it is practicable. Subsequent restart/increased power of the equipment can be initiated if the animal has been observed exiting its respective zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (i.e., 15 minutes for small odontocetes and 30 minutes for all other species). If pile driving shuts down for reasons other than mitigation (e.g., mechanical difficulty) for brief periods (i.e., less than 30 minutes), it may be activated again without ramp-up, if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective zones.		
LOA-10: Noise attenuation during impact pile driving	C	The Applicant will employ noise mitigation techniques during all impact pile driving that will attenuate pile driving noise by a minimum of 10 dB, such that measured ranges to isopleth distances corresponding to relevant marine mammal harassment thresholds are consistent with those modeled based on 10 dB attenuation, determined via sound field verification. The Applicant	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		will employ a double bubble curtain or an attenuation technology that achieves noise reduction equivalent to or greater than that achieved by a double bubble curtain.		
LOA-11: Cable landfall and marina activities – Visual monitoring	C	A minimum of two PSOs will be on active duty on the vibratory pile driving platform, or on a vessel nearby the construction vessel, from 30 minutes before, during, and 30 minutes after all pile driving.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
LOA-12: Cable landfall and marina activities – Pre-start clearance	C	For all pile driving, the Applicant will implement a 30-minute clearance period of the Clearance zones prior to the initiation of installation. During this period the Clearance zones will be monitored by the PSOs, using the appropriate visual technology for a 30-minute period. Installation may not be initiated if any marine mammal is observed within its respective Clearance zone. If a marine mammal is observed within a Clearance zone during the pre-start clearance period, installation may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for dolphins and pinnipeds and 30 minutes for all other species). Any large whale sighted by a PSO within 1,000 m of the pile that cannot be identified to species must be treated as if it were a NARW.	Marine Mammals	BOEM, BSEE, and NMFS
LOA-13: Cable landfall and marina activities – Clearance and shutdown zones	C	Clearance and shutdown zones for vibratory pile driving will be established as described in Table 43 of the LOA application.	Marine Mammals	BOEM, BSEE, and NMFS
LOA-14: Cable landfall and marina activities – Shutdown and power down procedures	C	The Clearance and Shutdown zones around pile driving activities will be maintained, as previously described, by PSOs for the presence of marine mammals before, during, and after pile driving activity. An immediate shutdown of the hammer will be required if a marine mammal is sighted within or approaching its respective Shutdown zone. The operator will comply immediately with any call for shutdown by the Lead PSO, except in cases where immediate shutdown would represent a human safety risk. Any disagreement between the Lead PSO and operator will be discussed only after	Marine Mammals	BOEM, BSEE, and NMFS

Measure	Project Phase	Description	Resource Area Mitigated	Anticipated Enforcing Agency
		shutdown has occurred. Subsequent restart of the equipment can be initiated if the animal has been observed exiting its respective Shutdown zone within 30 minutes of the shutdown, or, after an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species).		
LOA-15: HRG survey activities	C, O&M	BOEM will require the most recent Project Design Criteria and Best Management Practices for threatened and endangered species found at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf The specific measures identified in the LOA application were current as per the 2021 programmatic ESA section 7 consultation regarding offshore wind geophysical and geotechnical surveys (BOEM and NMFS 2021).	Marine Mammals	BOEM, BSEE, and NMFS

ATTACHMENT H-2
OTHER APPLICANT-PROPOSED MEASURES

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Table H-3 Summary Table

Measure Number	Measure	Description of Measure	Resource	Project Phase
1	Training for extreme weather conditions	In order to mitigate the potential impacts from physical oceanographic and meteorological conditions, Empire will require that all personnel, crew, and contractors complete training and are familiar with the safety plans developed for extreme weather conditions.	Physical and Oceanographic Conditions	Construction, Operations and Maintenance, Decommissioning
2	Project design	The Project will be designed with consideration of conditions in the Project Area.	Physical and Oceanographic Conditions	Construction, Operations and Maintenance, Decommissioning
3	Siting of offshore components to avoid anomalous or challenging geological conditions	The siting of offshore components to avoid anomalous or challenging geological conditions to the extent practicable.	Geological Conditions	Construction & Decommissioning
4	Project design and construction will consider geological condition	Project infrastructure will be designed and constructed with consideration of the geological conditions within the Project Area.	Geological Conditions	Construction & Decommissioning
5	Study and analysis of geological conditions in the Project Area	Additional study and analysis will be completed prior to construction and installation activities to inform the selection of methods to allow for Project infrastructure to be constructed in a way that allows for the least impact, both to and from, the geological conditions in the Project Area.	Geological Conditions	Construction & Decommissioning
6	Siting of onshore components in previously disturbed areas	The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable.	Geological Conditions	Construction & Decommissioning
7	Restoration of disturbed areas	Areas disturbed by construction activities will be restored (i.e., graded) to pre-construction conditions, to the extent practicable.	Geological Conditions	Construction & Decommissioning
8	Ongoing monitoring of assets that could be impacted by geological conditions	The on-going monitoring of assets that have the potential to be impacted by geological conditions, including foundations, and interarray and export cables, to confirm the cables have not become exposed or that the scour and cable protection measures have not worn away.	Geological Conditions	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
9	Siting of offshore components to avoid natural and anthropogenic hazard	Siting of the offshore components to minimize and avoid natural and anthropogenic hazards to the extent practicable.	Natural and Anthropogenic Hazards	Construction & Decommissioning
10	Deeper burial the submarine export ongoing discussions with the USACE	Deeper burial of the submarine export cables in areas within certain identified navigation channels, subject to ongoing discussions with the USACE and other applicable stakeholders.	Natural and Anthropogenic Hazards	Construction & Decommissioning
11	Deeper burial the submarine export and interarray cables in areas with seabed penetration	Deeper burial of the submarine export and interarray cables in areas identified as having seabed penetrating fishing activity.	Natural and Anthropogenic Hazards	Construction & Decommissioning
12	UXO survey for necessary areas	Complete detailed, dedicated UXO survey for areas deemed necessary prior to installation.	Natural and Anthropogenic Hazards	Construction & Decommissioning
13	Proper cable burial measures and protection accounting for mobile seabed; planning for potential sandwave removal	Implementation of measures to allow for proper cable burial and protection that accounts for mobile seabed in this area, as well as plan for the possibility of sandwave removal during any future repairs to the cables.	Natural and Anthropogenic Hazards	Construction & Decommissioning
14	Horizontal buffer of 164 ft for identified potential submerged cultural resources	Implementation of a horizontal buffer of at least 164 ft (50 m) for identified potential submerged cultural resources unless further investigation and/or consultation with the appropriate authorities deems unnecessary.	Natural and Anthropogenic Hazards	Construction, Operations and Maintenance, Decommissioning
15	Distribution of information and Local Notice to Mariners (LNM) and active engagement with applicable stakeholders	Distribution of information and LNM and active engagement with applicable stakeholders to ensure awareness of the positions of Project-related assets to avoid any collision or interference.	Natural and Anthropogenic Hazards	Construction, Operations and Maintenance, Decommissioning
16	Periodic inspections of offshore Project components to verify integrity	Periodic inspections of offshore Project components, including foundations, scour protection, and submarine export and interarray cables, to verify integrity of the Project components and to confirm adequate burial.	Natural and Anthropogenic Hazards	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
17	Provide as-built information to NOAA to support necessary updates to navigation charts	Provide as-built information to NOAA to support necessary updates to navigation charts in coordination with NOAA and other stakeholders as needed.	Natural and Anthropogenic Hazards	Operations and Maintenance
18	Implementation of soil erosion and sediment control plans; SWPPP	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.	Water Quality	Construction & Decommissioning
19	SSER Comprehensive Management Plan	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.	Water Quality	Construction & Decommissioning
20	NPDES permits and SWPPP	Obtain an industrial stormwater NPDES permit (if required) and develop a SWPPP if more than 1 ac (0.4 ha) of land is disturbed at any land fall or onshore substation per the CWA (33 U.S.C. § 1342). The plan will identify the measures that will be employed at the site to control the release of erosion and pollutants to the water and will outline an implementation and maintenance schedule.	Water Quality	Construction & Decommissioning
21	Agency-approved inadvertent return plan	Implementation of an agency-approved inadvertent return plan, approved by the applicable agencies, as necessary.	Water Quality	Construction & Decommissioning
22	SPCC Plan	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.	Water Quality	Construction, Operations and Maintenance, Decommissioning
23	Restricted access	Restricting access through wetlands and waterbodies 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 and the O&M Base due to the absence of wetlands within the onshore area.	Water Quality	Construction & Decommissioning
24	Following regulation for at-sea discharge and vessel-generated waste	Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.	Water Quality	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
25	SPCC Plan; OSRP	The management of accidental spills or releases of oils or other hazardous wastes through a SPCC plan for onshore activities and an OSRP for offshore activities, which will be provided for agency review and approval, as applicable.	Water Quality	Operations and Maintenance
26	SWPPP, SPCC inclusion of stormwater control feature inspection and cleaning	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 SPCC or appropriate Operations Plan.	Water Quality	Operations and Maintenance
27	Nitrogen oxide and VOC emission reduction credits	Where required, Empire will purchase sufficient emission reduction credits to offset the NOX and VOC emissions for Project-related activities. Empire will provide documentation of the purchase of offsets in accordance with the requirements set forth in the Record of Decision (ROD) and/or the issued OCS air permit.	Air Quality	Construction, Operations and Maintenance, Decommissioning
28	Vessels will meet Tier III Nitrogen oxide standards	Vessels constructed on or after January 1, 2016 will meet Tier III NOX requirements when operating within the North American Emission Control Area (200 nm [370.4 km]) established by the International Maritime Organization (IMO).	Air Quality	Construction, Operations and Maintenance, Decommissioning
29	Ultra-low diesel fuel usage	Project-related diesel-powered equipment will use ultra-low sulfur diesel fuel, per the requirements of 40 CFR § 80.510(b). (Beginning June 1, 2010, all non-road diesel fuel is subject to a 15-ppm sulfur content limit, which is defined in practice as ultra-low sulfur diesel fuel.)	Air Quality	Construction & Decommissioning
30	Low sulfur diesel fuel usage	Project-related vessels will use low sulfur diesel fuel where possible and be at or below the maximum fuel sulfur content requirement of 1,000 ppm established per the requirements of 40 CFR § 80.510(k).	Air Quality	Construction, Operations and Maintenance, Decommissioning
31	EPA emission standard compliance	Project-related vessels will comply with applicable EPA, or equivalent, emission standards.	Air Quality	Construction, Operations and Maintenance, Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
32	Data sharing with BOEM	Empire will provide BOEM with data on horsepower rating of all propulsion and auxiliary engines, duration of time operating in state waters, load factor, and fuel consumption for Project-related vessels to determine actual emissions from Project-related vessels, which will confirm that sufficient emissions offsets have been acquired.	Air Quality	Construction, Operations and Maintenance, Decommissioning
33	Information updates on equipment provided to BOEM and EPA	Empire will provide vessel engines and emissions control equipment information to BOEM and the EPA in accordance with the requirements set forth in the ROD and/or the issued OCS air permit.	Air Quality	Construction, Operations and Maintenance, Decommissioning
34	Compliance with state regulations on engine idling	Project-related vehicles, diesel engines, and/or nonroad diesel engines at the staging site will comply with applicable state regulations regarding idling. In New York State, 6 NYCRR 217-3 prohibits all on-road diesel-fueled and non-diesel-fueled heavy-duty vehicles from idling for more than five minutes. N.J.A.C. 7:27-14 and 7:27-15 restricts the unnecessary idling of diesel and gasoline engines, respectively, to three minutes.	Air Quality	Construction & Decommissioning
35	Construction equipment will be well-maintained	Construction equipment will be well-maintained and vehicles using internal combustion engines equipped with mufflers will be routinely checked to ensure they are in good working order.	In-Air Acoustic Environment	Construction & Decommissioning
36	Quieter-type adjustable backup alarms will be used for vehicles as feasible	Quieter-type adjustable backup alarms will be used for vehicles as feasible.	In-Air Acoustic Environment	Construction & Decommissioning
37	Noisy equipment will be located as far as possible from NSAs	Noisy equipment will be located as far as possible from NSAs.	In-Air Acoustic Environment	Construction & Decommissioning
38	A noise complaint hotline will be made available	A noise complaint hotline will be made available to help actively address all noise related issues.	In-Air Acoustic Environment	Construction & Decommissioning
39	HDD/Direct Pipe construction activities will occur during daytime period	HDD/Direct Pipe construction activities will occur during daytime period unless otherwise deemed acceptable from the appropriate regulatory authority.	In-Air Acoustic Environment	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
40	In the case of night operations, only the HDD drill rig and power unit will be used	In the case of night operations, only the HDD drill rig and power unit will be used, unless deemed acceptable from the appropriate regulatory authority.	In-Air Acoustic Environment	Construction & Decommissioning
41	Compliance with IMO noise standards	The vessels used for nearshore work and vessels transiting between Project ports and the Lease Area will comply with IMO noise standards, as applicable.	In-Air Acoustic Environment	Construction & Decommissioning
42	Noise-generating equipment may be located inside or outside with the use of noise barriers, if necessary	If necessary, subject to regulatory requirements and stakeholder engagement, noise-generating equipment (e.g., reactors and transformers) may be located inside or outside with the use of noise barriers.	In-Air Acoustic Environment	Operations and Maintenance
43	Limited lighting during construction	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.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
44	Siting in disturbed areas	Siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
45	Soil erosion and sediment control plans	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.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
46	Incorporation of the NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection	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.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
47	Implementation of an inadvertent return plan	The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
48	Implementation of an invasive species control plan	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.	Terrestrial Vegetation and Wildlife	Construction, Operations and Maintenance, Decommissioning
49	Revegetation of disturbed areas	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.	Terrestrial Vegetation and Wildlife	Construction, Operations and Maintenance, Decommissioning
50	SWPPP and/or SPCC Plan	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.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
51	seasonal restrictions for vegetation clearing	Evaluation of seasonal restrictions for vegetation clearing at EW 2 Onshore Substation C, where sensitive species are detected, to mitigate potential impacts to breeding individuals. This is not anticipated to be required at EW 1, EW 2 Onshore Substation A, or the O&M Base due to the highly developed nature of the onshore area and absence of suitable habitat.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
52	staggering silt fencing / erosion control devices	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.	Terrestrial Vegetation and Wildlife	Construction & Decommissioning
53	Implementation of a mitigation plan	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.	Terrestrial Vegetation and Wildlife	Operations and Maintenance
54	Site-specific mitigation	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.	Terrestrial Vegetation and Wildlife	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
55	Limitation of project personnel/vehicles	Limiting access of Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable.	Terrestrial Vegetation and Wildlife	Operations and Maintenance
56	Lighting reduction measures	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.	Terrestrial Vegetation and Wildlife	Operations and Maintenance
57	Invasive species survey	A formal survey for invasive plant species will be conducted before Project construction, if needed, in accordance with an Invasive Species Control Plan, to document the location of invasive plant stands within the limit of disturbance.	Terrestrial Vegetation and Wildlife	Operations and Maintenance
58	Siting in disturbed areas	The siting of onshore components in previously disturbed areas, existing roadways, and/or ROWs to the extent practicable.	Wetlands and Waterbodies	Construction & Decommissioning
59	Siting structures outside of special FHAs	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.	Wetlands and Waterbodies	Construction & Decommissioning
60	Implementation of soil erosion and sediment control plans; SWPPP	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.	Wetlands and Waterbodies	Construction & Decommissioning
61	NYSDEC Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection management practices	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.	Wetlands and Waterbodies	Construction & Decommissioning
62	Inadvertent return plan	The implementation of an inadvertent return plan, which will be provided for agency review and approval, as applicable.	Wetlands and Waterbodies	Construction & Decommissioning
63	SPCC plan	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.	Wetlands and Waterbodies	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
64	Restricted access	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.	Wetlands and Waterbodies	Construction & Decommissioning
65	Temporary matting to protect vegetation	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.	Wetlands and Waterbodies	Construction & Decommissioning
66	Invasive species control plan	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.	Wetlands and Waterbodies	Construction & Decommissioning
67	Restricted access	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.	Wetlands and Waterbodies	Construction & Decommissioning
68	Restoration of native species	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.	Wetlands and Waterbodies	Construction & Decommissioning
69	HDD	Consideration of the use of HDD for installation of the export cable landfalls at EW 2 to avoid surficial disturbances.	Wetlands and Waterbodies	Construction & Decommissioning
70	seasonal restrictions for vegetation clearing	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.	Wetlands and Waterbodies	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
71	staggering silt fencing / erosion control devices	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.	Wetlands and Waterbodies	Construction & Decommissioning
72	Restricted access	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.	Wetlands and Waterbodies	Operations and Maintenance
73	Landscape restoration plan	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.	Wetlands and Waterbodies	Operations and Maintenance
74	Mitigation monitoring for wetlands, waterbodies, and riparian zones	Mitigation monitoring at EW 2, if required and as 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.	Wetlands and Waterbodies	Operations and Maintenance
75	Stormwater control features; SWPPP; SPCC	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.	Wetlands and Waterbodies	Operations and Maintenance
76	Siting in disturbed areas	Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat and/or ROWs to the extent practicable.	Avian & Bat Species	Pre-Construction
77	Time of year restrictions	Adherence to time of year restrictions, as necessary, at EW 2 in sensitive onshore bird habitats, where feasible and required, unless otherwise determined acceptable by the applicable agencies. This is not anticipated to be required for EW 1 due to the highly developed nature of the onshore area and lack of natural vegetation and suitable habitat.	Avian & Bat Species	Pre-Construction, Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
78	Time of year restrictions	Avian: Avoidance of key habitats and tree clearing within the Oceanside POI parcel and the EW 2 Onshore Substation C site will occur between October and March, where appropriate, and required during sensitive times of year (e.g., breeding season), to minimize risk to tree nesting birds. This is not anticipated to be required for EW 1, EW 2 Onshore Substation A, or the O&M Base due to the highly developed nature of the onshore area and lack of natural vegetation and suitable habitat. Bat: Tree and vegetation clearing within the Oceanside POI parcel and the EW 2 Onshore Substation C site will occur between October and March. For any proposed clearing activities outside of this window, an acoustic and visual roosting tree survey plan will be developed, which includes emergence counts within 24 hours of tree removal to confirm absence of roosting northern long-eared bats.	Avian & Bat Species	Construction & Decommissioning
79	Time of year restrictions	Trees greater than 3 inches diameter at breast height, and identified as suitable bat habitat, will not be cleared from June 1 to July 31.	Avian & Bat Species	Construction & Decommissioning
80	Lighting restrictions	Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction of avian and bat species.	Avian & Bat Species	Construction & Decommissioning
81	Bird deterrent devices	Installation of bird deterrent devices, where appropriate, on offshore, above-water Project-related structures to minimize introduction of perching structures to the offshore environment.	Avian & Bat Species	Operations and Maintenance
82	Lighting restrictions	Lighting not required by the FAA and the USCG and for safety during offshore construction will be limited to reduce attraction of birds and bats, where practicable.	Avian & Bat Species	Construction, Operations and Maintenance, Decommissioning
83	Dead/injured bird reporting	An annual report will be submitted to DOI and USFWS by January 31, accounting for any dead or injured birds or 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.	Avian & Bat Species	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
84	OSRP	The development and enforcement of an ORSP (Appendix F).	Avian & Bat Species	Construction & Decommissioning
85	HDD or other trenchless technology	Consideration of the use of HDD or other trenchless technologies for installation of the export cable landfalls at EW 2 to avoid surficial disturbances.	Avian & Bat Species	Construction & Decommissioning
86	Monitoring program	Development of a 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.	Avian & Bat Species	Operations and Maintenance
87	Revegetation of disturbed areas	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.	Avian & Bat Species	Operations and Maintenance
88	ADLS	Lessee will use an FAA-approved ADLS, 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 impacts.	Avian & Bat Species	Operations and Maintenance
89	Avoidance of sensitive habitat	Avoiding, to the extent possible, siting structures (wind turbines, offshore substations, and submarine export and interarray cables) in areas of sensitive habitat, where feasible.	Benthic & Pelagic Resources	Pre-Construction
90	Spill prevention	Mitigation and avoidance measures to protect water quality, such as spill prevention.	Benthic & Pelagic Resources	Construction, Operations and Maintenance, Decommissioning
91	Designing lighting to avoid exposing wildlife to artificial light	Sensitive lighting schemes to minimize exposure of light.	Benthic & Pelagic Resources	Operations and Maintenance
92	Seasonal work window establishment	Establish seasonal work windows that avoid sensitive life stages, as feasible.	Benthic & Pelagic Resources	Pre-Construction
93	Silt curtains	Installing silt curtains is sensitive areas, as warranted by results of the sediment modeling.	Benthic & Pelagic Resources	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
94	Ramp-up pile driving	Using ramp-up pile driving protocols.	Benthic & Pelagic Resources	Construction & Decommissioning
95	Cable installation tools	Using cable installation tools during trenching/installing/ armoring cable activities that minimize the area and duration of sediment suspension, as feasible.	Benthic & Pelagic Resources	Construction & Decommissioning
96	HDD Plan	The use of HDD at export cable landfall at EW 2 to minimize physical disturbance of coastal habitats.	Benthic & Pelagic Resources	Construction & Decommissioning
97	HDD Plan	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.	Benthic & Pelagic Resources	Construction & Decommissioning
98	DPS vessels	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.	Benthic & Pelagic Resources	Construction & Decommissioning
99	OSRP	Using appropriate measures for vessel operation and implementing an OSRP, 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.	Benthic & Pelagic Resources	Construction & Decommissioning
100	Timing of construction	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.	Benthic & Pelagic Resources	Construction & Decommissioning
101	Cable burial to 4-6 feet depth	A commitment to sufficiently bury electrical cables (target 6 feet [1.2 meters]) 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.	Benthic & Pelagic Resources	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
102	Continued engagement with regulatory agencies and ENGOs	Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.	Benthic & Pelagic Resources	Construction, Operations and Maintenance, Decommissioning
103	OSRP	The development and enforcement of an OSRP (Appendix F).	Benthic & Pelagic Resources	Construction, Operations and Maintenance, Decommissioning
104	Scour protection	Installation of scour protection, as needed.	Benthic & Pelagic Resources	Construction
105	Continued engagement with agencies	Continued engagement with regulatory agencies, ENGOs, and other stakeholders on potential mitigation and best practices, as appropriate.	Marine Mammals & Sea Turtles	Construction & Decommissioning
106	seasonal closures	Seasonal pile driving closures.	Marine Mammals & Sea Turtles	Construction & Decommissioning
107	Ramp-ups, clearance & shut-down procedures	Ramp-up measures when impact pile driving is initiated.	Marine Mammals & Sea Turtles	Construction & Decommissioning
108	pre-clearance	Pre-clearance prior to the initiation of pile driving to ensure marine mammals are not located within relevant impact zones when pile driving begins.	Marine Mammals & Sea Turtles	Construction & Decommissioning
109	pile driving shutdown	Shutdown of impact pile driving based on confirmed detection of marine mammals within relevant impact zones, when feasible.	Marine Mammals & Sea Turtles	Construction & Decommissioning
110	Monitoring and exclusion zones	Establishment of clearance and shutdown zones enforced by: o Qualified NOAA Fisheries approved PSOs; o Real-time monitoring systems, as appropriate; o Use of PAM systems; and o Use of reduced visibility monitoring tools/technologies (e.g., night vision, infrared and/or thermal cameras)	Marine Mammals & Sea Turtles	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
111	PSOs	PSOs will be stationed at the pile driving platform/vessel as well as on a dedicated PSO vessel.	Marine Mammals & Sea Turtles	Construction & Decommissioning
112	Noise reducing technologies	Use of commercially available and technically feasible noise attenuation technologies to reduce pile driving noise.	Marine Mammals & Sea Turtles	Construction & Decommissioning
113	Speed restrictions	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.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
114	Speed restrictions	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.	Marine Mammals & Sea Turtles	Construction & Decommissioning
115	Vessel collision avoidance mitigation measures	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.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
116	Reference materials	Reference materials will be provided on board all Project vessels for identification of marine mammals.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
117	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	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.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
118	PSOs and/or Project personnel will check NOAA's website daily for any update on DMAs/Slow Zones	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.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
119	Sightings of North Atlantic right whales will be immediately reported the NOAA Fisheries North Atlantic Right Whale Sighting Advisory System	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).	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
120	All crew members responsible for navigation duties must receive site-specific training	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.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
121	Following regulation for at-sea discharge and vessel-generated waste	Project-related vessels will operate in accordance with laws regulating the at-sea discharges of vessel-generated waste.	Marine Mammals & Sea Turtles	Construction, Operations and Maintenance, Decommissioning
122	Avoidance of sensitive habitat	Siting of Project-components to avoid and minimize impacts to habitat of high value to marine mammals, directly and indirectly, to the greatest extent practicable.	Marine Mammals & Sea Turtles	Construction & Decommissioning
123	Use of dedicated lookout to reduce risk of collision	Use dedicated trained crew members lookout (independent of fulfilled by PSO[s] for applicable activities) to help reduce the risk of collision under certain circumstances.	Marine Mammals & Sea Turtles	Operations and Maintenance
124	Monitoring program development	Development of appropriate monitoring program(s) in close coordination with regulatory agencies and stakeholders.	Marine Mammals & Sea Turtles	Operations and Maintenance
125	Use of SOV concept	Use of SOV concept, supported by CTV(s), to reduce vessel traffic associated with Operations and Maintenance for the Project, if technically and commercially feasible.	Marine Mammals & Sea Turtles	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
126	buffer area for identified potential submerged archaeological resources	Implementation of a horizontal buffer of at least 164 ft (50 m) for identified potential submerged archaeological resources, unless further investigation and/or consultation with the appropriate authorities deems this unnecessary.	Marine Archaeological Resources	Construction, Operations and Maintenance, Decommissioning
127	Engagement with Tribes and cultural resource stakeholders	Additional evaluation of appropriate measures regarding paleolandscape features to be addressed with regulatory authorities, and informed by engagement with Tribes and cultural resource stakeholders.	Marine Archaeological Resources	Construction, Operations and Maintenance, Decommissioning
128	Siting in disturbed areas	Avoidance of culturally sensitive terrestrial archaeological resources by siting Project components in existing ROWs and previously disturbed areas, to the extent practicable.	Terrestrial Archaeological Resources	Construction & Decommissioning
129	An archaeologist will be present to monitor during ground-disturbing activities	An archaeological monitor will be present to monitor during ground-disturbing activities associated with onshore export cable trench excavations at EW 1 and EW 2.	Terrestrial Archaeological Resources	Construction & Decommissioning
130	Unanticipated Discoveries Plan	The development and implementation of an Unanticipated Discoveries Plan, which will be developed in coordination with federal and state agencies and the Tribes. The Unanticipated Discoveries Plan will be in accordance with state laws and will outline the procedures to follow if archaeological materials or human remains are discovered during construction activities, including contact information and reporting protocols if unanticipated discoveries are identified.	Terrestrial Archaeological Resources	Construction & Decommissioning
131	Outreach/engagement with Tribes and stakeholders	Continued outreach and engagement with relevant agencies, interested Tribes, and other stakeholders throughout the construction process to identify appropriate mitigation and monitoring measures during ground-disturbing activities, if deemed necessary.	Historic Properties & Architectural Properties	Construction & Decommissioning
132	Siting in disturbed areas	Avoidance of sensitive historic resources by siting onshore Project components in highly developed and previously disturbed areas to the extent practicable.	Historic Properties & Architectural Properties	Construction & Decommissioning
133	Following regulation for marking and lighting of above-water offshore components	Marking and lighting of above water offshore Project components will be consistent with regulatory requirements and guidance (see Section 3 for additional details on the proposed marking and lighting measures).	Historic Properties & Architectural Properties	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
134	Wind turbine design and appearance to follow BOEM recommendations	Wind turbine design and appearance will be in line with mitigation measures recommended by BOEM (2007).[1]	Historic Properties & Architectural Properties	Operations and Maintenance
135	Siting in disturbed areas	Onshore components have been proactively sited in highly developed and previously disturbed areas, where feasible, where they will introduce less visual contrast relative to their surroundings.	Visual Resources	Construction & Decommissioning
136	Vegetative screening	Vegetative screening, as needed, at the onshore substation sites to help screen views of the onshore substation by nearby residents, subject to New York and New Jersey permitting requirements.	Visual Resources	Construction & Decommissioning
137	Marking/lighting/painting WTGs according to regulations	Marking and lighting and paint color of above water offshore Project components will be consistent with regulatory requirements and guidance (see Section 3 for additional details on the proposed marking and lighting measures).	Visual Resources	Operations and Maintenance
138	Wind turbine design and appearance to follow BOEM recommendations	Wind turbine design and appearance will be in line with mitigation measures recommended by BOEM (2007).[1]	Visual Resources	Operations and Maintenance
139	Lighting design to reduce light pollution	Lighting at the onshore substation site will be designed to reduce light pollution, where feasible (e.g., downward lighting, motion-detecting sensors).	Visual Resources	Operations and Maintenance
140	Use of design standards of Waterfront Revitalization Program	The EW 1 onshore substation and O&M Base will meet the design standards set forth in the Waterfront Revitalization Program policies, as applicable (see Appendix AA).	Visual Resources	Operations and Maintenance
141	ADLS	Implementation of an ADLS on turbines (or a similar system) to turn the aviation obstruction lights on and off in response to detection of nearby aircraft, as a base case, pending commercial availability, technical feasibility, and agency review and approval.	Visual Resources	Operations and Maintenance

[1] BOEM (Bureau of Ocean Energy Management). 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternative Use of Facilities on the Outer Continental Shelf – Final Environmental Impact Statement, Section 5 Potential Impacts of Alternative Energy Development. Available online at: https://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Alt_Energy_FPEIS_VolIIFrontMatter.aspx. Accessed May 23, 2019.

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
142	Vegetative screening	Vegetative screening, as needed, along the north side of the EW 2 Onshore Substation A site to help screen views of the substation by nearby residents, subject to New York and New Jersey permitting requirements.	Visual Resources	Operations and Maintenance
143	Siting in disturbed areas	Installation of onshore components within existing ROWs and within previously developed areas designated for such uses, to the extent practicable.	Population, Economy, Employment, and Housing and Property Values	Construction & Decommissioning
144	Siting in disturbed areas	Installation of onshore components within existing ROWs and within previously developed areas designated for such uses, to the extent practicable.	Land Use and Zoning	Construction & Decommissioning
145	Development of a Traffic Management Plan	The development of a Traffic Management Plan, to be developed in coordination with, and approved by, the affected local municipalities, as applicable.	Land Use and Zoning	Construction & Decommissioning
146	Security measures on active construction sites	The addition of security measures to monitor, and proper marking of, active construction sites, as deemed necessary.	Land Use and Zoning	Construction & Decommissioning
147	Local community updates and communication	Regular updates to the local community through social media and public notices and/or other appropriate communications tools.	Land Use and Zoning	Construction & Decommissioning
148	Coordination with agencies, officials, and stakeholders for future land development plans	Coordination with appropriate local and municipal agencies, officials, and stakeholders, in consideration of future land development plans.	Land Use and Zoning	Operations and Maintenance
149	Marking of onshore components	The onshore components will be properly marked.	Land Use and Zoning	Operations and Maintenance
150	Restoration of onshore project area	The onshore Project Area will be restored to conditions consistent with approvals from local authorities and/or property owners.	Land Use and Zoning	Operations and Maintenance
151	Minimize impacts to public access in the EW 2 onshore substation design, as feasible	Empire will evaluate minimizing impacts to public access in the EW 2 onshore substation design, as feasible.	Land Use and Zoning	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
152	Security measures on active construction sites and security vessels monitoring	The addition of security vessels monitoring, and proper marking of, active construction sites.	Recreation and Tourism	Construction & Decommissioning
153	Development of a Traffic Management Plan	The development of a Traffic Management Plan, to be developed in coordination with, and approved by, the affected local municipalities.	Recreation and Tourism	Construction & Decommissioning
154	Local community updates and communication	Regular updates to the local community through the issuance of LNMs, social media, public notices, and/or other appropriate communications tools.	Recreation and Tourism	Construction & Decommissioning
155	Marking of wind turbines and offshore substations with USCG/PATON requirements	The wind turbines and offshore substations will be properly marked in accordance with USCG guidance, including the PATON requirements (see Section 3 for additional details on the proposed marking and lighting measures).	Recreation and Tourism	Operations and Maintenance
156	Vessels will not be restricted from entering the operational wind farms areas	Vessels will not be restricted from entering the operational wind farms areas, and as a result, these structures may attract local charters for sightseeing and recreational fishing.	Recreation and Tourism	Operations and Maintenance
157	Local community updates and communication	Regular updates to the local community through social media, public notices, and/or other appropriate communications tools.	Environmental Justice	Construction, Operations and Maintenance, Decommissioning
158	Siting in disturbed areas	Installation of onshore components within existing ROWs and within previously developed areas designated for such uses, to the extent practicable.	Environmental Justice	Construction, Operations and Maintenance, Decommissioning
159	Development of a Traffic Management Plan	The development of a Traffic Management Plan, to be developed in coordination with, and approved by, the affected local municipalities, as applicable.	Environmental Justice	Construction, Operations and Maintenance, Decommissioning
160	Development of a Traffic Management Plan	The development of a Traffic Management Plan, to be developed in coordination with, and approved by, the affected local municipalities, as applicable.	Land Transportation and Traffic	Construction, Operations and Maintenance, Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
161	Development of Project-related vehicle routes	The development of Project-related vehicle routes to and from construction sites, which are consistent with allowable uses, to the extent practicable.	Land Transportation and Traffic	Construction, Operations and Maintenance, Decommissioning
162	Highly visible lighting/marking of active construction sites	Highly visible marking and lighting of active construction sites.	Land Transportation and Traffic	Construction, Operations and Maintenance, Decommissioning
163	Establishment of temporary, localized construction zones	Temporary, localized construction zones to minimize areas or sections of road closure.	Land Transportation and Traffic	Construction, Operations and Maintenance, Decommissioning
164	Local community updates and communication	Regular updates to the local community through social media, public notices, and/or other appropriate communications tools.	Land Transportation and Traffic	Construction, Operations and Maintenance, Decommissioning
165	Consultation with DoD Clearinghouse	Continue consultation with DoD Clearinghouse, including the engagement of a formal Mitigation Agreement process to offset identified impacts to radar systems. On July 29, 2020, Empire received a request from the DoD Clearinghouse to enter into a partnership to initiate mitigation discussion for potential impacts resulting from the construction and installation of the Project. Empire intends to enter into this partnership, responding with a confirmation letter on August 19, 2020. Empire met with the DoD in November 2021 and discussions are ongoing to finalize the mitigation agreement.	Aviation	Construction & Decommissioning
166	Minimize and/or mitigate potential impacts to high frequency weather & current radar systems	Coordination with NOAA to minimize, and/or mitigate potential impacts to high frequency weather and current radar systems.	Aviation	Construction & Decommissioning
167	Direction communication with applicable agencies and personnel to alert of construction movements	Direct communication with applicable agencies and personnel to alert the appropriate parties to planned construction movements and actions.	Aviation	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
168	Marking/lighting of wind turbines and construction equipment in accordance with FAA's Advisory Circular number 70/7460-1L	All wind turbines and construction equipment will be properly lit and marked in accordance with FAA's Advisory Circular number 70/7460-1L within FAA jurisdiction and beyond, or other methods as deemed required during consultation and as applicable (see Section 3 for additional information on proposed marking and lighting measures.	Aviation	Construction, Operations and Maintenance, Decommissioning
169	Regular communication/updates with key aviation stakeholders and with DoD Clearinghouse	Regular communications and updates with key aviation stakeholders, including the DoD Clearinghouse, on wind turbine locations. On July 29, 2020, Empire received a request from the DoD Clearinghouse to entire a partnership to initiate mitigation discussion for potential impacts resulting from the construction and installation of the Project. Empire intends to enter into this partnership, responding with a confirmation letter on August 19, 2020. Empire met with the DoD in November 2021 and discussions are ongoing to finalize the mitigation agreement.	Aviation	Operations and Maintenance
170	Continued consultation with stakeholders	Continued consultation with stakeholders, including but not limited to: the USCG, New York Vessel Traffic Service, PANYNJ, and the USACE on best practices.	Marine Transportation and Navigation	Construction & Decommissioning
171	Highly visible lighting/marking of active construction sites	Highly visible marking and lighting of active construction sites.	Marine Transportation and Navigation	Construction & Decommissioning
172	Vessel compliance with international and flag state regulations	Compliance by vessels associated with the Project with international and flag state regulations including the COLREGs and the SOLAS.	Marine Transportation and Navigation	Construction & Decommissioning
173	Compliance with existing uses and management of surrounding waterway	Utilization of existing TSSs, maintained channels, and transit lanes by vessels associated with the Project to comply with existing uses and management of the surrounding waterway, to the extent practicable.	Marine Transportation and Navigation	Construction & Decommissioning
174	Completion of a Cable Installation Plan	Completion of a Cable Installation Plan, detailing how cable installation will be managed to ensure disruption is minimized, in particular within port approaches.	Marine Transportation and Navigation	Construction & Decommissioning
175	Completion of a Construction Method Statement	Completion of a Construction Method Statement, detailing specific construction logistics between New York ports and the Lease Area, inclusive of transport configuration, vessels, and schedule of transport operations.	Marine Transportation and Navigation	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
176	Contract agreement that all construction vessels be equipped with working AIS transceivers at all times	Inclusion by Empire of a requirement in contracts that all construction vessels be equipped with working AIS transceivers at all times.	Marine Transportation and Navigation	Construction & Decommissioning
177	Marine coordination for vessels	Marine coordination for vessels associated with the Project (i.e., a central coordination hub from which all Project vessel movements will be managed, and third-party traffic will be monitored).	Marine Transportation and Navigation	Construction & Decommissioning
178	Minimum advisory safe passing distances for cable laying vessels	Minimum advisory safe passing distances for cable laying vessels (where feasible).	Marine Transportation and Navigation	Construction & Decommissioning
179	Monitoring of third-party vessel traffic by AIS	Monitoring of third-party vessel traffic by AIS.	Marine Transportation and Navigation	Construction & Decommissioning
180	Implementation of a safety zone around active construction sites	The implementation of up to a 1,640-ft (500-m) safety zone around active construction sites (including partially installed wind turbines) pending agreement with USCG.	Marine Transportation and Navigation	Construction & Decommissioning
181	Creation/Implementation of an SMS	Creation and implementation of an SMS (**Appendix G**).	Marine Transportation and Navigation	Construction & Decommissioning
182	Implementation of Layout Rules	Implementation of the Layout Rules (see **Section 3**) during layout design process, most notably: - One nautical mile separation between wind farm and the edge of the TSS lanes. - Straight line edges parallel to TSS lanes (no isolated or protruding turbines). - At least one line of orientation in final layout.	Marine Transportation and Navigation	Construction & Decommissioning
183	Regular updates to the local marine community regarding positions of installation activities	Regular updates, including the positions of installed and partially installed structures, to the local marine community through social media, the USCG LNM, and active engagement with Maritime Association of the Port of New York and New Jersey Harbor Safety, Navigation, and Operations Committee.	Marine Transportation and Navigation	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
184	Ongoing consultation with stakeholders	Ongoing consultation with stakeholders, in particular, in relation to the submarine export cable(s).	Marine Transportation and Navigation	Construction & Decommissioning
185	Use of buoys/support vessels to mark temporary working areas	The potential use of buoys and/or support vessels to mark temporary working areas or potential hazards (e.g., partially-installed structures).	Marine Transportation and Navigation	Construction & Decommissioning
186	Project Support Vessel monitoring	The operation of Project Support Vessels monitoring and communicating with vessels operating in the area.	Marine Transportation and Navigation	Construction & Decommissioning
187	Regular updates to the local marine community on safety zones	Regular safety zone updates to the local marine community through social media, the USCG LNM, and active engagement with Maritime Association of the Port of New York and New Jersey Harbor Safety, Navigation, and Operations Committee.	Marine Transportation and Navigation	Construction & Decommissioning
188	Dynamic construction and safety zones	Dynamic construction and safety zones where feasible, focusing on sites being actively worked on, to minimize the extent of the affected area.	Marine Transportation and Navigation	Construction & Decommissioning
189	Marking of wind turbines and offshore substations with USCG/BOEM requirements	The wind turbines and offshore substation will be properly marked and lit in accordance with IALA O-139 and USCG/BOEM requirements, unless a variance is approved by the applicable agency prior to construction (see Section 3 for additional details on the proposed marking and lighting measures).	Marine Transportation and Navigation	Operations and Maintenance
190	Project Layout Rules	Project Layout Rules will be implemented to facilitate ease of navigation in and around the wind farm to minimize allision risk.	Marine Transportation and Navigation	Operations and Maintenance
191	1nm separation distance from vessel traffic within neighboring TSS lanes	Project-enacted "Developable Area" will facilitate a 1-nm (1.8-km) separation distance from vessel traffic within neighboring TSS lanes.	Marine Transportation and Navigation	Operations and Maintenance
192	Updates to NOAA on location of applicable project infrastructure	Information will be provided to NOAA so that charts (nautical and electronic) can be updated with the location of applicable Project infrastructure.	Marine Transportation and Navigation	Operations and Maintenance
193	Minimum blade clearance of 85 ft for wind turbines	Wind turbines will have a minimum blade clearance of 85 ft (26 m) above mean higher high water.	Marine Transportation and Navigation	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
194	Vessel compliance with international and flag state regulations	Compliance by vessels associated with the Project with international and flag state regulations including the COLREGs and the SOLAS.	Marine Transportation and Navigation	Operations and Maintenance
195	Development and implementation of an ERP	The development and implementation of an ERP.	Marine Transportation and Navigation	Operations and Maintenance
196	Marine coordination for vessels	Marine coordination for vessels associated with the Project (i.e., a central coordination hub from which all Project vessel movements will be managed, and third-party traffic will be monitored).	Marine Transportation and Navigation	Operations and Maintenance
197	Compliance with existing uses and management of surrounding waterway	Utilization of existing TSSs, maintained channels, and transit lanes by vessels associated with the Project to comply with existing uses and management of the surrounding waterway, to the extent practicable.	Marine Transportation and Navigation	Operations and Maintenance
198	Closed circuit television for site monitoring	Closed circuit television installed on certain structures within the array for the purpose of monitoring activity within the site.	Marine Transportation and Navigation	Operations and Maintenance
199	Communication with fisherman on location of project structures	Locations of the wind farm structures will be provided directly to fishermen for the purpose of displaying the wind farm electronically via their on-board equipment.	Marine Transportation and Navigation	Operations and Maintenance
200	Facilitation of USCG SAR trials	Facilitation of USCG SAR trials within and near the Lease Area.	Marine Transportation and Navigation	Operations and Maintenance
201	Operational SAR Procedures	Operational SAR Procedures in place that detail how the Project will cooperate with USCG in the event of an emergency situation.	Marine Transportation and Navigation	Operations and Maintenance
202	Development of a marine pollution contingency plan	The development of a marine pollution contingency plan (e.g., **Appendix F Oil Spill Response Plan**).	Marine Transportation and Navigation	Operations and Maintenance
203	Establishment of operational procedures for Project vessels	The establishment of operational procedures for Project vessels such as entry/exit points and designated routes.	Marine Transportation and Navigation	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
204	Provision of self-help capability	Provision of self-help capability (i.e., any onshore or vessel/turbine-based resources or facilities available to Empire that may assist in the event of an emergency).	Marine Transportation and Navigation	Operations and Maintenance
205	Cable routing study	Cable routing study, including geophysical and geotechnical surveys, stakeholder input and environmental and social constraints to develop submarine export cable routes that avoid or minimize interactions with anchorage areas.	Marine Transportation and Navigation	Operations and Maintenance
206	Completion of a Cable Installation Plan	Completion of a Cable Installation Plan, detailing how cable installation will be managed to ensure disruption is minimized, in particular within port approaches, and monitored once installation is complete.	Marine Transportation and Navigation	Operations and Maintenance
207	Completion of a CBRA	Completion of a CBRA to identify appropriate cable burial depths and to identify any needs for additional cable protections.	Marine Transportation and Navigation	Operations and Maintenance
208	Periodic monitoring of cable burial and protection measures	Periodic monitoring of cable burial and protection measures to ensure they remain effective, with regular monitoring of protection in vicinity of areas of existing anchoring as identified within the cable burial risk assessment.	Marine Transportation and Navigation	Operations and Maintenance
209	Potential real-time monitoring of Project cable assets	Potential real-time monitoring of Project cable assets using AIS to proactively notify vessels of potential interactions.	Marine Transportation and Navigation	Operations and Maintenance
210	Implementation of a Fisheries Mitigation Plan	Continued implementation of a Fisheries Mitigation Plan throughout the construction process to alert local fishing industries to relevant construction activities through the use of in-person communications, social media, website communications, and LNMs.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
211	Cable route planning	Cable route planning to avoid areas of hard or steep seabed where burial is difficult, if those areas coincide with high fishing activity.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
212	Rolling construction zones	Utilization of rolling construction zones to minimize areas closed off to fishing.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
213	Minimize overlap with areas/time of high activity	Where feasible, planning the location and timing of construction activities that minimize overlap with areas or times of high activity.	Commercial Fisheries & Recreational Fishing	Pre-Construction
214	Continued engagement with fishing industry	Continued active engagement with the fishing industry on the timing and location of construction so that they can, where possible, elect to fish in other areas and plan accordingly.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
215	Continued use of offshore OFLRs	Continued use of offshore OFLRs to facilitate communications with the fishing community.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
216	Continued communications between FLO and	Continued communications between FLO and fisheries on the areas of temporary construction closures, when they are re-opened, updates on schedules through email serves, flyers, websites.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
217	CBRA	A CBRA to determine sufficient burial depth along the submarine export cable route and, where target burial depth cannot be reached, secondary protection shall be considered.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
218	Identification of sensitive spawning and fishing periods	Continued work with the fishing industry and fisheries agencies to identify sensitive spawning and fishing periods to actively avoid or reduce interaction with receptors during construction, where feasible.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
219	Marking of wind turbines and offshore substations with USCG/BOEM requirements	Marking and lighting all wind turbines and offshore substations in accordance with USCG, BOEM, and IALA O-139 guidance.	Commercial Fisheries & Recreational Fishing	Construction, Operations and Maintenance, Decommissioning
220	Safety vessel	Utilization of a safety vessel to alert mariners to safety zones and/or active construction areas where appropriate.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
221	Safety zones	Implementation of 1,640-ft (500-m) safety zones around relevant structures, activities, and vessels in a dynamic approach, as previously defined for the Block Island Wind Farm (81 FR 31862). Should USCG Safety Zone authorities not extend beyond 12 nm (22 km) at the time of construction, Empire will utilize a combination of safety vessels, LNMs, and COLREGS to promote both awareness of these activities and the safety of the construction equipment and personnel.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
222	AIS	Installation of operational AIS on all vessels associated with the construction and operation of the Project.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
223	TSS usage	Project construction vessels will utilize, to the extent practicable, the surrounding TSSs while transiting to and from the Lease Area.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
224	Temporary lighting as an alert	Temporary lighting and marking may be used during the construction phase to alert mariners to areas under construction.	Commercial Fisheries & Recreational Fishing	Construction & Decommissioning
225	Continued communications and alerts to fishing industry	In the event of maintenance within the offshore environment, the Project will alert the fishing industry to the occurrence of these activities. Communication methods will include the use of FLOs, social media, website communications, and LNM.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
226	Layout Rules	The Project will utilize the Layout Rules (as described in **Section 3**) to achieve wind farm layouts, wind turbine spacing and lines of orientation within the array that facilitate continued access to traditional fishing grounds.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
227	Submarine export and interarray cables	Submarine export and interarray cables will be buried to a target burial depth of 6 ft (1.8 m).	Commercial Fisheries & Recreational Fishing	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
228	Following installation of the submarine	Following installation of the submarine export and interarray cables, the Project will conduct cable burial surveys at appropriate intervals to assess if target burial depth is being maintained.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
229	Micro-siting of the submarine	Micro-siting of the submarine export cable route to further reduce potential impacts on sensitive habitats and minimize areas where burial is more challenging.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
230	Regular updates to the local	Regular updates to the local marine community through Project websites, social media, the USCG LNM and active engagement with other stakeholders.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
231	To minimize risk of anchors	To minimize risk of anchors and fishing gear snagging the submarine export cable, the submarine export cable route has been routed to target areas where chances of burial are improved.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
232	Limited use of concrete mattresses	The use of concrete mattresses as surface cable protection will be limited.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
233	Project component locations provided to NOAA	All submarine export cable, interarray cable, wind turbine, and offshore substation locations will be provided to NOAA and updated on nautical charts appropriately.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
234	Project component marked for navigation	To the extent practicable and in consultation with the fishing industry, turbine locations and cable routes will be marked on the most common types of software used by fishermen for navigation and fishing.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance
235	Installation of AIS signals on WTGs	Installation of AIS signals on turbines, as appropriate, to facilitate safe navigation.	Commercial Fisheries & Recreational Fishing	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
236	Vessel usage of existing waterways	Project vessels will utilize transit lanes, fairways, and predetermined passage plans consistent with existing waterway uses, to the extent practicable.	Department of Defense and OCS National Security Maritime Uses	Construction & Decommissioning
237	Regular communications and updates will occur with key national security maritime stakeholders	Regular communications and updates will occur with key national security maritime stakeholders on Project-related construction vessel activities.	Department of Defense and OCS National Security Maritime Uses	Construction & Decommissioning
238	Active engagement with key national security stakeholders	Active engagement with key national security stakeholders including U.S. Fleet Forces, the USCG, and U.S. Navy Office of Cable Protection will take place. This engagement will be conducted through the DoD Clearinghouse, with an increase in frequency expected as Empire moves closer to commencement of construction activities. On July 29, 2020, Empire received a request from the DoD Clearinghouse to enter into a partnership to initiate mitigation discussion for potential impacts resulting from the construction and installation of the Project. Empire intends to enter into this partnership, responding with a confirmation letter on August 19, 2020.	Department of Defense and OCS National Security Maritime Uses	Construction & Decommissioning
239	Dynamic construction and safety zones	Dynamic construction and safety zones will be implemented where feasible, focusing on sites being actively worked on, to minimize the extent of the affected area.	Department of Defense and OCS National Security Maritime Uses	Construction & Decommissioning
240	Partially constructed structures and safety zones marked and lit in accordance with IALA O-139/BOEM/USCG guidance	Partially constructed structures and safety zones will be properly marked and lit in accordance with IALA O-139, USCG requirements, and the 2021 BOEM Lighting/Marking Guidance (see **Section 3** for additional details on the proposed marking and lighting measures).	Department of Defense and OCS National Security Maritime Uses	Construction, Operations and Maintenance, Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
241	Updates to NOAA on as-built information	As-built information will be provided to NOAA Fisheries to support necessary updates to navigation charts in coordination with NOAA Fisheries and other stakeholders as needed.	Department of Defense and OCS National Security Maritime Uses	Operations and Maintenance
242	Coordination with USCG to facilitate training exercises	Empire will work with the USCG to facilitate training exercises within the operational wind farm, as requested.	Department of Defense and OCS National Security Maritime Uses	Operations and Maintenance
243	Regular communication with key national security stakeholders, including the DoD Clearinghouse	Regular communication and updates will occur with key national security stakeholders, including the DoD Clearinghouse on the timing and location of maintenance activities and Project-related activities that may affect national security operations.	Department of Defense and OCS National Security Maritime Uses	Operations and Maintenance
244	Safety zones up to 1,640 ft (500 m) around active construction sites.	Implement safety zones up to 1,640 ft (500 m) around active construction sites.	Marine Energy and Infrastructure	Construction & Decommissioning
245	Operation of security/support vessels during construction activities	Operate security/support vessels, where appropriate, to monitor and communicate with vessels operating in the area during periods of construction activity.	Marine Energy and Infrastructure	Construction & Decommissioning
246	Highly visible lighting/marking of active construction sites	Use highly visible marking and lighting of active construction sites.	Marine Energy and Infrastructure	Construction & Decommissioning
247	Regular updates to the local marine community	Regular updates to the local marine community through Project websites, social media, the USCG LNM and active engagement with other stakeholders.	Marine Energy and Infrastructure	Construction, Operations and Maintenance, Decommissioning
248	Siting to avoid sensitive habitats, recks, reefs, other structures	Site Project-related components to avoid sensitive habitats, wrecks, reefs, and other structures that support offshore marine uses to the extent practicable.	Marine Energy and Infrastructure	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
248	Siting to avoid sensitive habitats, recks, reefs, other structures	Site Project-related components to avoid sensitive habitats, wrecks, reefs, and other structures that support offshore marine uses to the extent practicable.	Marine Energy and Infrastructure	Construction & Decommissioning
249	Marking of wind turbines and offshore substations with USCG/BOEM requirements	Marking of wind turbines and offshore substations in accordance with IALA O-139, USCG requirements, and the 2021 BOEM Lighting/Marking Guidance (see **Section 3** for additional details on the proposed marking and lighting measures).	Marine Energy and Infrastructure	Operations and Maintenance
250	Vessel transit will not be restricted and may provide recreational opportunities	Vessels will not be restricted from entering the operational wind farms areas, and as a result these structures may attract local charters for sightseeing and recreational fishing.	Marine Energy and Infrastructure	Operations and Maintenance
251	Provision of locations of structures for inclusion in NOAA charts	Provision of locations of structures for inclusion in NOAA charts.	Marine Energy and Infrastructure	Operations and Maintenance
252	Implementation of a safety zone around active construction sites	Implement safety zones up to 1,640 ft (500 m) around active construction sites.	Other Coastal and Marine Uses	Construction & Decommissioning
253	Operation of security/support vessels during construction activities	Operate security/support vessels, where appropriate, to monitor and communicate with vessels operating in the area during periods of construction activity.	Other Coastal and Marine Uses	Construction & Decommissioning
254	Highly visible lighting/marking of active construction sites	Use highly visible marking and lighting of active construction sites.	Other Coastal and Marine Uses	Construction & Decommissioning
255	Regular updates to the local marine community	Regular updates to the local marine community through Project websites, social media, the USCG LNM and active engagement with other stakeholders.	Other Coastal and Marine Uses	Construction, Operations and Maintenance, Decommissioning
256	Siting to avoid sensitive habitats, recks, reefs, other structures	Site Project-related components to avoid sensitive habitats, wrecks, reefs, and other structures that support offshore marine uses to the extent practicable.	Other Coastal and Marine Uses	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
257	Marking of wind turbines and offshore substations with USCG/BOEM requirements	Marking of wind turbines and offshore substations in accordance with IALA O-139, USCG requirements, and the 2021 BOEM Lighting/Marking Guidance (see **Section 3** for additional details on the proposed marking and lighting measures).	Other Coastal and Marine Uses	Operations and Maintenance
258	Vessels will not be restricted from entering the operational wind farms areas	Vessels will not be restricted from entering the operational wind farms areas, and as a result these structures may attract local charters for sightseeing and recreational fishing.	Other Coastal and Marine Uses	Operations and Maintenance
259	Provision of locations of structures for inclusion in NOAA charts	Provision of locations of structures for inclusion in NOAA charts.	Other Coastal and Marine Uses	Operations and Maintenance
260	Design of project components to withstand extreme conditions	Project infrastructure and equipment will be designed to be able to withstand extreme conditions, and will be protected both externally and internally by a lightning protection system.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
261	Development of an emergency evacuation plan	Development and implementation of an emergency evacuation plan that will be incorporated into the overall site ERP.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
262	Restricted access	Restrict access to both onshore and offshore work sites to authorized and qualified personnel.	Public Health and Safety	Construction & Decommissioning
263	Implementation of	Implement up to a 1,640-ft (500-m) safety zone around active offshore construction sites.	Public Health and Safety	Construction & Decommissioning
264	Implementation of a safety zone around active construction sites	Implement safety zones around active onshore construction sites.	Public Health and Safety	Construction & Decommissioning
265	Prevention of unauthorized access	Secure onshore construction sites with a fence and lock to prevent unauthorized access.	Public Health and Safety	Construction & Decommissioning
266	Securing construction equipment	Securing construction equipment within fenced work areas.	Public Health and Safety	Construction & Decommissioning
267	Security monitoring onshore/offshore	Use of security to monitor both onshore and offshore construction sites.	Public Health and Safety	Construction & Decommissioning

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
268	Spill response kits	Construction sites will contain spill response kits.	Public Health and Safety	Construction & Decommissioning
269	Use of secondary containment for oils and greases	Use of secondary containment for oils and greases in accordance with all state and federal regulations.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
270	Transport hazardous materials in water-tight containers	Transport hazardous materials in water-tight containers.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
271	Training program for Project personnel	Train Project personnel, as applicable, in accordance with relevant regulations and company policy, including the site-specific emergency evacuation routes, warning signals, locations of fire extinguishers and first aid kits, as well as the chain of command.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
272	Lighting/marking of construction sites for safety	Construction sites will be clearly marked and lighted, in a manner sufficient to safeguard personnel and public safety.	Public Health and Safety	Construction & Decommissioning
273	Project-specific SMS development	Development and implementation of a Project specific SMS.	Public Health and Safety	Construction, Operations and Maintenance, Decommissioning
274	SPCC and OSRP plans	Implementation of a SPCC Plan for onshore activities and OSRP for offshore activities that will be provided for agency review and approval, as applicable.	Public Health and Safety	Operations and Maintenance
275	Prevention of unauthorized access	Secure the onshore substation and O&M Base with a fence and lock to prevent unauthorized access.	Public Health and Safety	Operations and Maintenance
276	Marking of wind turbines and offshore substations with USCG/BOEM requirements	Marking of wind turbines and offshore substations in accordance with IALA O-139, USCG requirements, and the 2021 BOEM Lighting/Marking Guidance (see **Section 3** for additional details on the proposed marking and lighting measures).	Public Health and Safety	Operations and Maintenance

Table H-3 Summary Table (continued)

Measure Number	Measure	Description of Measure	Resource	Project Phase
277	Use of appropriate, agency-approved marking and lighting around the onshore substations and O&M Base	Use of appropriate, agency-approved marking and lighting around the onshore substations and O&M Base.	Public Health and Safety	Operations and Maintenance
278	Equip the base of turbine tower with a lock	Restrict access to the interior of the wind turbines and offshore substations by a locked door at the base of the tower.	Public Health and Safety	Operations and Maintenance
279	Restricted access	Only trained and qualified personnel will be allowed access to the onshore substations, wind turbines, and offshore substations to perform O&M activities.	Public Health and Safety	Operations and Maintenance
280	Spill response kits	Project sites will contain spill response kits.	Public Health and Safety	Operations and Maintenance

ATTACHMENT H-3
BIRD AND BAT MONITORING FRAMEWORK

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Empire Offshore Wind Projects (EW 1 and EW 2):
Proposed Bird and Bat Monitoring Framework

Submitted by:

M. Wing Goodale, Andrew T. Gilbert, Iain J. Stenhouse, and Merra Howe
Biodiversity Research Institute

Introduction

The purpose of this document is to propose a framework for monitoring measures for bird and bat species for an offshore wind facility located in Lease Area OCS-A 0512 (Lease Area)[1]. Empire Offshore Wind LLC (Empire) has prepared a Construction and Operations Plan (COP) to support the siting, development, and operation of two wind farms within the Lease Area, known as Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2; collectively referred to hereafter as the Project). The COP, as submitted to the Bureau of Ocean Energy Management (BOEM), provides information about the Project and is inclusive of potential impacts and corresponding environmental protection measures for bird and bat species as referred to at the time of COP preparation (Section 5.3). Empire anticipates that turbine installation for EW1 will occur in 2025–2026 and for EW2 2026–2027. This monitoring framework supplements the measures identified in the COP, is intended to cover both EW1 and EW2, and is focused solely on the offshore footprint of the Project within the Lease Area and surrounding waters.

Monitoring questions, equipment, and effort are detailed in Table 1. The monitoring approaches were selected to be consistent with existing permitted projects, technological limitations, and existing baseline data. Empire plans to deploy bat and bird acoustic detectors; deploy offshore and onshore Motus receivers, as well as provide funding to support tagging of target species (e.g., Endangered Species Act [ESA] listed birds, nocturnal migrants, terns, and/or bats); and conduct digital aerial surveys. Empire supports publishing the results in peer-reviewed journals after final reports have been submitted to federal agencies. **A detailed monitoring plan ("Post-Construction Monitoring [PCM] plan" hereafter) will be developed through ongoing discussion with stakeholders and regulators and will be coordinated with regional research efforts**. This framework is independent from environmental research commitments to NYSERDA as part of the EW 2 Purchase and Sale Agreement (PSA), but all offshore bird and bat monitoring efforts occurring at the Project will be coordinated. The detailed plan will include details on how monitoring timing will be related to the project phases.

[1] Little to no long-term impacts are expected from onshore wind activities (see COP Appendix Q and S), and it was thus determined that monitoring of such activities was not necessary.

Table 1. Monitoring Questions, Equipment, and Effort

Focal Group	EW Monitoring Questions	Equipment	Effort
Bats	• What species are present? • What time of year are bats active offshore? • How does activity vary between nacelle and turbine base? • How does bat activity relate to temperature and wind speed?	Acoustic Detectors	• *Start*: EW 2 operation • *Duration*: 2 years • *Frequency*: Nightly, March–December • *Coverage*: up to 6 turbines (nacelle and base)
Nocturnal Migratory Birds	• What vocalizing nocturnal songbird migrants are present? • What time of year are birds migrating offshore? • How is migratory activity related to weather?	Acoustic Detectors	• *Start*: EW 2 operation • *Duration*: 2 years • *Frequency*: Nightly, April–November • *Coverage*: 2 substations
ESA-listed Birds; other tagged birds and bats	• What ESA-listed species are present around the Lease Area? • What time of year are the animals present? • How is activity related to weather conditions?	Motus Receivers and Tags	• *Start*: EW 2 operation • *Duration*: up to 5 years • *Frequency*: Continuous, April–November • *Coverage*: # turbines TBD; 2–4 coastal stations; 300/tags year
Marine Birds	• What is the avoidance behavior of marine birds? • How does density vary across the Lease Area?	Digital Arial Surveys	• *Start*: EW 2 operation • *Duration*: 2 years • *Frequency*: Monthly • *Coverage*: 10%, 4 km buffer
Birds and Bats	• What dead or injured species are found incidentally?	Incidental Observations	Project lifetime

Bat Acoustic Monitoring

Bats have been documented offshore in the U.S. (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; BOEM 2013; Hatch et al. 2013; Dowling et al. 2017) and within the Lease Area (COP Appendix R: Bat Survey Report). A 2018 acoustic survey in the Lease Area provided a baseline characterization of the Lease Area prior to construction, including an inventory of the species present in the Area (see Appendix R in of the 2018 Bat Survey Report). However, questions remain about the extent to which bats may fly through the Lease Area after wind turbines are installed. Acoustic detectors installed at the offshore substation or wind turbine platforms (nacelle and base) can improve understanding of the following: (1) what species are present offshore; (2) what the time of year bats are active offshore; (3) how activity varies between the nacelle and wind turbine base; and (4) how bat activity is related to temperature and wind speed.

After EW 2 has started operation, acoustic monitoring will be conducted for at least two years. Effort will consider recommendations from the Regional Wildlife Science Collaborative and logistical constraints. While dependent on logistics and attachment options, up to 12 ultrasonic bat detectors will be installed at up to six wind turbines in the early spring or late winter (March) for each year of monitoring, and Empire will also consider installing acoustic detectors on construction vessels. The final research design will be described in the PCM plan and will include a power analysis (if necessary), location of detectors, data analysis protocols, and data storage protocols. Since studies in Europe demonstrate that bat activity varies between the wind turbine hub and transition platform (Brabant *et al.* 2018), paired detectors will be installed on both nacelle and wind turbine base, to the extent practicable. The detectors will record calls of both migratory tree bats and cave-hibernating bats, including the federally-listed northern long-eared bat (*Myotis septentrionalis*). All recorded acoustic data will be processed with approved software to filter out poor quality data and identify the presence of bat calls. Analysis will adhere to federal guidance as it evolves for northern-long eared bat as well for other species if ESA-listing status changes. All high frequency calls will then be classified by an acoustician. A balanced call review sampling approach will be taken over the two years of data collection, and data review is expected to take a reasonable amount of time.

Nocturnal Migratory Bird Acoustic Monitoring

Breeding songbirds can migrate over the Atlantic Outer Continental Shelf (Drury & Keith 1962, Adams, Lambert, *et al.* 2015, Adams, Chilson, *et al.* 2015), but there are questions about the extent to which migrants use the offshore environment, and how they will be exposed to the wind turbines in the Lease Area. Acoustic detectors have been used at offshore wind facilities (Hüppop *et al.* 2016) and are commonly used to study vocalizing songbird migration (Farnsworth 2005). Acoustic detectors installed at the offshore substation can improve understanding of the following: (1) what vocalizing nocturnal migratory songbird species are present; (2) what time of year are birds migrating offshore; and (3) how is migratory activity related to weather.

After EW 2 has started operation, two avian acoustic detectors will collect data for two spring to fall seasons. A detector will first be tested at a substation to determine if there is any sound interference. Contingent on a successful test, a detector will be installed at each of the two offshore substations—detectors will not be installed at wind turbines because the ambient noise would interfere with bird detection, and the number of detectors is limited by the number of substations. The acoustic data will be post-processed through a filter, and then a final species group identification will be conducted by a qualified avian biologist. Given the potential for large numbers of acoustic detections, the avian acoustic data will be sub-sampled to focus on peak migration periods and analysis will be limited to 400 hours, spread over the two years of data collection.

Motus Tracking Network and Tags

Tracking studies using onshore automated telemetry receiving stations (hereafter, Motus receivers and tags) have been conducted with birds listed under the ESA: Piping Plovers (*Charadrius melodus*), Red Knots (*Calidris canutus rufa*), and Roseate Terns (*Sterna dougallii;* Loring *et al.* 2019, Loring *et al.* 2018). However, the coastal Motus receivers had limited coverage offshore (Loring et al. 2019). Monitoring use of the Lease Area during operation with Motus receiving stations can improve the understanding on use of the Lease Area by ESA-listed birds, as well as other species carrying Motus tags, such as migratory songbirds, shorebirds, and bats.

Motus tracking studies can improve the understanding of the following: (1) what ESA-listed species are present around the Lease Area; (2) what time of year are the birds present; and (3) how is activity related to weather conditions.

Offshore Motus stations will be designed, operated, calibrated, and managed according to the current USFWS's Offshore Motus Guidance[2]. After EW 2 has started operation, monitoring of the Lease Area would be conducted up to five years. Monitoring would be targeted during the spring, summer, and fall, but could continue through the winter, depending on logistics. The number of turbines on which Motus receivers will be installed will be detailed in the PCM plan and based on the current USFWS Motus Guidance. Optimized coverage across both EW 1 and EW 2 will be determined using a design tool currently being developed through a New York State Energy Research and Development Authority (NYSERDA) funded project.[3] Empire will also support the maintenance and/or upgrading of two to four coastal receivers identified by USFWS. Motus tags (up to 300 per year) will be provided to researchers working with ESA-listed birds for at least three consecutive years. The specific species will be determined in consultation with BOEM and USFWS, and Empire will consider providing Motus tags to bat researchers. For the expected life of the supported tags, species presence/absence will be analyzed by comparing detections within the Lease Area to coastal and any other offshore towers. All detections will be analyzed to understand relationships with time of day, season, and weather conditions. Data will be compiled, analyzed, and reported based on recommendations in the current USFWS Offshore Motus Guidance, with a final complete analysis provided approximately six months following the end of the supported tag period projected tag-life.

Digital Aerial Surveys

Existing data provide baseline information on the exposure of birds to the Lease Area: (1) NYSERDA regional digital aerial surveys, (2) NYSERDA New York Wind Energy Area (WEA) specific digital aerial surveys, (3) Empire Wind Lease Area specific digital aerial surveys, and (4) version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models (Curtice *et al.* 2016)[4]. The digital aerial surveys covering the Lease Area conducted from 2016–2019 can be replicated post-construction because the aircraft flew above turbine height. Digital aerial surveys can improve understanding of the following: (1) what are the avoidance behaviors of marine birds exposed to the project and do birds identified as being vulnerable to displacement in Europe (e.g., auks) avoid large contemporary turbines which are spaced further apart; and (2) how does the density of birds vary across the Lease Area and are there higher concentrations of birds vulnerable to collision (e.g., gulls) around specific turbines. Digital aerial surveys are also useful in capturing distribution and abundance data for multiple taxa – e.g., birds, marine mammals, sea turtles, fish, bats – as well as human activities in the area, such as fishing vessel activity, and information on floating marine debris[5].

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[2] Specific protocols will be described in the Post-Construction Monitoring (PCM) plan.
[3] https://www.briloon.org/renewable/automatedvhfguidance
[4] MDAT models supported characterization of the lease area, but they will not be used in pre- and post-construction comparisons.
[5] Collection of information on floating marine debris is already a standard practice for the surveys.

After EW 2 has started operation, following the methods used for the baseline surveys and BOEM guidelines, digital aerial surveys would be conducted monthly for two years, and will have at least 10% coverage by area of the Lease Area, including a sample of the entire lease area, plus a 4 km buffer. A density analysis will be conducted for all species with sufficient detections for a pre- and post-construction comparison, and additional analyses may be conducted on species identified as having a higher exposure to impact-producing factors, as detailed in the Construction and Operations Avian Assessment (COP Appendix Q). The post-construction survey results would be compared to baseline data using spatial models. Since a post-construction survey initiated after EW 2 is built would be approximately eight years after the last baseline survey, a study design assessment would be conducted to determine how sensitive species abundance and distribution is to temporal variation. The results of this analysis could support decision making on whether other funds could be used to expand the survey effort through both space and time. Density models will be developed while surveys are ongoing so that upon completion of the final survey these models need only be updated with new data.

Documentation of Dead and Injured Bats and Birds

Empire will document dead or injured birds or bats found incidentally on vessels and project structures during construction, operation, and decommissioning in an annual report to BOEM. For each animal found, a form will be filled out that will include basic site information, GPS location, and photos taken from multiple perspectives along with a ruler for scale. Experienced biologists will determine if any carcasses could be ESA-listed. If a listed species is identified, Empire will then report the record to BOEM, USFWS, and appropriate state agencies. Carcasses with federal or research bands or tags will be reported to the U.S. Geological Survey (USGS) Bird Band Laboratory, BOEM, and USFWS. Due to health and safety concerns and logistical constraints, it will not be possible to collect carcasses, but EW will evaluate alternative options, including possibly collecting feathers from the carcasses.

Reporting

For the lifetime of the monitoring effort, Empire will submit an annual report to BOEM that will summarize all information as recommended in USFWS's Offshore Motus Guidance, including but not limited to monitoring activities, preliminary results, and any proposed changes to the monitoring plan. The report will be presented to BOEM and USFWS in an annual meeting and, if needed, adjustments to the monitoring will be considered. In addition, all observation and effort data from pre- and post-construction surveys will be provided to relevant regional, publicly accessible databases, such as the Ocean Biodiversity Information System's Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP), the Northwest Atlantic Seabird Catalog, and the North American Bat Monitoring Program (NABat). Depending on the methodology, tracking data will also be added to appropriate regional databases, such as the Motus Wildlife Tracking System.

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ATTACHMENT H-4
EMPIRE WIND FISHERIES AND BENTHIC MONITORING PLAN

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EMPIRE WIND FISHERIES AND BENTHIC MONITORING PLAN

Prepared for:

equinor

Empire Offshore Wind LLC
Stamford Office
600 Washington Blvd
Suite 800
Stamford, CT 06901

Prepared by:

INSPIRE ENVIRONMENTAL

INSPIRE Environmental
Newport, Rhode Island 02840

September 23, 2022

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LIST OF ACRONYMS

ACCOL	Anderson Cabot Center for Ocean Life
ANOSIM	Analysis of Similarities
aRPD	apparent redox potential discontinuity
BACI	Before-After-Control-Impact
BAG	Before-After Gradient
BIWF	Block Island Wind Farm
BOEM	Bureau of Ocean Energy Management
BRUV	Baited Remote Underwater Video
CI	Confidence Interval
CPUE	Catch per Unit Effort
CTD	Conductivity Temperature Depth
CV	coefficient of variation
ECDF	Empirical cumulative distribution function
EFH	Essential fish habitat
EFP	Exempted Fishing Permit
Empire	Empire Offshore Wind LLC
EMF	Electromagnetic fields
EW1	Empire Wind 1
EW 2	Empire Wind 2
FMP/BMP	Fisheries and Benthic Research Monitoring Plan
ft	feet
GAM	Generalized Additive Model
GLM	Generalized Linear Model
GLMM	Generalized Linear Mixed Model
ha	hectare(s)
HD	High definition
HMS	Highly Migratory Species
ITIS	Integrated Taxonomy Information System
kg	kilogram(s)
km	kilometer(s)
LOA	Letter of Acknowledgement
LPIL	lowest possible taxonomic unit
m	meter(s)
mm	millimeter(s)
mi	mile(s)
nm	nautical mile(s)
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center

NEFSC PSB	Northeast Fisheries Science Center Protected Species Branch
NJDEP	New Jersey Department of Environmental Protection
nMDS	non-metric Multidimensional Scaling
NMFS	National Marine Fisheries Service
NMFS-PRD	National Marine Fisheries Service Protected Resources Division
NOAA	National Oceanic and Atmospheric Administration
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OSS	offshore substation
PAM	passive acoustic monitoring
POI	Points of Interconnection
PV	Plan View
ROSA	Responsible Offshore Science Alliance
ROV	Remotely Operated Vehicle
SMAST	School for Marine Science and Technology
SPI	Sediment Profile Imaging
TED	Turtle Excluder Devices
µm	micron
UHD	ultra-high definition
USBL	Ultra Short Baseline
VMS	Vessel Monitoring System
VTR	Vessel Trip Report
WEA	Wind Energy Area
WTG	wind turbine generator

1.0 INTRODUCTION

Empire Offshore Wind LLC (Empire) proposes to construct and operate an offshore wind farm located in the designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). The Lease Area covers approximately 79,350 acres (ac; 32,112 hectares [ha]) and is located approximately 14 statute miles (mi) (12 nautical miles [nm], 22 kilometers [km]) south of Long Island, New York and 19.5 mi (16.9 nm, 31.4 km) east of Long Branch, New Jersey (Figure 1-1). The Lease Area was awarded through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of New York.

Empire proposes to develop the Lease Area in two wind farms, known as Empire Wind 1 (EW 1) and Empire Wind 2 (EW 2). Monitoring efforts at both EW 1 and EW 2 will be combined and covered in this Fisheries and Benthic Monitoring Plan. EW 1 and EW 2 will be electrically isolated and independent from each other. Each wind farm will connect via offshore substations (OSS) to separate Points of Interconnection (POIs) at onshore locations by way of export cable routes and onshore substations. In this respect, the Project includes two onshore locations in New York where the renewable electricity generated will be transmitted to the electric grid.

Offshore components of the Project will consist of up to 174 wind turbines and supporting tower structures, and two offshore substations, using up to 176 foundations. In addition, there will be associated support and access structures (for the wind turbines and offshore substations) and up to 260 nm (481 km) of inter-array cable (up to 116 nm [214 km] for EW 1 and up to 144 nm [267 km] for EW 2), all of which will be located in federal waters within the Lease Area. In addition, the Project will include up to 66 nm (122 km) of submarine export cables, consisting of up to two routes to New York:

- Up to 40 nm (74 km) to the EW 1 landfall, of which 24 nm (44 km) is in federal waters and 16 nm (30 km) in state waters; and
- Up to 26 nm (48 km) to the EW 2 landfall, of which 18 nm (33 km) is in federal waters and 8 nm (15 km) is in state waters

The Project includes two onshore substation locations:

- EW 1 onshore substation in Brooklyn, New York; and
- EW 2 Onshore Substation A or EW 2 Onshore Substation B in Oceanside, New York.

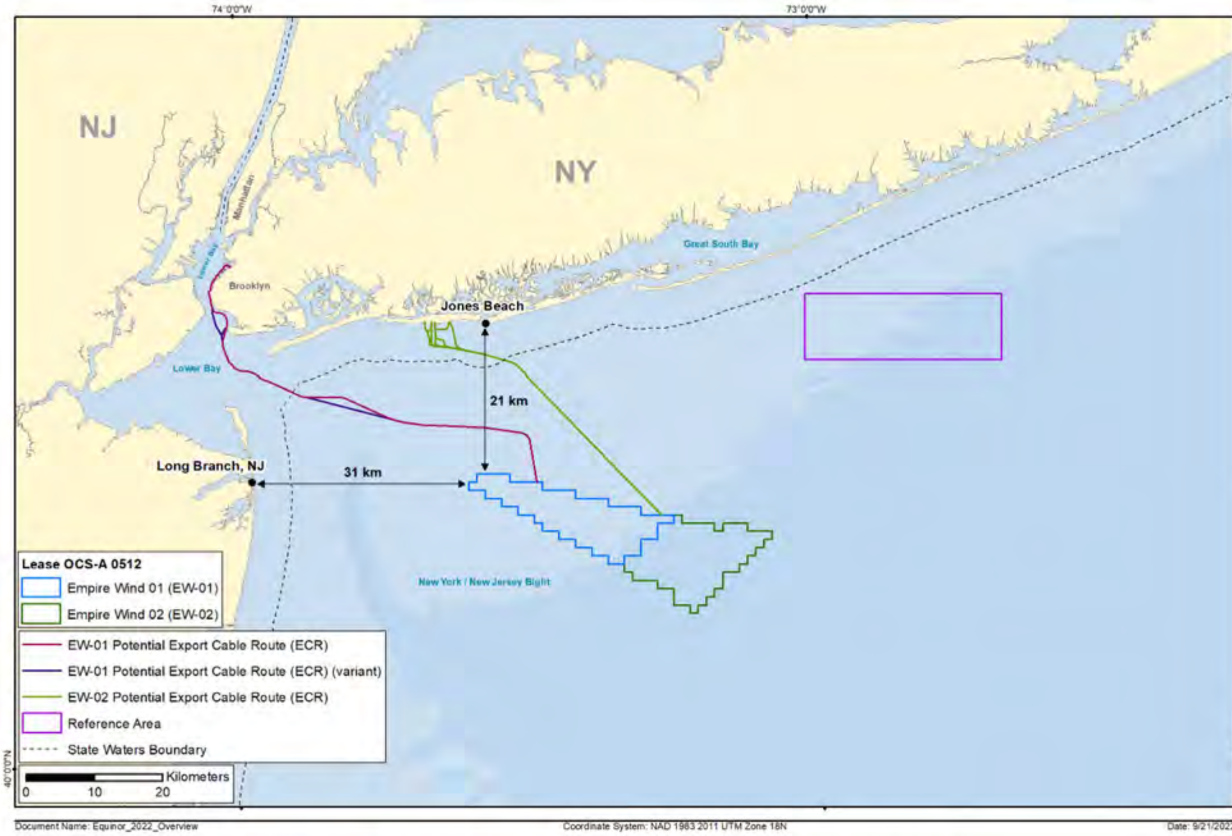

Figure 1-1. Map of the Project Area, including Export Cable routes

2.0 OVERVIEW OF FISHERIES AND BENTHIC MONITORING

This Fisheries and Benthic Research Monitoring Plan (FMP/BMP) has been developed in accordance with recommendations set forth in "Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf" (BOEM 2019), which state that a fishery survey plan should aim to:

- Identify and confirm which dominant benthic, demersal, and pelagic species are using the project site, and when these species may be present where development is proposed;
- Establish a pre-construction baseline which may be used to assess whether detectable changes associated with proposed operations occurred in post-construction abundance and distribution of fisheries;
- Collect additional information aimed at reducing uncertainty associated with baseline estimates and/or to inform the interpretation of research results; and
- Develop an approach to quantify any substantial changes in the distribution and abundance of fisheries associated with proposed operations.

BOEM also provides guidance related to specific survey gears that can be used to complete the fisheries monitoring including otter trawl, beam trawl, gillnet/trammel net, and ventless traps. BOEM guidelines stipulate that two years of pre-construction fisheries monitoring data are recommended, and that data should be collected across all four seasons. Consultations with BOEM and other agencies are encouraged during the development of fisheries monitoring plans. BOEM also encourages wind developers to review existing data, and to seek input from the local fishing industry to select survey equipment and sampling protocols that are appropriate for the area of interest. Benthic monitoring that is planned for New York state waters is described in a separate monitoring plan.

Additional fisheries monitoring guidance was obtained from the Responsible Offshore Science Alliance's "Offshore Wind Project Monitoring Framework and Guidelines" (2021). These guidelines build on existing BOEM guidance, outlining the fundamental elements to include in offshore wind fisheries monitoring plans and associated studies for commercial-scale offshore wind farms and identifying the primary resources to help draft and review such plans. Based on existing BOEM guidance and best practices developed to date, this document helps to:

- Streamline project monitoring plan development and review by providing comprehensive standardized recommendations for monitoring marine resources affected by offshore wind development projects;
- Ensure project monitoring plans and supporting studies are effectively designed to provide necessary information that can be used to understand and minimize adverse impacts on marine resources from offshore wind development consistent with established BOEM, National Marine Fisheries Service (NMFS), and state guidelines, best science practices, and decision maker and developer data needs;
- Encourage the use of standardized protocols to collect and analyze biological and environmental data that can be integrated with existing survey data and other research;
- Support the integration of monitoring efforts across multiple spatial and temporal scales (site-specific to regional/ecosystem and before/after construction);
- Focus monitoring efforts on important commercial and recreational species, habitats, and other resources that may be impacted by or vulnerable to offshore wind development; and
- Encourage proactive engagement, collaboration, and involvement among state and federal agencies, research institutions, wind developers, and fishery members and representatives.

This monitoring plan will be revised through an iterative process, and survey protocols and methodologies have been and will continue to be refined and updated based on feedback received from stakeholder groups. The majority of the research described in this plan will be performed on contracted commercial and recreational fishing vessels whenever practicable. Further, the fieldwork, data analysis and interpretation, data management, and reporting described in the monitoring plan will be performed by INSPIRE Environmental unless otherwise identified.

Empire is committed to conducting research and monitoring in a responsible manner. While this plan does incorporate some traditional fisheries independent survey techniques, the majority of the proposed survey designs utilize non-extractive methodologies to reduce mortality of fish and invertebrate species, as well as minimize interactions with protected resources. Advanced technologies will be used to assess potential impacts to fish and invertebrates while limiting impacts from the monitoring itself. Where practicable, surveys have been designed to utilize protocols and methodologies from monitoring projects within other offshore wind lease areas to increase data compatibility and comparability and contribute to regional monitoring efforts.

3.0 FISHERIES MONITORING

3.1 SUMMARY OF REGIONAL FISHERIES MONITORING

Existing fishery independent and dependent data were identified and reviewed during the development of this FMP. Several established fisheries independent surveys have been conducted within the Empire Wind Lease Area, as well as in the vicinity the Export Cable Route. These surveys provide examples of on-going and recent work that help to characterize marine communities throughout the NY Bight and surrounding region. This section provides a summary of fisheries monitoring within the region, prior to construction of the Empire Wind Project.

Guida et al. (2017) compiled a regional overview of the species composition and seasonal dynamics within the NY WEA. Catches from the Northeast Fisheries Science Center (NEFSC) bottom trawl survey, conducted between 2003 and 2016, showed a seasonal shift in species composition for this region that occurs between winter and summer. During colder months, Atlantic herring, little skate, and winter skate were the numerically dominant species caught. In the warmer months, this transitioned to butterfish, little skate, longfin squid, and Atlantic sea scallop (Guida et al. 2017). Longfin squid were a core species present in August in beam trawl catches that also collected their benthic egg mops (Guida et al. 2017).

The New Jersey Department of Environmental Protection (NJDEP) and the New York State Department of Environmental Conservation (NYSDEC) have developed bottom trawl surveys that operate within NJ and NY state waters, respectively. The Ocean Stock Assessment Program samples 30-39 stations from Sandy Hook to Cape May, New Jersey, five times per year (NJDEP 2022). In New York, the Nearshore Ocean Trawl Survey is a ten-year long project that started in 2017. The survey is conducted once per season and samples from Breezy Point to Block Island Sound in water depths up to 30 meters (m) (NYSDEC 2022). In addition to traditional trawl survey sampling, the Nearshore Ocean Trawl Survey also tags striped bass during fall surveys. The top species sampled (by weight) in 2021 were winter skate, clearnose skate, smooth dogfish, little skate, scup, summer flounder, longfin squid, and Atlantic sturgeon (NYSDEC 2022).

The Fish and Fisheries Study, commissioned by the New York State Energy Research and Development Authority (NYSERDA) as part of the New York State Offshore Wind Master Plan, examined available data within an 'Area of Analysis' off the coast of New York and New Jersey. This area contained the majority of the Empire Wind Lease Area (Ecology and Environment Engineering, P.C. 2017). Datasets including habitat data, fishery-independent data, and fishery-dependent data were obtained from state and federal agencies, fisheries councils and commissions, universities, and non-governmental organizations. Feedback was also provided by industry stakeholders such as regulatory agencies, industry representatives and active commercial fishermen. The Fish and Fisheries Study provides a review and summary of available biological and fisheries information within the region. It also provides spatially explicit data on the geographic patterns of fishing effort and revenue in the area, based on information collected through Vessel Monitoring Systems (VMS), Vessel Trip Reports (VTR), and stakeholder input.

Recent work by Ingram et al. (2019) utilized passive acoustic monitoring (PAM) techniques as a non-extractive method to collect baseline data on Atlantic sturgeon movement through the NY WEA. From November 2016 through February 2018, 181 unique sturgeon were detected throughout the WEA. Sturgeon presence was highly variable between seasons, peaking in detections in late fall through early winter (November- January), with few detections during warmer months (July-September).

Additional data sources that characterize NY Bight regional baseline data include:

- Atlantic sea scallop resource surveys including School for Marine Science and Technology's (SMAST) drop camera surveys (Bethoney et al. 2018), dredge surveys (Hart 2015), and Coonamesset Farm Foundation (CFF) Habitat Camera (HabCam) surveys (CFF 2022).
- Northeast Area Assessment and Monitoring Program (NEAMAP) bottom trawl survey that samples annually from Cape Cod, MA to Cape Hatteras, NC, in water depths ranging from 60 to 120 feet (ft) (NEAMAP et al. 2021).
- Larval fish and lower trophic level zooplankton surveys (Thorne et al. 2020).
- Acoustic surveys, paired with bottom trawl surveys to quantify abundance and distribution of pelagic fishes and squid in the NY Bight (Thorne et al. 2020).
- Bottom trawl surveys conducted within NY state waters along the South Fork Wind Farm export cable route by Cornell Cooperative Extension (CCE) from Smith Point Inlet to Montauk Point (CCE 2022).

Regional approaches to monitoring have been suggested to better understand potential cumulative effects of offshore wind development on fisheries resources and operations. Utilizing standardized fisheries monitoring protocols will aid in understanding the spatial extent of impacts to marine resources, outside of disturbance to the individual lease areas (McCann 2012; MADMF 2018; ROSA 2021). This FMP was designed to complement existing data collection efforts, where practicable, by federal and state agencies, research institutions and other offshore wind developers as recommended by the Responsible Offshore Science Alliance (ROSA).

3.2 ESSENTIAL FISH HABITAT

The Empire Wind Project (Lease Area and cable routes) is designated Essential Fish Habitat (EFH) to 39 species with one or more life stages existing within the project area. These species include:

- New England Fish –Atlantic cod, Atlantic herring, clearnose skate, haddock, little skate, monkfish, ocean pout, pollock, red hake, silver hake, white hake, windowpane flounder, winter flounder, winter skate, witch flounder, and yellowtail flounder;
- Mid-Atlantic Fish – Atlantic butterfish, Atlantic mackerel, black sea bass, bluefish, scup, and summer flounder;
- Invertebrates – Atlantic sea scallop, Atlantic surfclam, longfin squid, and ocean quahog; and
- Highly Migratory Species (HMS) – albacore tuna, bluefin tuna, skipjack tuna, yellowfin tuna, basking shark, blue shark, common thresher shark, dusky shark, sandbar shark, sand tiger shark, shortfin mako shark, smooth dogfish, spiny dogfish, tiger shark, and white shark.

Several species without designated EFH but listed as National Oceanic and Atmospheric Administration (NOAA) Trust Resources can also be found within the project area. These species include several species of shad and river herring (alewife and blueback herring), American eel, Atlantic menhaden, Atlantic striped bass, tautog, weakfish, Jonah crab, and horseshoe crab.

3.3 FISHING ACTIVITY IN THE REGION

Commercial fishing activity within the Empire Wind Lease Area and along the Export Cable routes was characterized using several sources of publicly available information that include VMS and VTR data from the Northeast and Mid-Atlantic Ocean Data Portals (Northeast Ocean Data 2022; Mid-Atlantic Data Portal 2022) and VTR data from NOAA Fisheries (2022a). Equinor's Fisheries Liaisons have also acquired information on the fisheries that operate in the region through extensive outreach and conversations with commercial, charter, and recreational fishermen.

Recently, NOAA Fisheries (2022a) developed a public website that uses VTRs and Dealer Reports to summarize annual landings and revenue for each offshore wind project along the US East Coast. These reports help to characterize the major species harvested, gear types used, and the ports most likely to be affected by offshore wind development, for federally permitted species (NOAA 2022a). Fisheries that include VTR reporting requirements, including party/charter vessels, are represented in these summaries, whereas summaries are not provided for those fisheries without federal reporting requirements (e.g., federally permitted lobster vessels, state permitted vessels, and some HMS permitted vessels). The socioeconomic data regarding commercial fishing activity in the Empire Wind Lease Area from 2008-2019 are summarized below.

Various federally permitted fisheries conduct operations within the Empire Wind Lease Area, but the area has experienced lower levels of fishing effort in recent years. The number of commercial trips peaked in 2008, when 4,519 trips were taken in the Empire Wind Lease Area, and has been decreasing since (Table 3-1). Vessels from Point Pleasant, NJ, Freeport, NY, and Point Judith, RI conducted the greatest number of trips in the area in 2019 (Table 3-2). Point

Pleasant, NJ had the highest number of vessels conduct trips in the area in 2019 (n = 30), followed by Point Judith, RI (n = 29) and New Bedford, MA (n = 27) (Table 3-2). During the same year, the target species that accounted for the greatest number of trips to the Empire Wind Lease Area were summer flounder, black sea bass, monkfish, longfin squid, and skates (Table 3-3).

In terms of revenue, the top-five most valuable species landed from 2008 to 2019 within the Empire Wind Lease Area were the Atlantic sea scallop, longfin squid, summer flounder, Atlantic mackerel, and surf clam (Table 3-4). Atlantic herring was the species with the highest landings by weight, followed by Atlantic mackerel, longfin squid, Atlantic sea scallop, and surf clam. Additional species landed from the area include monkfish, American lobster, and black sea bass (Table 3-4).

Over the same twelve-year time-period, the scallop dredge fishery accounted for the highest revenue, followed by the bottom trawl and clam dredge fisheries (Table 3-5). VMS data for the scallop dredge fleet from 2015 to 2016 show that the fishery operated in the eastern portion of the Lease Area (Figure 3-1). The multispecies groundfish bottom trawl fleet scarcely used the eastern portion of the Lease Area (Figure 3-2), while the squid fleet operated in the middle to eastern portion of the area (Figure 3-3). The multispecies groundfish and clam dredge fisheries (from 2015 to 2016) scarcely operated within the Empire Wind Lease Area (Figure 3-4). The mid-water trawl fishery had the highest number of landings, followed by the bottom trawl and scallop dredge fisheries from 2008 to 2019 (Table 3-5). From 2015 to 2016, the mid-water trawl fishery operated mainly in the central portion of the area, with lower amounts of effort on the western and eastern boundaries (Figure 3-5). Other gear types fished in this area include lobster pots, sink gillnets, pots (other), purse seines, and handlines (Table 3-5).

Party/charter vessel usage of the Empire Wind Lease Area reached an 11-year high in 2018, when the annual revenue stemming from the area was estimated to be $155,000; a $125,000 increase when compared to the year before (Table 3-6). During the same time period, NOAA (2022a) estimates that for-hire vessels from only NY and NJ ports used the area. These vessels mainly targeted black sea bass, scup, red hake, bluefish, Atlantic cod, summer flounder, tautog, sea robins, and triggerfish (Table 3-7).

Table 3-1. The Number of Trips and the Corresponding Number of Vessels Utilizing the Empire Wind Lease Area from 2008 to 2019 (NOAA 2022a)

Year	Number of Trips	Number of Vessels
2019	1,105	180
2018	1,696	208
2017	1,796	226
2016	2,201	279
2015	2,106	276
2014	2,353	338
2013	2,260	229
2012	3,187	322
2011	3,398	384
2010	3,006	374
2009	4,300	365
2008	4,519	330

Table 3-2. The Number of Trips and the Corresponding Number of Vessels Utilizing the Empire Wind Lease Area, by Port in 2019 (NOAA 2022a)

Port	Number of Trips	Number of Vessels
Atlantic City, NJ	11	4
Beaufort, NC	17	11
Cape May, NJ	36	13
Chincoteague, VA	7	7
Freeport, NY	104	4
Hampton Bay, NY	5	3
Hampton, VA	20	11
Montauk, NY	20	7
New Bedford, MA	44	27
Newport News, VA	7	7
Point Judith, RI	64	29
Point Pleasant, NJ	336	30
Shinnecock, NY	7	3
Stonington, CT	5	3
Total	**683**	**159**

Table 3-3. The Number of Trips and Coinciding Number of Vessels by Target Species, Taken within the Empire Lease Area During 2019 (NOAA 2022a)

Species	Number of Trips	Number of Vessels
Summer Flounder	615	97
Black Sea Bass	505	89
Monkfish	451	98
Longfin Squid	434	86
Scup	401	80
Skates	381	51
Silver Hake	265	59
Red Hake	258	45
American Lobster	231	27
Bluefish	205	54
Butterfish	191	53
Atlantic Mackerel	133	40
Dogfish Smooth	109	20
Jonah Crab	102	10
Sea Scallop	87	53
Rock Crab	77	3
Dogfish Spiny	74	14
Squeteague Weakfish	67	25
Conger Eel	65	25
Tautog	57	8
Menhaden	44	5
Atlantic Herring	38	12
Sea Robins	27	12
Surf Clam	24	10
Northern Puffer	17	11
Bonito	15	7
Triggerfish	13	9
Golden Tilefish	12	5
Blueline Tilefish	9	3
King Whiting	9	7
Nk Eel	9	4
American Eel	8	4
Striped Bass	6	3
Spanish Mackerel	4	4
Amber Jack	3	3
Knobbed Whelk	3	3
Total	**4949**	**1039**

Table 3-4. The Revenue and Landings by Species, for the Empire Wind Lease Area during 2008 to 2019 (NOAA 2022a)

Species	Twelve Year Revenue	Twelve Year Landings
Sea Scallop	$5,960,000	610,000
Longfin Squid	$877,000	711,000
Summer Flounder	$343,000	110,000
Atlantic Mackerel	$166,000	719,000
Surf Clam	$112,000	156,000
Atlantic Herring	$101,000	793,000
American Lobster	$55,000	11,000
Monkfish	$53,000	23,000
Black Sea Bass	$39,000	11,000
All Others	$37,000	55,000
Total	**$7,743,000**	**3,199,000**

Table 3-5. The Revenue and Landings by Gear Type for the Empire Wind Lease Area during 2008 to 2019 (NOAA 2022a)

Gear Type	Twelve Year Revenue	Twelve Year Landings
Dredge-Scallop	$5,466,000	546,000
Trawl-Bottom	$1,948,000	1,316,000
Dredge-Clam	$290,000	346,000
Trawl-Midwater	$187,000	1,319,000
Pot-Lobster	$62,000	16,000
Gillnet-Sink	$24,000	16,000
All Others	$13,000	32,000
Pot-Other	$6,000	4,000
Seine-Purse	$2,000	14,000
Handline	$2,000	1,000
Total	**$8,000,000**	**3,610,000**

Table 3-6. The Party/Charter Vessel Estimated Revenue by Year from the Empire Wind Lease Area (NOAA 2022b)

Year	Annual Revenue
2008	$23,000
2009	$2,000
2010	$42,000
2011	$24,000
2012	$22,000
2013	$12,000
2014	$39,000
2015	$27,000
2016	$26,000
2017	$30,000
2018	$155,000
Total	**$403,000**

Table 3-7. The Estimated Catch from Party/Charter Vessel Target Species in the Empire Wind Lease Area from 2008 to 2018 (NOAA 2022b)

Species	Eleven Year Fish Count
All Others	6,980
Black Sea Bass	6,807
Scup	6,241
Red Hake	5,830
Bluefish	742
Cod	702
Summer Flounder	464
Tautog	176
Sea Robins	40
Triggerfish	17
Total	**27,999**

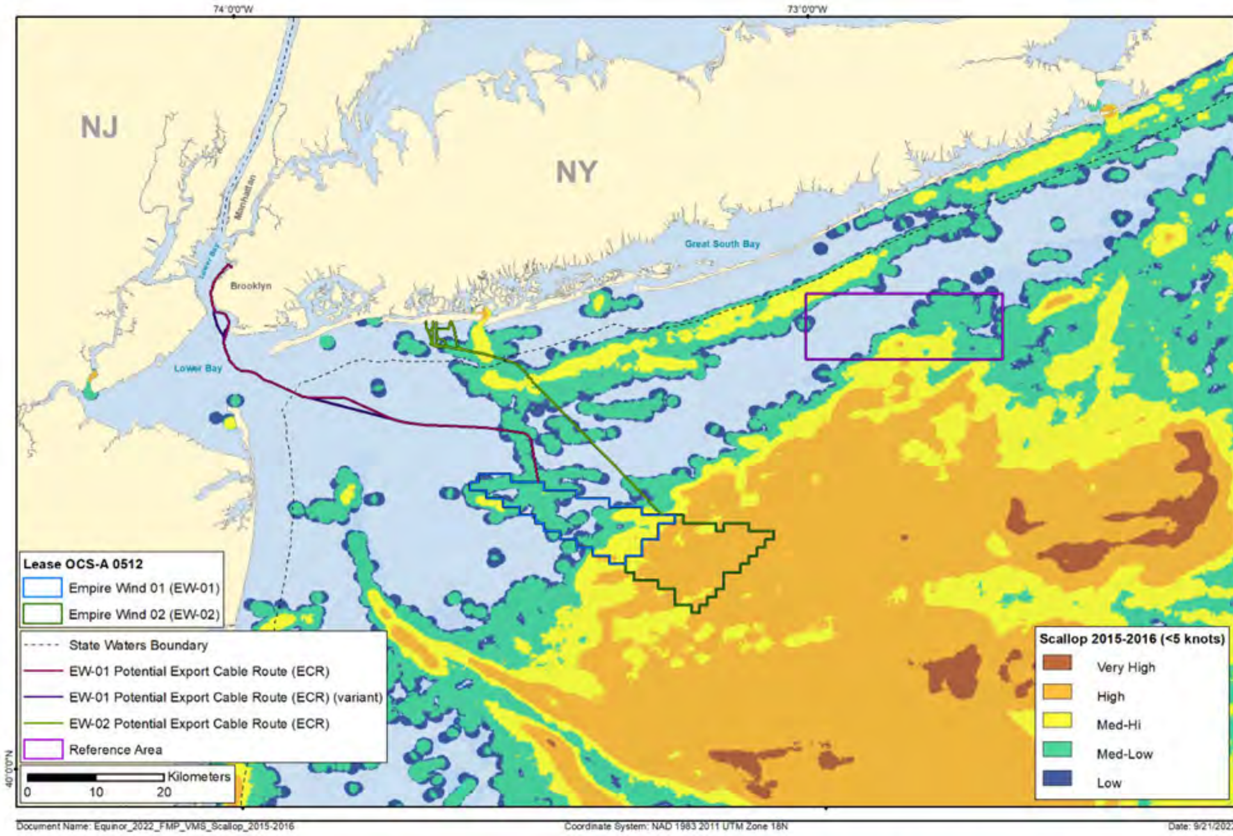

Figure 3-1. VMS data for the scallop dredge fleet from 2015 to 2016 in the Empire Wind region

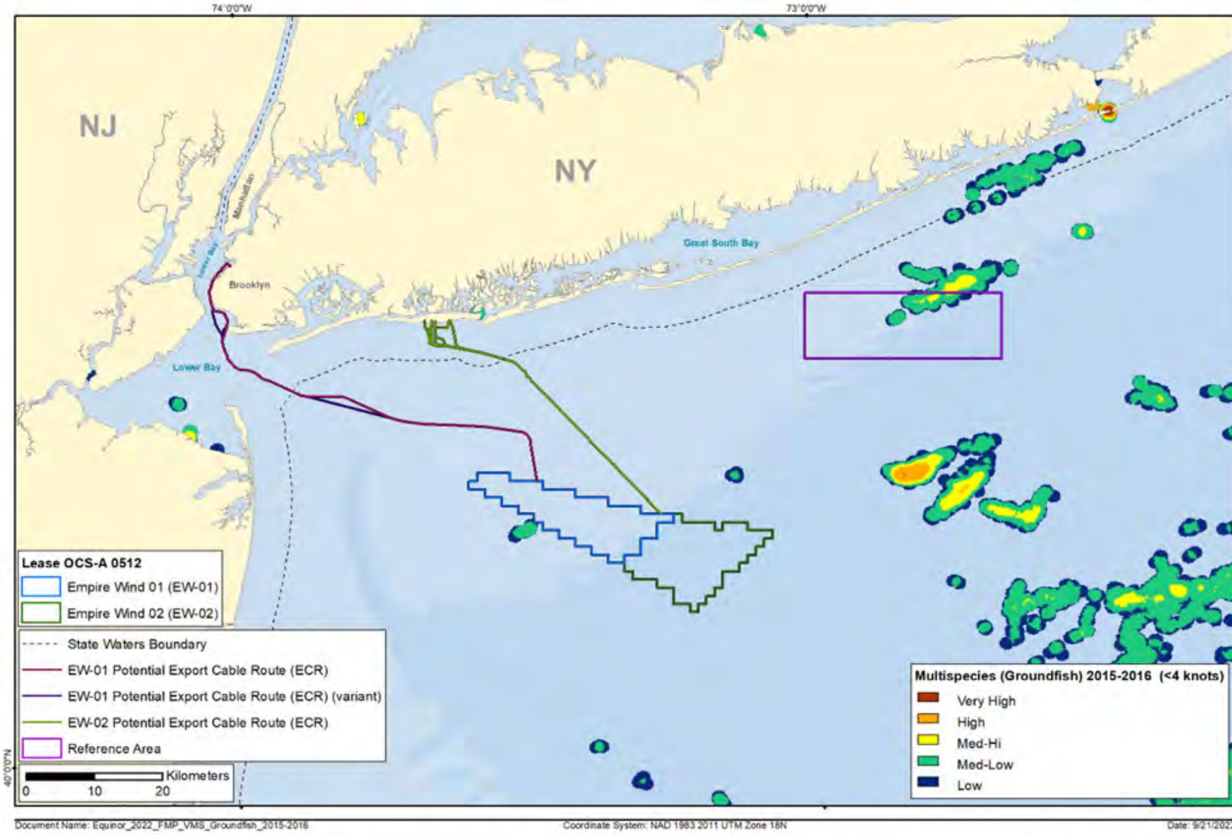

Figure 3-2. VMS data for the multispecies groundfish fishery from 2015 to 2016 in the Empire Wind region

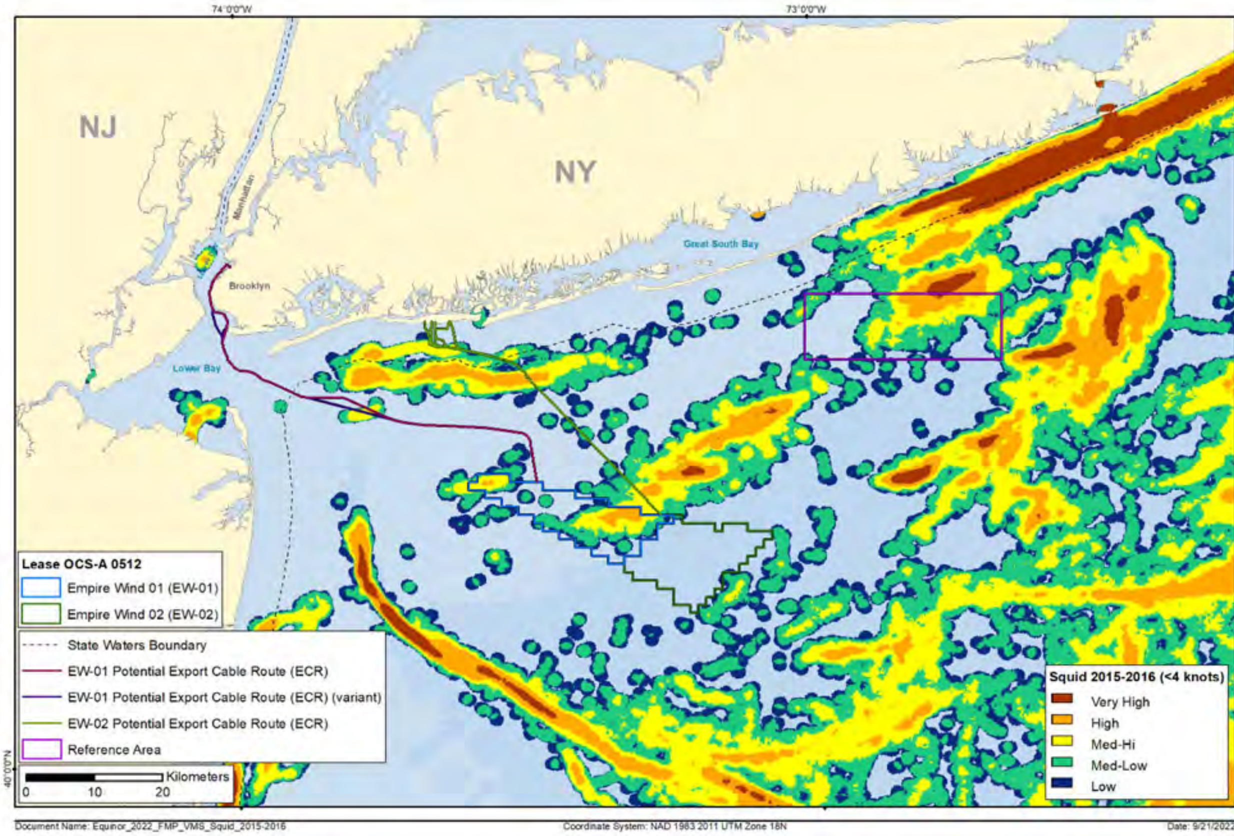

Figure 3-3. VMS data for the squid fishery from 2015 to 2016 in the Empire Wind region

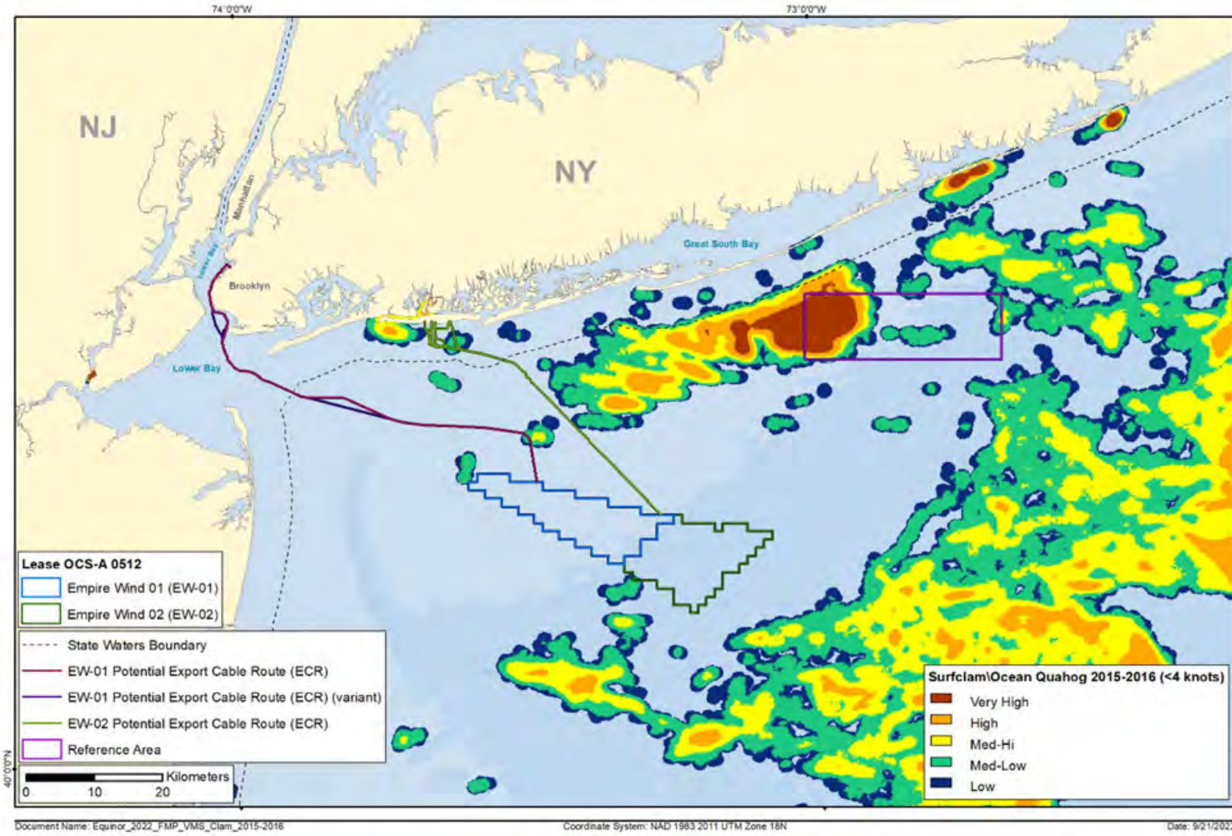

Figure 3-4. VMS data for the clam dredge fishery from 2015 to 2016 in the Empire Wind region

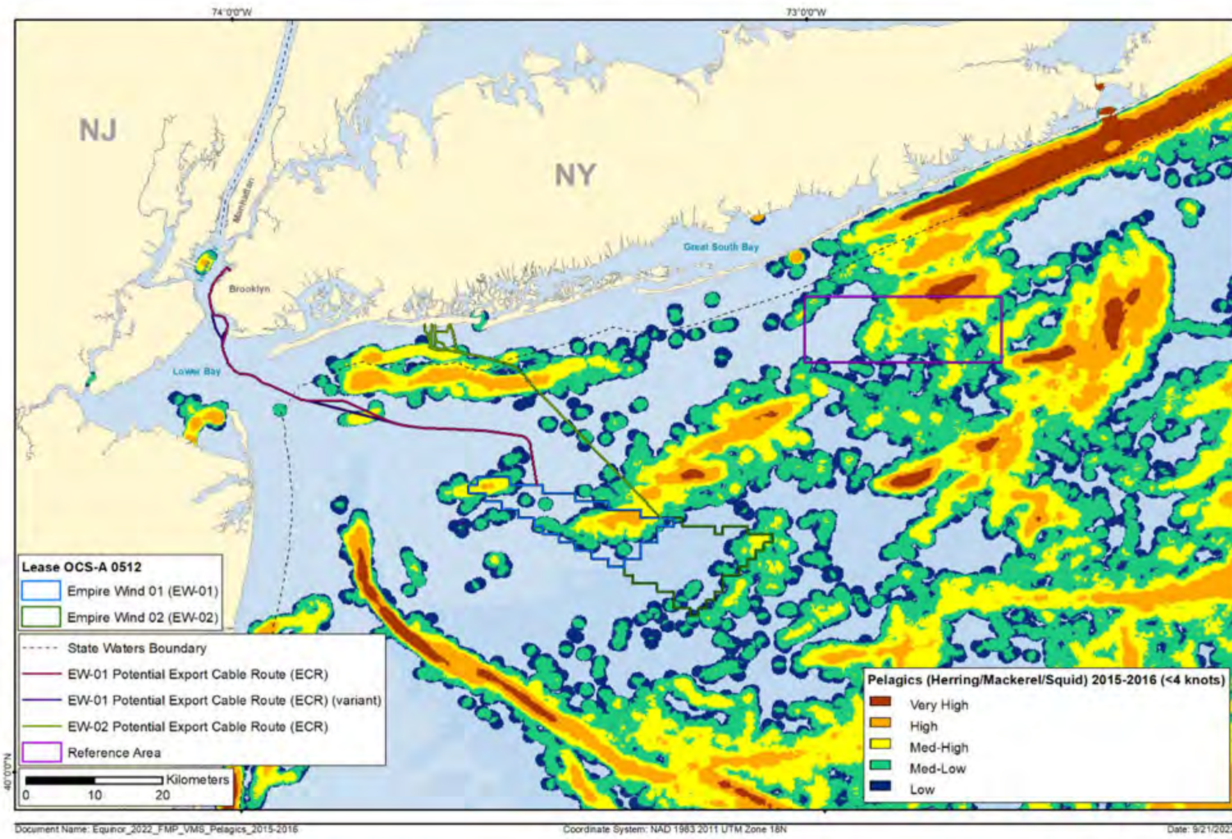

Figure 3-5. VMS data for the mid-water trawl (pelagics) fishery from 2015 to 2016 in the Empire Wind region

3.4 FISHERIES MONITORING SURVEY METHODS

Based on the review of fisheries activities and available fisheries independent data in the Empire Wind Lease Area and along the export cable routes, this FMP was designed to address several focused objectives related to impacts of the Empire Wind development on fisheries in the area. As outlined in Section 2.0, the proposed fisheries monitoring techniques focus on the use of non-extractive methodologies or propose modifications to traditional techniques to reduce mortality of fish and invertebrate species and to minimize interactions with protected species.

3.4.1 Trawl Survey

3.4.1.1 Survey Design

A trawl survey targeting longfin squid within the Lease Area will be conducted in the Fall (September and October) using a symmetrical Before-After-Control-Impact (BACI) experimental design. This trawl survey will be conducted by a contracted commercial fishing vessel with experience targeting squid in the trawl fishery and with the capability of operating the survey gear. Longfin squid are typically targeted using bottom otter trawl gear and the fishery has been active in the central portion of the Lease Area (Figure 3-3) with longfin squid constituting the third highest landings and second highest revenue over the last 12 years (Table 3-4).

The primary objective of the pre-construction monitoring survey is to investigate the biomass (kilograms [kg/tow]) of longfin squid and bycatch species in the Empire Wind Lease Area (Impact Area) relative to the reference area (Control). The trawl survey will also collect information on size structure of the target species as well as on the size structure and fish condition for bycatch species. Two years of pre-construction sampling will occur starting in the fall of 2023. Sampling will continue during the construction phase of the project and for a minimum of two years post-construction, with the duration of post-construction monitoring being informed by developing guidance from BOEM and ROSA.

The objectives of the trawl survey targeting longfin squid are as follows:

- **Objective 1** - Evaluate relative changes in the biomass of longfin squid and fish and invertebrate bycatch species between the Empire Wind Lease Area and the reference area between pre-construction, during construction, and post-construction time periods.
- **Objective 2** - Assess potential changes in the size structure of longfin squid and fish and invertebrate bycatch species between Empire Wind Lease Area and the reference area between pre-construction, during construction, and post-construction time periods.
- **Objective 3** - Investigate potential changes in the composition of fish and invertebrate species between Empire Wind Lease Area and the reference area between pre-construction, during construction, and post-construction time periods.

A BACI study design will allow for quantitative comparisons of relative biomass and size structure to be made before and after construction between the Empire Wind Lease Area and the reference area (Underwood 1992; Smith et al. 1993). Sampling replication across time and space allows for the detection of possible changes caused by construction and operation of the wind farm (Underwood 1992).

NOAA Fisheries is currently evaluating methods to reduce sea turtle bycatch within the trawl fishery south of Massachusetts (NOAA Fisheries 2022b). Nineteen percent of documented sea turtle interactions in the Northeast and Mid-Atlantic trawl fishery that occurred in the period 2000-2019 occurred on trips where longfin squid was the majority species landed. To reduce the number of sea turtle interactions in the fishery, NOAA Fisheries has conducted research on the use of Turtle Excluder Devices (TED) within trawl nets. (Dealteris and Parkins 2010; Milliken et al. 2020). With NOAA Fisheries considering the requirement of TEDs in the longfin squid fishery, the proposed trawl survey will also utilize a TED with a bottom-oriented escape outlet to reduce the likelihood of a take of protected species (sea turtles, Atlantic sturgeon) during survey operations.

The NEFSC Protected Species Branch (PSB) is currently developing a smaller TED for use with nets towed by smaller vessels typical of the inshore squid fishery off Long Island (H. Milliken, pers. comm.). The Empire Wind squid trawl survey will collaborate with PSB and utilize this smaller TED in the survey gear. Data collected as part of the survey will be shared with the PSB team to provide a comparative dataset that will assist in testing and calibration of the TED for evaluating its use in the commercial fishery.

3.4.1.2 Sampling Stations

The trawl survey will be executed using a BACI experimental design, with observations occurring within the reference area serving as a regional proxy for relative abundance of longfin squid and bycatch fish and invertebrate species away from the influence of project activities or activities associated with other offshore wind development. The reference area encompasses the same approximate area as the Empire Wind Lease Area (325 km^2), is approximately 30 km southwest of the Empire Wind Lease Area, 10 km from the Sunrise Wind export cable to the northeast, and is outside the major shipping lanes stemming from New York Harbor (Figure 1-1).

The reference area was selected to reflect similar depths and benthic habitats as the Empire Wind Lease Area. Data provided in the Northwest Atlantic Ecoregional Assessment indicate that the Empire Wind Lease Area primarily consists of fine, medium, and coarse sand (Greene et al. 2010). Additional site characterization assessments commissioned by Equinor confirm that the site is primarily comprised of sands of varying grain sizes (see Section 4.1 below; Empire Offshore Wind Construction and Operations Plan [COP] Appendix T, Benthic Resource Characterization Reports, Tetra Tech 2022). The reference area was also evaluated relative to the survey strata of the NEFSC bottom trawl survey. The NEFSC trawl survey is the only regional trawl survey that overlaps with the offshore location of the Empire Wind Lease Area. The Lease Area is mostly contained within Stratum 1010 with a small portion of the western end of the Lease Area within 3110 (Figure 3-6). Modifications to the location of the reference area may be considered based on input received from local fishing industry groups, state and federal agencies, or following discussion with the fishing industry partners that are selected to execute the trawl survey.

Both the Empire Wind Lease Area and reference area exhibit a depth range of 22-42 m. The trawl survey will be stratified by depth with the number of survey tows evenly distributed between a "shallow" depth stratum (<35 m) and a "deep" stratum (>35 m). Each survey stratum will be evenly divided into grid cells and two grid cells will be selected randomly within each stratum for sampling tows before each survey trip (Figure 3-7). The location of trawl sampling stations may be subject to change due to the presence of fixed gear (e.g., gillnets), or other factors that may preclude a randomly selected location from being sampled safely. Therefore, alternate sampling locations will be randomly chosen within each grid cell for each survey. If a primary sampling location is found to be untrawlable based on the captain's professional judgement, sampling will instead occur at one of the randomly selected alternate sampling locations. If any marine mammals or other protected species are sighted in the vicinity of a trawl tow, sampling will be delayed at that location in order to minimize the risk of an interaction. Empire will work with the survey scientists and captain and crew of the trawl vessel(s) to evaluate whether construction activities will impact the execution of the trawl survey.

A power analysis was conducted using trawl survey data from the Block Island Wind Farm (BIWF) and NEFSC trawl survey datasets (Attachment A) to determine sample sizes needed to achieve sufficient statistical power to detect a potential impact, given background variability in catches. NEFSC trawl survey data from 2010 through 2018 were obtained from Phil Politis (Northeast Fisheries Science Center Bottom Trawl Program Lead, personal communication), and only tows from Stratum 1010 were used to inform the power analysis. From 2010 through 2018, the NEFSC trawl survey sampled in the spring and fall. Monthly catch data from the two reference sites sampled during the BIWF trawl survey were also reviewed to determine the extent to which the seasonal NEFSC trawl survey captured intraannual biomass peaks for different species of interest. Power analysis represents the relationships among the four variables involved in statistical inference: sample size (N), effect size, and type I (α) and type II (β) error rates (Cohen 1992). Of primary interest for this study is the interaction between temporal and spatial factors, specifically the contrast between the temporal change at the Empire Wind Lease Area relative to the temporal change at the reference site (Equation 2 in Attachment A). Power curves were constructed to demonstrate how statistical power for the interaction contrast varies as a function of the variance in the catch data, the effect size (i.e., the percent change at the Empire Wind Lease site relative to the reference site), sample size (i.e., number of trawl tows per area in each season), and the number of reference sites that are sampled (Attachment A, Figures A4 and A5). When analyzing for changes in relative biomass, achieving a statistical power of at least 0.8 is intended, which is generally considered to be the minimum standard for scientific monitoring (Cohen 1992). This ensures that the monitoring will have a probability of at least 80% of detecting an effect of the stated size when it is actually present. A single alpha (0.10) was used for the power analysis, and the power analysis was completed assuming two years of pre-construction and post-construction monitoring.

A sample size of 16 trawl tows per area will be targeted per sampling season in each year at the start of the survey. Based on the results of the power analysis (Attachment A, Figure A5), this level of sampling is expected to have at least 80% power to detect a 50% temporal decrease for longfin squid biomass at the Project area relative to the reference area for moderate coefficient of variation (CV) estimates (0.6-0.8). An examination of the NEFSC and BIWF trawl survey data indicates that longfin squid exhibited moderate to high levels of interannual and intraannual (e.g., seasonal or monthly) variability in catch rates (Attachment A, Figures A2 and A3 and Table A1). Given the magnitude of variability in catch rates that will likely be exhibited in the Empire trawl survey, it is not practicable to attempt to capture a small effect size (e.g., 25%) for longfin squid. This power analysis assumes that the variance in the catch rates during the Empire trawl survey will be similar to the variance observed during the BIWF and NEFSC trawl surveys. Following the collection of the first year of trawl survey data, the observed variability will be calculated for longfin squid in the catch. The achievable effect sizes will also be identified following the first year of the survey, once the realized magnitude of variability is better understood, and once regional guidance regarding target effect sizes has been formalized through ROSA. Given the predicted power of the study design for the anticipated magnitude of variability (i.e., range of CVs from 0.6 to 1.2), the sample sizes proposed for the first year of the trawl survey are robust.

3.4.1.3 Trawl Survey Methods

All survey activities will be subject to rules and regulations outlined under the Marine Mammal Protection and Endangered Species Acts. Efforts will be taken to reduce marine mammal, sea turtle, and seabird injuries and mortalities caused by incidental interactions with fishing gear. As mentioned above, deploying trawl gear will be delayed if marine mammals are sighted in the vicinity of the sampling station. All gear restrictions, closures, and other regulations set forth by take reduction plans (e.g., Harbor Porpoise Take Reduction Plan, Atlantic Large Take Whale Reduction Plan) will be adhered to as with typical scientific fishing operations to reduce the potential for interaction or injury.

The trawl survey will be carried out during September and October, when longfin squid is most abundant in the region as indicated in the BIWF and NEFSC trawl survey data (Attachment A, Figures A2 and A3). Four survey tows (two in each depth stratum) will be conducted in both the Empire Wind Lease and the reference area, twice each month (16 tows total in each area in each sampling year). Two sampling events will occur each month to distribute sampling effort and target the peak seasonal biomass. Within a sampling event, the replicate tows within the Empire Wind Lease Area and the reference area will be completed within as few days as possible, given practical constraints imposed by weather or other factors (e.g., mechanical issues with vessel). Efforts will also be made to have consistent timing between surveys (e.g., two weeks), to the extent possible.

The trawl survey will be conducted using a trawl net fitted with a TED designed by the NEFSC's PSB team (Milliken et al. 2020). The trawl net used will be typical of the local squid fishery with modifications to accommodate the TED and a bottom-oriented escape outlet. The codend will be fitted with a 2.5 cm (1 inch) knotless codend liner to sample squid and other marine taxa across a broad range of size and age classes.

Net mensuration equipment will be used during the survey to provide the captain and scientific crew with real-time information on door spread, wing spread, and headrope height. This information also allows the area swept (km^2) to be calculated for each tow, which is needed in order to estimate absolute abundance. The position, heading, and speed of the vessel will be monitored throughout each tow using a software program that is integrated with a GPS unit (e.g., NEFSC Fisheries Logbooks Data Recording System, or similar). A temperature logger attached to the trawl net will be used to record bottom temperature continuously (e.g., every 30 seconds) during trawling.

Similar to the methods employed on other regional surveys (e.g., NEAMAP and NYSDEC Nearshore Ocean Trawl survey), all tows will be completed during daylight hours, and the target tow duration will be 20 minutes. The relatively short tow duration is also expected to minimize the potential for interactions with protected species and marine mammals. A target tow speed of approximately 3 knots will be used. The tow will begin when the winches are locked, and an acceptable net geometry is established. The amount of wire set with each trawl to achieve the target net geometry will be left to the professional judgement of the captain, dependent upon the depth and the in-situ conditions.

Animals collected from each trawl tow will be sorted, identified to the species level, weighed, and enumerated consistent with the sampling approach of NEAMAP. Taxonomic guides that can be utilized to assist with species identification include *NOAA's Guide to Some Trawl-Caught Marine Fishes* (Flescher 1980), *Bigelow and Schroeder's Fishes of the Gulf of Maine* (Collette and Klein-MacPhee 2002), Kells and Carpenter's (2011) *Field Guide to Coastal Fishes from Maine to Texas.* Species will be identified consistently with the Integrated Taxonomy Information System (ITIS). The following information will be collected for each trawl that is sampled; catch per unit effort (CPUE), species diversity, and size structure of the catch. All species captured will be documented for each valid trawl sample. When large catches occur, sub-sampling may be used to process the catch, at the discretion of the lead scientist. The three sub-sampling strategies that may be employed are adapted from the NEAMAP survey protocols and include straight subsampling by weight, mixed subsampling by weight, and discard by count sampling (Bonzek et al. 2008). The type of sub-sampling strategy that is employed will be dependent upon the volume and species diversity of the catch.

The biomass (weight, kg) of each species will be recorded on a motion-compensated marine scale and used to calculate CPUE. Length will be recorded for the dominant (i.e., most commonly encountered) and priority species in the catch. To assess the condition of individual organisms, up to 100 individuals of each species (and size class) will be measured (to the nearest cm) and individually weighed. Length (e.g., total length, fork length, mantle length) will be recorded for each species consistent with the measurement type specified in the Northeast Observer Program Biological Sampling Guide. After sampling, all catch will be returned to the water as quickly as possible to minimize mortality.

Oceanographic data will be collected at each trawl station using a Conductivity Temperature Depth (CTD) sensor (or similar). The CTD will sample the vertical profile of the water column at each station. The CTD profile will be collected at either the start or end of each tow at the discretion of the captain and/or lead scientist. Bottom temperature information will be collected for the duration of each tow using a gear mounted temperature sensor or a temperature sensor that is included in the suite of net mensuration electronics.

Should any interactions with protected species (e.g., marine mammals, sea birds, sea turtles, sturgeon) occur, the contracted scientists will follow the sampling protocols described for the Northeast Fisheries Observer Program (NEFOP) in the Observer On-Deck Reference Guide (NEFSC 2016). If any protected species are captured during trawling, the sampling and release of those animals will take priority over sampling the rest of the catch. Reporting of interactions with marine mammals, such as small cetaceans and pinnipeds, will be dependent on the type of permit issued to the project; once the permit type has been specified, Empire will contact NMFS Protected Resources Division (NMFS-PRD) for guidance on reporting procedures. Additionally, protocols for handling live or deceased protected species of sea turtles, sturgeon, or marine mammals will be dependent on the type of permit (i.e., Exempted Fishing Permit [EFP] or Letter of Acknowledgement [LOA]) issued to the project. Once the permit type has been specified, Empire will contact NMFS-PRD for guidance on handling protocols. Entangled large whales or interactions with sea turtle species will be reported immediately to NOAA's stranding hotline via telephone (866-755-NOAA) and interactions with sturgeon species will be reported immediately to NOAA via the incidental take reporting email (incidental.take@noaa.gov); a follow up detailed written report of the interaction (i.e., date, time, area, gear, species, and animal condition and activity) will be provided to the NMFS Greater Atlantic Regional Fisheries Office (incidental.take@noaa.gov) within 24 hours. Any biological data collected during sampling of protected species will be shared as part of the written report that is submitted to the NMFS Greater Atlantic Regional Fisheries Office, and any genetic samples obtained from sturgeon will be provided to the NMFS Greater Atlantic Regional Fisheries Office Protected Resources Division. Due to the potential for communicable diseases, all physical sampling and handling of marine mammals and seabirds will be limited to the extent Empire health and safety assessments and plans allow.

3.4.1.4 Trawl Station Data

The following data elements will be collected during each sampling effort:

- Station number
- Latitude and longitude at the start and end of the tow
- Time at the start and end of the tow
- Vessel speed and heading
- Water depth at the start and end of the tow
- Wind speed
- Wave height
- Weather conditions (e.g., cloud cover, precipitation)
- Tow speed
- Gear condition/performance code at the end of the tow
- Oceanographic data, as collected using a CTD and a temperature logger (see Section 3.4.1.3).

3.4.1.5 Data Management and Analysis

All field data will be reviewed and verified before being entered into a relational database. Rigorous quality control audits will be performed on database tables using standardized, systematic queries to identify data and input errors. Species names (common and scientific) will be verified and tabulated for consistency with regional databases. Only audited and verified data will be exported from the relational database for use in analyses.

The pre-construction data will allow for characterization of the baseline fish and invertebrate community structure (with focus on longfin squid) in both the Project Area and reference area. For the pre-construction monitoring, the results presented in annual reports will focus on descriptive and quantitative comparisons of the fish and invertebrate communities in the Project

Area and the reference area to describe spatial, seasonal, and annual differences in relative abundance, species composition, and size distribution. For the dominant species in the catch, relative abundance will be compared amongst the reference and impact areas using descriptive statistics (e.g., mean, range) and length frequency data by species will be compared between areas using descriptive statistics, graphical techniques (empirical cumulative distribution function [ECDF] plots), and appropriate statistical tests (e.g., the Kolmogorov-Smirnoff test). Species composition will be compared between the impact and reference area using appropriate multivariate techniques (e.g., Analysis of Similarities; ANOSIM). By continuing sampling during and after construction, the trawl survey will allow quantification of any detectable changes in relative abundance, demographics, or community structure associated with proposed operations. The BACI design for this survey plan allows the catch of numerically dominant species to be compared between the before and after construction periods in the two treatment types (reference and impact), using appropriate statistical modeling. The use of a reference area will ensure that larger regional changes in demersal fish and invertebrate community structure will be captured and delineated from potential impacts of the proposed Project. Analyses presented in the final synthesis report will focus on identifying changes in the fish community in the Project Area between pre-and post-construction that did not also occur at the reference area (or the reverse) that could be attributed to either construction or operation of the wind turbines.

Once post-construction data are collected, the primary research question to be addressed will examine the magnitude of difference in the temporal changes in relative longfin squid biomass between the reference and impact areas. This research question can be framed using the following hypotheses:

- $H_Ø$-Changes in relative biomass in both the reference and impact areas will be statistically indistinguishable between time periods (before and after).
- H_1-Changes in relative biomass will not be the same at the reference and impact areas between time periods (before and after; two-tailed).

In this symmetrical BACI design, there are multiple years of sampling in each time period (pre- and post-construction) and two depth strata within the reference area. A Generalized Linear Modeling (GLM) framework will be used to describe the data and estimate the 90% Confidence Interval (CI) on the BACI contrast. At a minimum, season and location (impact or reference site) will be evaluated as covariates in the model, but the modeling framework could be expanded to include other relevant covariates such as temperature, depth, and salinity. Multiple error distributions will be evaluated to determine the model structure that best describes the data. The interaction contrast that will be tested is the difference between the temporal change (i.e., average over the post-operation period minus the average over the pre-operation period) at the wind farm and the average temporal change at the reference area. A statistically significant impact would be indicated by a 90% CI for the estimated interaction contrast that excludes zero. Using a 90% CI allows 95% confidence statements for the lower or upper bound (e.g., if the lower bound of the 90% CI for the mean is greater than 0, this indicates 95% confidence that the mean exceeds 0).

Length frequency data for the dominant species in the catch will be analyzed. The first goal of the length-frequency analysis will be to examine whether the size structure of these species changes over time (pre- vs. post-construction). The second goal will examine how the size structure of these species varies between areas (Project Area vs. reference area). To achieve these two goals, length frequency data will be compared between times and locations for common species using descriptive statistics (e.g., range, mean) and graphical and statistical comparisons using ECDFs, a Kolmogorov-Smirnov test (Sokal and Rohlf 2001), or another appropriate method based on the characteristics of the data.

An adaptive sampling strategy will be employed, whereby data collected early in the study will be analyzed to assess statistical power and modify the sampling scheme or sampling intensity as needed (Field et al. 2007). Upon completion of the first year of trawl survey sampling, a power analysis (e.g., Gerrodette 1987) will be conducted. The variance (e.g., Relative Standard Error [RSE]) associated with the relative abundance estimates for dominant species in the catch will be calculated. Power curves will be used to demonstrate how statistical power varies as a function of effect size and sample size (i.e., number of trawl samples per area). When analyzing changes in the relative biomass of dominant species in the catch, we will aim to attain a statistical power of at least 0.8 to ensure that the monitoring will have a probability of at least 80% of detecting a 50% decrease in longfin squid biomass at the Project Area relative to the reference area. A single two-tailed alpha (0.10) will be evaluated during the power analysis, assuming two years of pre-construction and post-construction monitoring. The results of the power analysis could be used to modify the monitoring protocols in subsequent years. The decision to modify sampling will be made after evaluating several criteria including the amount of variability in the data, the statistical power associated with the study design, and the practical implications of modifying the monitoring protocols.

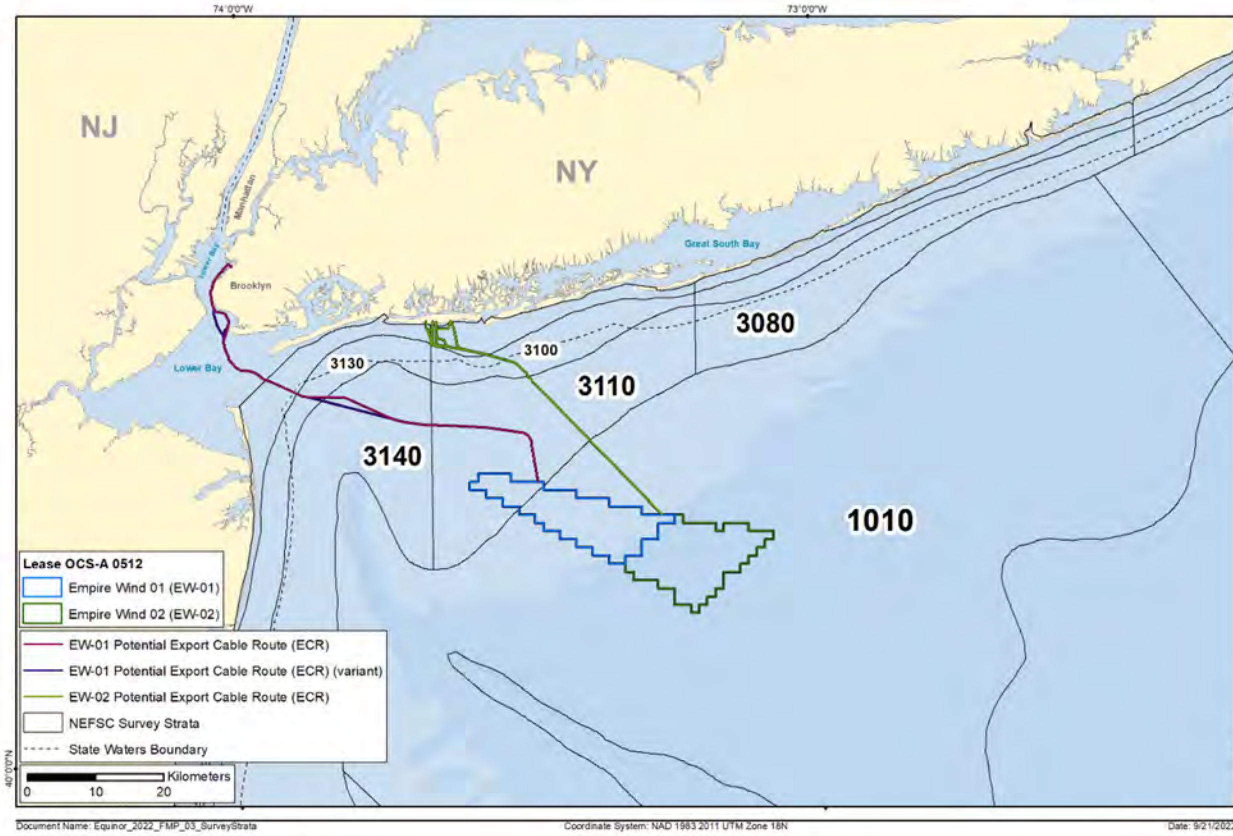

Figure 3-6. NEFSC survey strata and the Empire Wind Lease Area

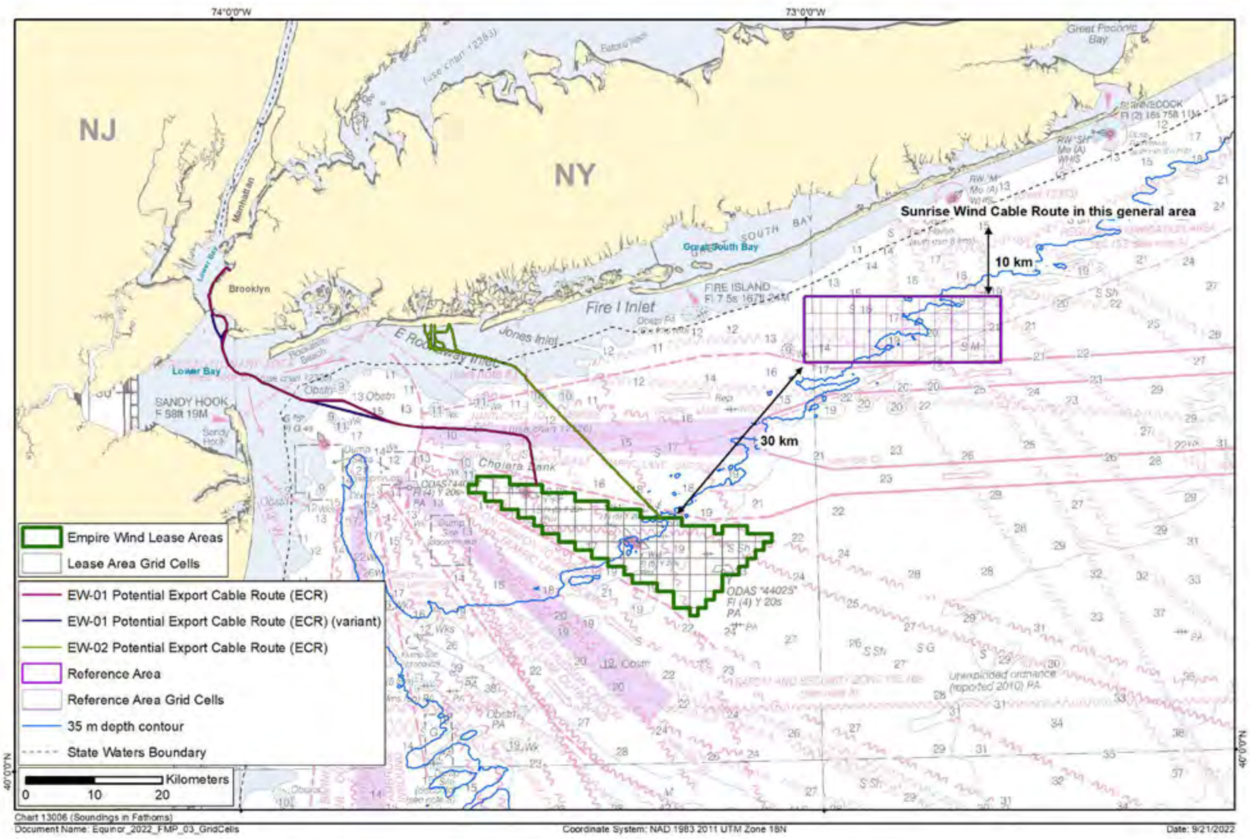

Figure 3-7. Map of the Empire Wind Lease Area and planned reference area for the trawl survey with the areas divided into grid cells and the 35 m depth contour identified

3.4.2 Baited Remote Underwater Video (BRUV) Survey

3.4.2.1 Survey Design

Empire will partner with INSPIRE Environmental to conduct a Baited Remote Underwater Video (BRUV) survey to assess the relative abundance and community composition of structure-oriented fish species within the Empire Wind Lease Area. Observations from wind farms in Europe have indicated that a community shift may occur when foundations are installed in areas that lack structured habitat, where structure-oriented species begin to inhabit these introduced turbine foundations due to a "reef effect" (Degraer et al. 2020). At Block Island Wind Farm located in Rhode Island state waters, abundances of structure-oriented species (black sea bass and Atlantic cod) increased near the wind farm after turbine installation (Wilber et al. 2022). Additionally, it is expected that structure-oriented species from more southerly regions will begin to inhabit foundations as their distributions continue to shift northward due to climate change (Hare et al. 2016). Traditional fisheries-independent survey techniques such as trawls do not sample structure-oriented species reliably as these gears are not able to survey in complex habitats (Hilborn and Waters 1992).

Traditionally, fixed-gear types are used for fisheries-independent sampling in hard bottom habitats (lobster traps, fish pots, gillnets) and these techniques are being utilized for monitoring within other offshore wind lease sites in the Northeast that contain complex bottom (South Fork Wind, LLC and INSPIRE Environmental 2022; Revolution Wind, LLC and INSPIRE Environmental 2021). These gear types often employ the use of vertical lines attached to buoys that float at the surface for use in retrieval of the gear after an extended soak time (days). With current efforts to minimize interactions of vertical lines with protected species, particularly the critically endangered North Atlantic Right Whale, non-traditional survey methods must be implemented to reduce the potential for these interactions. Additionally, these fixed-gear surveys are extractive fisheries methods that likely introduce a degree of mortality to the catch. BRUVs offer the advantages of a shorter soak time (minutes), non-extractive sampling, the ability to sample species not caught in traditional gear types, sampling a wide range of habitats, and examining video footage at a later time if needed (Langlois et al. 2020; Curry-Randall et al. 2020). Because the cameras are baited, BRUVs are particularly adept at detecting species highly attracted to bait, such as sharks (Torres et al. 2020). BRUVs have been proven to be an effective tool to monitor fish species in a variety of habitats around the world (Langlois et al. 2010; Mallet and Pelletier 2014; Harrison and Rosseau 2020; Cole et al. 2022), including structure-oriented species at wind farms in Europe (Griffin et al. 2016).

The BRUV survey will utilize a Before-After Gradient (BAG) design to assess the spatial extent of wind farm effects on adult and juvenile structure-oriented fish species. In particular, the survey will provide information on whether the abundances of structure-oriented species increase with increasing proximity to the turbines following construction. An increase in abundance would suggest a "reef effect", whereby the addition of offshore wind foundations and scour protection creates new habitat for fish, which leads to subsequent increases in abundance in the Project Area (Anderson and Ohman 2010; Bergstrom et al. 2013). This "reef effect" has been documented in approximately half of the offshore wind farm monitoring studies that have tested for this impact (Glarou et al. 2020). The proposed survey design also eliminates the need for a Reference Area, which is required in a BACI design. Sampling effort is focused on sampling sites along a spatial gradient within the work area, rather than using a reference location that may not wholly represent conditions within the work area (Methratta 2020). This design also allows for the examination of spatial variation and does not assume homogeneity across sampling sites within the Project Area (Methratta 2020).

3.4.2.2 Sampling Stations

The Empire Wind BRUV survey is designed to occur seasonally (spring, summer, fall, winter) within the Lease Area, with monitoring targeted for two years pre-construction and two years post-construction. Monitoring is also planned during construction, provided the survey will not interfere with construction operations.

The methodologies and sampling distances employed in previous offshore wind studies were considered in the design of the BRUV survey. Bergstrom et al. (2013) used fyke nets to sample along transects that spanned a distance of 20 to 1,350 m from a turbine foundation and observed that four of the seven fish species examined demonstrated increased densities near the turbine. Griffin et al. (2016) used BRUVs to compare fish abundance and assemblage composition between locations adjacent to turbine foundations vs. 100 m distant in the Irish Sea. Stenberg et al. (2015) used gillnets to sample at three increasing distance categories from the turbine foundations ('near' = 0-100 m, 'middle' = 120-200 m, and 'far' = 230-330 m) and demonstrated that fish with an affinity to rocky habitats were most abundant close to the turbine foundations. In a review of European wind farm case studies, Methratta (2020) noted that the majority of direct effects associated with turbine foundations (e.g., habitat provision, attraction, food provision) are expected to occur on a local scale (i.e., 10 - 100s of meters from the turbine foundation). Currently, the South Fork Wind Farm is conducting a BAG study utilizing a 900-m string of 18 fish pots, spaced 50 m apart, deployed in a straight line away from the base of turbine foundations to examine the spatial extent of wind turbine effects on black sea bass (South Fork Wind, LLC and INSPIRE Environmental 2022).

Sampling will occur at eight randomly selected planned turbine locations. These sampling locations will remain fixed for the duration of the survey (pre- and post-construction). As with the squid trawl survey, the Lease Area with be comprised of two depth strata, where four turbine locations will be sampled in each of the "shallow" (<35 m) and "deep" (>35 m) strata. At each sampling station, four BRUV's will be deployed at increasing distances from the planned turbine foundation location to examine the spatial extent of effects from the turbine foundation and surrounding scour protection (Figure 3-8). During the pre-construction period the first BRUV will be placed within the buffer zone around the planned turbine foundation location. Post-construction, the BRUV will be placed as close to the turbine foundation as is safely possible and that will allow for an adequate field of view around the turbine base. Three additional BRUVs will be placed at distances of 50 m, 100 m, and 200 m from the base of the turbine so that sampling occurs close to the turbine base and outside of habitat altered by turbine construction.

3.4.2.3 Survey Methods

To ensure data comparability and compatibility across wind farm projects, The BRUV survey will be conducted following best practices outlined in Birt et al. 2021 and gear designs provided by Langlois et al. 2020 (Figure 3-9) as outlined in the Ocean Wind Offshore Wind Farm Fisheries Monitoring Plan (2021). BRUVs will be rigged with a vertical line and buoy to the surface to facilitate retrieval of each BRUV. BRUVs will be deployed for approximately 60 minutes. Video will be captured using a camera with high resolution such as GoPro Hero 9 cameras or similar. The video recorded by the BRUVs will be processed by INSPIRE Environmental using computer software appropriate for video analysis (Behavioral Observation Research Interactive Software [BORIS; Friard and Gamba 2016] or similar). All fish will be identified to species when possible. The primary response variable that will be generated from the BRUV's is MaxN, which is the moment in the video where the maximum number of individuals for a given species are observed. MaxN is the most common metric associated with BRUVs (Bicknell et al. 2019) and is considered to be a conservative estimate of relative abundance because it removes concerns that the same fish can be counted more than once (Griffin et al. 2016). Strategic design of each of the BRUVs with two video cameras can enable fish length and distance measurements to be estimated from the recordings. Measurements will only be taken for those species of greatest interest and fisheries value (e.g., black sea bass, tautog). As recommended by Langlois et al. 2020, individual fish lengths will be measured at the same time that MaxN is observed. In order to estimate fish length from the video footage the methods from previous work (e.g., Langlois et al. 2020; Birt et al. 2021; Harvey et al. 2021) will be followed. A secchi disk will be lowered from the vessel at each sampling station to assess the transparency of the water and help quantify visibility and assist with video data analysis.

3.4.2.4 Station Data

The following data elements will be collected during each sampling effort:

- Station number
- Latitude and longitude for each BRUV deployment
- Time at the start and end of the BRUV deployment
- Water depth at each BRUV location
- Wind speed
- Wave height
- Weather conditions (e.g., cloud cover, precipitation)
- Bait type used
- Oceanographic data, as collected using a CTD and a temperature logger (see Section 3.4.1.3).

3.4.2.5 Data Management and Analysis

The BAG survey design will allow for the characterization of pre-construction community structure of fish species present in the Empire Wind Lease Area and will continue sampling after construction to quantify any changes in relative abundance associated with the construction and operation of wind turbines at the site. For the pre-construction monitoring, the results presented in annual reports will focus on descriptive and quantitative comparisons of the fish metrics at increasing distances from a wind turbine foundation to describe spatial, seasonal, and annual differences in relative abundance, species composition, and size distribution. Several statistical models will be compared (e.g., GLM, Generalized Linear Mixed Model [GLMM], or Generalized Additive Model [GAM]) with distance treated as a main effect (continuous variable), and the best fitting model for each species will be used to estimate the 90% CI on the before-after change in the distance coefficient. Further, information on depth and bottom temperature collected at sea may be considered as covariates in the model to evaluate their influence on fish abundances. Habitat data collected during the benthic SPI/PV surveys (Section 4.0) and from Equinor geophysical surveys can also be considered as covariates in the model to evaluate the influence of habitat on fish abundance. Species composition will be compared before and after construction using a Bray-Curtis Index and multivariate techniques (e.g., ANOSIM). Graphical methods and descriptive statistics will be used to assess changes in the fish assemblage over time, as a function of distance from the turbines. These graphical techniques may help to elucidate the spatial scale at which relative abundance changes the most with distance from the turbine foundation. By continuing sampling during and after construction, the BRUV survey will allow quantification of any detectable changes in relative abundance, demographics, and community structure associated with proposed operations. Analyses presented in the final synthesis report will focus on identifying changes in the fish community in the Project Area between pre-and post-construction time periods at increasing distance from the turbine foundations that could be attributed to either construction or operation of the wind turbines.

The primary question to be addressed is whether fish metrics (either abundances of individual species or assemblage composition) will change relative to distance from a turbine foundation following their installation. This research question can be framed using the following hypotheses:

- $H_{\emptyset}$-Fish metrics will not change over time and will remain consistent with respect to the distance from a turbine.
- H_1-Fish metrics will change over time and will not be consistent with respect to distance from the turbine.

Species composition will be compared before and after construction using a Bray-Curtis Index and multivariate techniques (e.g., ANOSIM).

An adaptive sampling strategy will be employed, whereby data collected early in the study will be analyzed to assess statistical power and modify the sampling scheme or sampling intensity as needed (Field et al. 2007). Upon completion of the first four seasonal sampling events, a power analysis (e.g., Gerrodette 1987) will be conducted to evaluate the power of the sampling design. The variance associated with the relative abundance estimates for dominant species in the catch will be calculated. Power curves will be used to demonstrate how statistical power varies as a function of effect size and sample size (i.e., number of samples per area). A single two-tailed alpha (0.10) will be evaluated during the power analysis. The results of the power analysis will be considered and can be used to modify the monitoring protocols in subsequent years. The decision to modify sampling will be made after evaluating several criteria including the amount of variability in the data, the statistical power associated with the study design, and the practical implications of modifying the monitoring protocols.

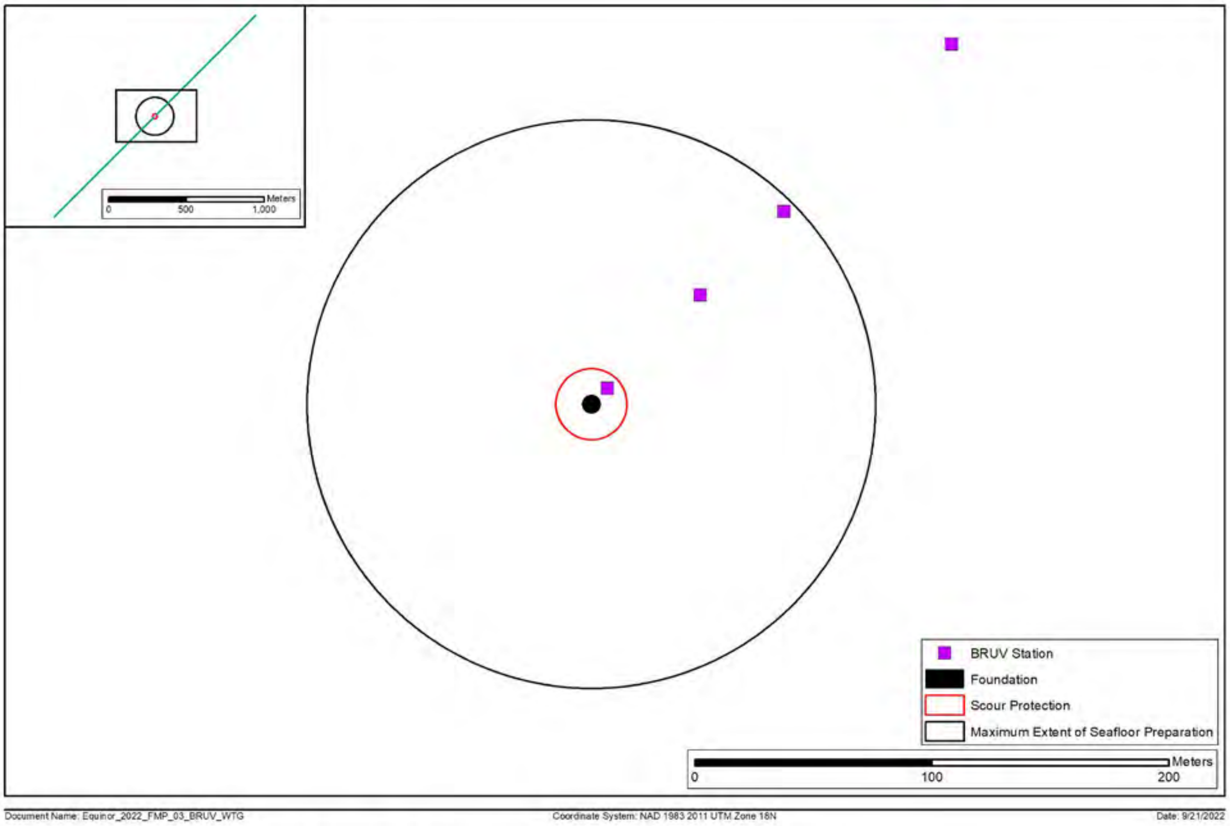

Figure 3-8. Proposed BRUV survey sampling distances

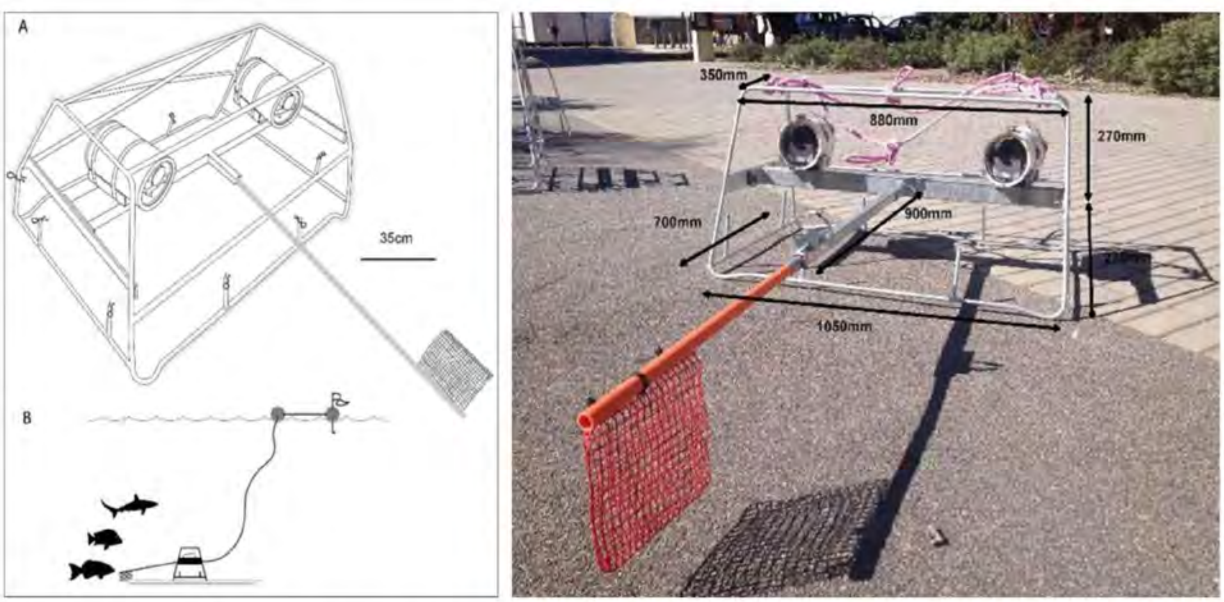

Figure 3-9. Example of BRUV (from Langlois et al. 2018) design to be adapted for use in the Empire Wind BRUV survey

3.4.3 Environmental DNA (eDNA) Sampling

Empire Wind is partnering with researchers from INSPIRE Environmental, Monmouth University, and St. Anselm's College to carry out a comprehensive eDNA survey at the Empire Wind Lease Area. The eDNA sampling will occur concurrent with the trawl and BRUV surveys, enabling a more holistic understanding of the relative abundance and composition of the species assemblage at the Empire Wind site, while ground-truthing a relatively novel, non-extractive monitoring method.

eDNA sampling can be used to collect information on species presence/absence, abundance, and biodiversity. Aquatic animals constantly shed their DNA into the surrounding water in the form of scales, damaged tissue, eggs, metabolic waste, and other biological residue. This DNA persists in the water for a short time period. During eDNA sampling, a small volume of water is collected and filtered. The sample is then analyzed, and the DNA collected in the sample is compared to a genetic reference library. Because each species has a unique complement of genes, the DNA fragments collected in the sample can be used to identify the species that were present in the area when the sample was taken.

eDNA analysis is typically conducted in one of two ways, metabarcoding or qPCR analysis. qPCR is typically used when the analysis is focused on a single species of interest, and the objective is to estimate the relative abundance of the species in the sampling area. With metabarcoding, high throughput genetic sequencing is used to sample for the presence of multiple species in order to investigate questions related to biodiversity and community composition. With metabarcoding, different genetic primers are used to assess the diversity of different taxonomic groups. A metabarcoding approach will be implemented for this monitoring effort and each sample of water will be analyzed for two primers: bony fish and cartilaginous fish, with a third primer analyzed for invertebrates from trawl survey samples.

eDNA offers several advantages over traditional fisheries sampling methods because it is non-extractive, it does not result in stress or mortality to the organisms that are identified. Unlike bottom-tending mobile sampling gear, eDNA sampling can be performed without causing any damage to the benthic habitat, and eDNA does not necessitate the use of fixed vertical lines that can lead to marine mammal entanglements. In addition, eDNA samples can be taken in areas with hard bottom benthic habitats that cannot be sampled using a trawl or other mobile bottom-tending sampling gear. eDNA can also detect a species throughout each stage of its' life cycle, thus avoiding issues associated with size/age selectivity. In the marine environment, experiments suggest that eDNA is detectable for ~48 hours (Collins et al. 2018), meaning that detections represent recent presence of a given fish species, making eDNA a valuable tool for time series. However, one drawback associated with eDNA sampling is understanding the rate at which different species shed DNA into the water column and understanding how that varies as a function of ontogeny, behavior, and abiotic factors such as temperature (Knudsen et al., 2019).

eDNA offers an exciting opportunity to investigate several questions of importance to fisheries science including; monitoring the presence/absence of rare and endangered species, estimating relative abundance, understanding community composition, detecting shifts in species distribution, monitoring the spread of invasive species, and understanding how introduced habitats affect species diversity and abundance. Improvements to DNA reference libraries are continuously occurring (e.g., Stoeckle et al. 2020a) enabling a greater variety of species to be detected through eDNA sampling.

Recent studies have completed paired sampling using eDNA and a trawl survey, and the results offer insights into the capabilities of this innovative technology to improve our understanding of the marine ecosystem (e.g., Thomsen et al. 2016; Knudsen et al. 2019; Liu et al. 2019; Salter et al. 2019; Stoeckle et al. 2020b; Afzali et al. 2021; Kirtane et al. 2021; Russo et al. 2021; Maiello et al. 2022). Stoeckle et al. (2020b) compared species diversity and relative abundance between eDNA samples and trawl catches from the NJDEP seasonal trawl survey. This study used a metabarcoding approach, and two primers were analyzed, one for bony fish, and another for cartilaginous fish. During a given month, 70-87% of the fish species detected by eDNA were also captured in the trawl, and peak seasonal abundance agreed between the two methods for 70% of the fish species. Interestingly, in all months, eDNA results indicated a greater species diversity than trawl sampling, illustrating the promise of eDNA for investigating biodiversity in the coastal ocean.

Salter et al. (2019) conducted paired sampling using eDNA and a trawl survey in the coastal waters of the Faroe Islands. This study used a qPCR approach, where the eDNA sampling was focused primarily on evaluating the distribution and abundance of Atlantic cod. In general, there was good agreement between the two sampling methods with regards to the presence and absence of cod. At the spatial scale of an individual sampling station there was generally low correlation between the biomass of cod observed in trawl catches and the concentration of cod DNA in the sample. However, when the data were aggregated and examined at a regional level, a strong correlation was found between the standardized CPUE of cod in the trawl and the concentration of cod DNA obtained in the sample.

Knudsen et al. (2019) completed paired sampling between eDNA and a trawl survey to compare the relative abundance and distribution of cod, herring, plaice, Atlantic mackerel, and European flounder in the Baltic Sea. While this study did not find significant correlations between eDNA concentrations and trawl survey catch rates, the eDNA concentrations measured for some species were associated with areas where different species were known to be most abundant. In addition, some species such as mackerel and European eel were detected using eDNA but were not present in trawl survey catches. Closek et al. (2019) used multiple methods (eDNA, trawl survey, and visual survey for marine mammals) to investigate the species composition in the Central California Current ecosystem. eDNA samples detected 48 fish taxa, and 11 species of marine mammals. Of the 48 fish taxa identified using eDNA, only 17 taxa were also collected using a trawl. On the other hand, the trawl survey observed 28 fish taxa, of which 17 taxa were also identified using eDNA. This study indicates that paired sampling using eDNA and trawl provides a more holistic understanding of species composition and biodiversity.

Stat et al. (2019) used eDNA metabarcoding and BRUV's to examine species diversity on reef and seagrass communities inside and outside a marine reserve in Western Australia. The fish community described by eDNA and BRUV's combined contained greater than 30% more generic richness than either method sampled on its own. In addition, species not detected by one method were very often detected by the other. Cole et al. (2022) also utilized eDNA and BRUV's to compare biodiversity between structured (oyster reefs) and unstructured (sand) habitats. eDNA metabarcoding detected a greater number of species than BRUV's, but both were able to resolve differences in species diversity between both habitats at fin spatial scales. Mercaldo-Allen et al. (2021) used eDNA in combination with video footage to assess fish assemblages attracted to oyster aquaculture cages and boulder habitat in Long Island Sound. Seven species were identified in the videos compared to 42 species by eDNA.

Two years of sampling are planned prior to the commencement of offshore construction. The eDNA survey will continue during the construction phase, and a minimum of two years of eDNA monitoring will be completed following offshore construction.

The primary research question associated with the eDNA survey is, does the construction and operation of the Empire Wind Project impact the community composition of fishery resources? Several metrics will be evaluated to assess the community composition, including species richness, dominant species, and relative abundance. The use of a BACI sampling design in the bottom trawl survey will allow for quantitative comparisons of community composition to be made before and after construction, and between reference and impact areas (Underwood 1992; Smith et al. 1993). The BAG design of the BRUV survey will allow for the examination of changes in community composition at increasing distance away from turbine locations. Pairing the eDNA sampling with the trawl and BRUV surveys will allow for a more holistic evaluation of community composition over time and space.

3.4.3.1 Sampling Stations

At each trawl survey sampling location in the Empire Wind Lease Area and the reference area, an eDNA sample will be collected (see Section 3.4.1.2). Therefore, during each sampling event, eight samples will be targeted for collection in the Empire Wind impact area and the trawl survey reference area, for a total of 32 samples each year. At each BRUV survey location, four samples will be taken that correspond to the sites where video data is recorded, for a total of 32 samples per seasonal sampling event, for a total of 132 samples each year. Additional surface samples will be taken at a subset of station locations (See Section 3.4.2.2).

3.4.3.2 Survey Methods

To ensure consistency with prior regional eDNA sampling efforts, samples will be collected using the procedures described in Stoeckle et al. (2020b). Briefly, water will be collected with a 1.2 L stainless steel polypropylene-lined Kemerer bottle. The bottle will be triple-rinsed with sample water before collection. At each location, water samples will be collected within 2 m of the bottom. At a subset of locations, paired surface and bottom water samples will be collected to check for differences in the community composition between the surface and the bottom. In addition, to ensure that the water samples have not been contaminated, six control samples will be collected during each survey. The final sample will be collected into a sterilized 1-liter polypropylene bottle and stored on ice or in a freezer until transferred to a laboratory for filtering. If the sample cannot be filtered within 24 hours it will be stored frozen.

Preceding the collection of water samples for eDNA analyses, water quality parameters will be measured in vertical profiles using a CTD as described in Section 3.4.1.3 (in trawl survey). To promote consistency with regional sampling efforts, the filtration and processing procedures described in Stoeckle et al. (2020b) will be followed. Collection bottles will be thawed for ~24 hours at 4°C and contents poured into a glass filter manifold attached to wall suction with a 47-mm, 0.45 µm pore size nitrocellulose filter (Millipore). Filters will be folded to cover retained material and stored in sterile 15-milliliter tubes at -80°C. As negative controls for each sampling event, several 1-liter samples of laboratory tap water will be filtered using the same equipment and procedures, and on the same day as the field samples. After filtration of contents, collection bottles will decontaminated by washing extensively with tap water, including vigorous shaking of partially filled containers with tops closed, and then air-dried and stored at room temperature-a procedure which relies on mechanical cleansing and dilution, eliminates amplifiable fish DNA from field collection bottles and filtration equipment, while avoiding possible exposure of water samples to residual bleach or other DNA destroying agents (Stoeckle et al. 2017). Frozen filters will be shipped to the Analytical Laboratory at University of MD Institute for Marine and Environmental Biotechnology for DNA extraction, library building for finfish, cartilaginous fish, and marine invertebrates, and Illumina sequencing. Products of this service will include de-multiplexed FastQ files and the extracted DNA, which will be archived in a monitored, alarmed –80°C freezer at Monmouth University.

3.4.3.3 Station Data

The following data will be collected during each sampling effort:

- Station number and sample ID
- Latitude and longitude
- Time
- Water depth
- Wind speed
- Wave height
- Weather conditions
- Oceanographic data, as collected using a CTD

3.4.3.4 Data Management and Analysis

Bioinformatics will use the DADA2 package (Callahan et al. 2016) run in R statistical computing environment according to procedures, and using the internal 12S bony / cartilaginous fish libraries, described in Stoeckle et al. (2017) and Stoeckle et al. (2020b). A 100% sequence match will be used to assign species-level taxonomic identifications. The results of bioinformatics analyses will be the number of sequence reads per taxonomic unit identified in the 12S reference sequence list. These data will be summarized in tables and graphs for each sampling event. Raw and processed data will be archived on secure servers at Monmouth University, as well as on removable media (e.g. external SDD drives).

The bioinformatics will be used to test the following hypothesis:

- $H_{\varnothing}$: Fish community composition will not differ before, during, or after construction of the Empire Wind Project
- H_1: Fish community composition will differ before, during, or after construction of the Empire Wind Project.

The following univariate metrics of the fish community composition will be evaluated in the analyses: species richness, dominant species, relative abundance, in addition to appropriate multivariate techniques (Bray-Curtis dissimilarity, non-metric Multidimensional Scaling [nMDS]) The hypothesis will be evaluated for each of the indicators using appropriate means testing techniques depending on the distribution of data collected (ANOVA or Kruskal-Wallis for parametric vs. non-parametric assessment, respectively, and analysis of similarities (ANOSIM) for the multivariate data). If significant differences are found among time periods, or among sampling areas, while controlling for seasonality, additional post-hoc testing will be performed to determine where differences were detected (e.g., before, during, after). In addition, the eDNA samples will be compared to data collected during the trawl and BRUV surveys to evaluate how information on relative abundance, presence/absence and community composition differ between the different sampling approaches. Comparisons of species richness and dominant species can be made seasonally or annually in tables or bar charts. Regression analyses can be used to examine the relationship between relative abundance determined through trawling/video vs. eDNA surveys. Specifically, relative abundance by eDNA will be computed as the number of 'reads' for a given species relative to all reads recovered for fishes in a given sample set (e.g., season), compared to relative trawl abundance (e.g., biomass/tow) of a given species relative to total mass of fish caught in a given season. Similar analyses using these relative proportions were recently published comparing trawl and eDNA assessments of fish community composition and relative biomass (Figure 8 in Stoeckle et al. 2020b). Additionally, in deep-water habitat off southwest Greenland, eDNA sequence reads from fish assemblages were correlated with biomass and abundance data obtained from trawling (Thomsen et al. 2016).

3.4.4 Acoustic Telemetry

3.4.4.1 Survey Design

Empire Wind is partnering with researchers from Monmouth University, Stony Brook University, INSPIRE Environmental, and the Anderson Cabot Center for Ocean Life (ACCOL) at the New England Aquarium to conduct acoustic telemetry monitoring at the Empire Wind Lease Area. This study will use an array of fixed station acoustic receivers to monitor the movements, presence, and persistence of several commercially and recreationally important species (e.g., black sea bass, summer flounder, winter flounder, tautog) as well as the federally endangered Atlantic sturgeon. The focal species and array design were determined based on previous work conducted by the research team within the Empire Wind Project Area (Frisk et al. 2019).

Passive acoustic telemetry can be used to monitor animal presence and movements across a range of spatial and temporal scales. Individuals tagged with an acoustic transmitter that pass within the range (tens to hundreds of meters) of an acoustic receiver provide information on an animal's presence, movements, and behavior at a fine scale within the area of interest. The use of this technology has grown over the last decade with hundreds to thousands of receivers deployed along the US. East Coast (Hussey et al. 2015; Freiss et al. 2021). By utilizing information collected across receiver arrays and shared through established data sharing networks, telemetry can also monitor animal presence and movement over a range of spatial scales (tens to hundreds of kilometers) and time scales (e.g., months to years). Therefore, passive acoustic telemetry is an ideal technology to monitor presence, residency, and movements of species within WEAs using non-lethal methods and to evaluate short and long-term impacts of wind energy projects on these movement parameters.

Acoustic telemetry has been used to investigate the behavior and movements of fish species in offshore wind areas in Europe. Reubens et al. (2013a) monitored juvenile cod residency patterns, habitat use, and seasonal movement at the C-Power offshore wind farm in the North Sea and found that the majority of cod aggregated near the foundations and were resident within the wind farm for extended periods of time in the summer and autumn. Winter et al. (2010) tagged sole (n=40) and cod (n=47) with acoustic transmitters and tracked their movements within the Egmond aan Zee wind farm and a nearby reference area. They concluded that sole did not exhibit avoidance of the wind farm, nor did they appear to be attracted to the foundations. Instead, seasonal movements were interpreted as occurring at spatial scales larger than the wind farm.

Several acoustic telemetry projects are ongoing or proposed at offshore wind lease sites along the US East Coast. Scientists from the Massachusetts Division of Marine Fisheries, the UMass Dartmouth School for Marine Science and Technology, Rutgers University, the Nature Conservancy, Woods Hole Oceanographic Institute, and the Northeast Fisheries Science Center are using acoustic telemetry (fixed and mobile) to monitor habitat preference and utilization of spawning Atlantic cod in and around Cox Ledge within the South Fork (South Fork Wind, LLC and INSPIRE Environmental 2022) and Revolution Wind (Revolution Wind, LLC and INSPIRE Environmental 2021) lease areas. Researchers from the ACCOL and INSPIRE Environmental are conducting a long-term acoustic telemetry project examining the presence and persistence of several HMS within the nine lease areas comprising the Southern New England Wind Energy Area. Researchers from Rutgers University and Delaware State University are using multiple acoustic methods to monitor several different species both within and around the Ocean Wind lease area off the New Jersey coast (Ocean Wind, LLC 2021). Researchers from Monmouth University, Stony Brook University, and the Cornell Cooperative extension are also using acoustic telemetry to monitor the potential effects of electromagnetic fields (EMF) and fish and invertebrate species along the export cable routes of the South Fork and Sunrise Wind Farms (South Fork Wind, LLC and INSPIRE Environmental 2022; Sunrise Wind LLC 2022).

Within the Empire Wind project area, Frisk et al. (2019) demonstrated the use of acoustic telemetry to monitor the habitat utilization of Atlantic sturgeon, winter flounder, summer flounder, black sea bass, striped bass, and several species of elasmobranch. The authors observed seasonal occupancy of the Lease Area by these species, with Atlantic sturgeon utilizing the entire Lease Area in winter. The study greatly enhanced the understanding of sturgeon movements in offshore environments where data are lacking. The current monitoring study will build on the pre-construction findings of Frisk et al. (2019) as well as continue monitoring during construction and post-construction to better understand the movements and utilization of the Project Area by these species.

3.4.4.2 Survey Methods

A receiver array comprised of 34 receivers is proposed for deployment within the Empire Wind Project Area (Figure 3-10). Vemco VR2AR-X acoustic release omnidirectional receivers will provide maximum coverage for robust and rigorous reporting. The VR2AR-X receivers can detect a tagged individual from a radius of 700 to 1,100 m from the receiver location depending on sea conditions, ambient noise, and transmitter strength. Previous ocean arrays maintained by the research team suggest an average detection radius of 1 km. Each receiver will therefore continuously monitor an area of approximately 2 to 3 km^2 over the course of the proposed study. Each receiver will be equipped with a mooring recovery system that will utilize the receiver's acoustic release mechanism to deploy a retrieval line once the receiver is recalled to allow for recovery of the mooring used to anchor the receiver in place. The receivers will be deployed year-round and receivers will be retrieved for data download twice per year.

Vemco acoustic transmitters will be deployed on several species of interest including, but not limited to, striped bass, black sea bass, summer flounder, winter flounder, and Atlantic sturgeon. Capturing of animals tagged within this study will be successfully completed through a variety of proven fishery sampling techniques (e.g., gillnet, long line, rod-and-reel) appropriate for each species. Trawling may be conducted two times per year with a three-to-one two-seam trawl (25-m headrope, 30.5-m footrope) with 12-cm stretched mesh forward netting that tapered down to 8-cm stretched mesh rear netting lined with a 6.4-mm mesh codend liner and towed with 1.5-m Thyboron brand type 11 steel trawl doors (Dunton et al. 2010; Dunton et al. 2015; Melynchuk 2017). Tows will be conducted for 5-10 minutes at speed of 3-3.5 knots. If gillnets are used to sample Atlantic sturgeon, deployed nets from 91.4 m to up to 366 m (example sample nets may be Net 1: up to 365.76 m or 4 panels 13.97 cm Stretch mesh x .90 mm 25 meshes deep; Net 2: up to 365.76 m or 4 panels 25 – 33 cm Stretch x.90 mm 12 - 15 meshes deep). Deployed nets will be continuously monitored, and the vessel will not leave the site of deployed gear. Fish may also be tagged through commercial fish trap and/or rod-and-reel.

Individuals will be surgically implanted with various Vemco acoustic transmitters depending on the size of the fish. Over the duration of the project, 325 tags will be deployed per year. Larger individuals (e.g., striped bass, Atlantic sturgeon) will be implanted with a V16 ultrasonic transmitter (69 kHz, high-power output = 158 dB re 1 µPa at 1 m, random transmitter delay = 120 s, life span = 2,435 d). Medium to small individuals (summer flounder, winter flounder, black seabass, tautog) will be tagged with either a V13 (69 kHz, high-power output = 151 dB re 1 µPa at 1 m, random transmitter delay = 180 s life span = 648 d) or a V9 (69 kHz, high-power output = 152 dB re 1 µPa at 1m, random transmitter delay = 120 s life span = 520 d). Once the transmitter has been inserted, the incision will be closed with a minimum of three absorbable interrupted sutures. The incision area will then be cleaned once more with betadine. A betadine/petroleum ointment will also be put on sutures and site of the incision site to aid in the recovery of the animals to deter bacterial infection.

3.4.4.3 Data Management and Analysis

The resulting detection data downloaded from acoustic receivers will be analyzed with the overall goal of establishing pre-construction information on species presence and persistence in the Empire Wind Lease Area. The primary question to be addressed is, what is the presence, persistence, and space utilization of the species of interest within the Empire Wind Lease Area? This research question can be framed using the following hypotheses:

- $H_Ø$-Species presence, persistence, and movements will not change between time periods (before and after).
- H_1- Species presence, persistence, and movements will change between time periods (before and after).

Short- and long-term presence, site fidelity (i.e., residency/persistence), fine- and broad-scale movement patterns, and inter-annual presence within the Lease Area (i.e., whether individuals return to the receiver array each year) will be examined. Any detection data obtained through participation in regional telemetry data sharing networks (see below) will be incorporated into analyses, particularly to examine the distribution and movements of species beyond the boundaries of the Lease Area. Analyses will include detailed detection history plots for each tagged individual that depict all detections logged for an animal over the course of a year. Summary tables and figures will be generated that describe: the number of times each fish was detected by receivers within the array, the detection history for each fish, the total number of receivers each individual was detected on, movements within the array, and monthly patterns in presence and persistence. In addition to the local-scale acoustic monitoring achieved by the proposed receiver array, broad-scale movement data will be accomplished through participation in regional telemetry data sharing programs, by obtaining detection data from our tagged animals detected within arrays deployed by other researchers in the greater Atlantic region.

All detection data of animals tagged by other researchers and recorded by the acoustic receivers in this study will be distributed to those researchers through participation in regional telemetry networks such as the Ocean Tracking Network or the Mid-Atlantic Acoustic Telemetry Network (MATOS). Detection data obtained for transmitters that are not deployed as part of this study will be disseminated to the tag owners (it is the policy of regional data sharing programs that the 'owner' of the data is the entity that purchased and deployed the transmitter, not the entity that detected it on their receiver). Inclusion of these detection data in analyses will be requested of the tag's owner (i.e., metadata on the species detected, number of detections, amount of time the animal was detected in our receiver array, etc.). Participation in data sharing networks will increase both the spatial and temporal extent of monitoring for species tagged as part of this study and allow for the collection of additional data on the presence and persistence of other marine species tagged with acoustic transmitters in and around the Empire Wind Lease Area.

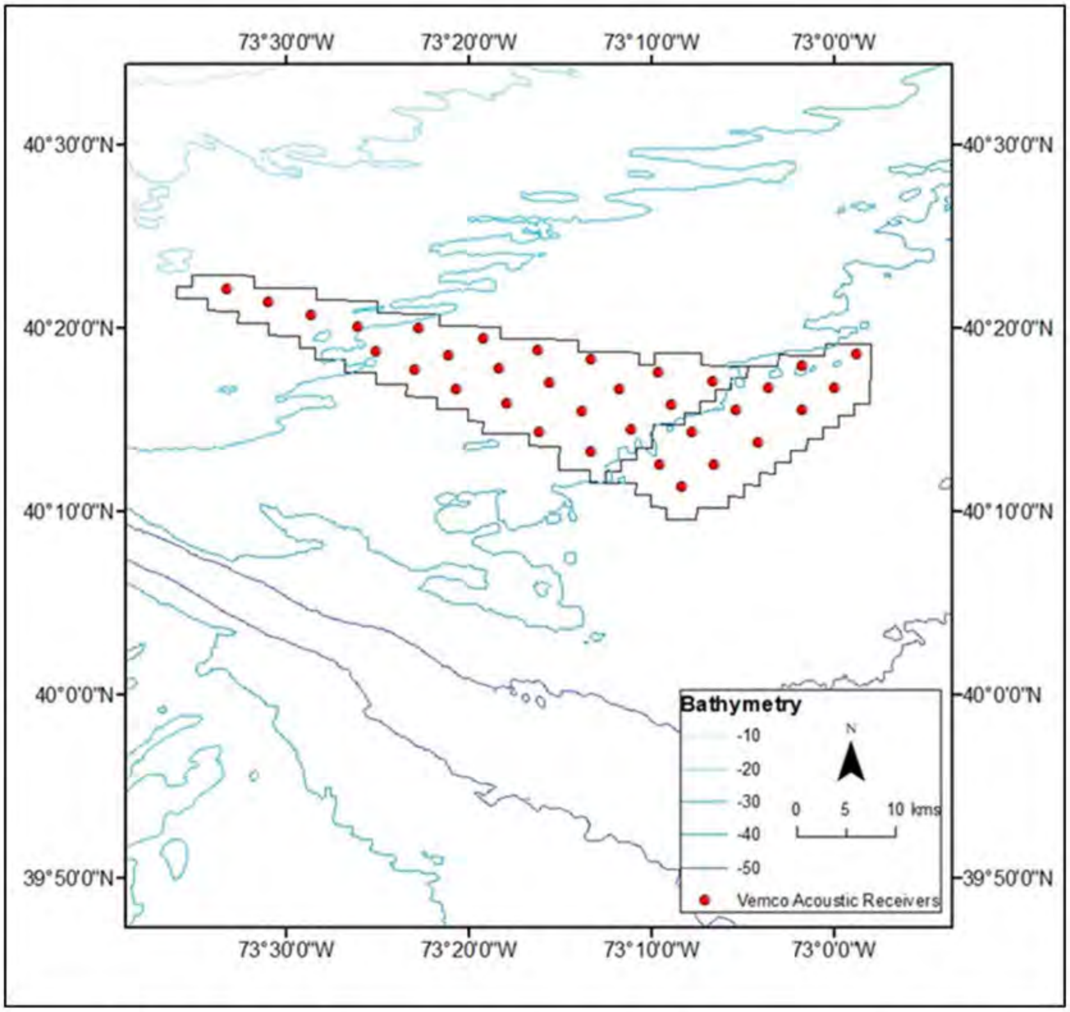

Figure 3-10. Proposed receiver locations within Empire Wind Project Area

3.4.5 Sea Scallop Plan View (PV) Camera Surveys

Sea scallops (*Placopecten magellanicus*) are an important benthic species in the area of the Empire Wind Project. The scallop population in this region support a productive and lucrative commercial fishery (Table 3-4). In particular, the eastern portion of the Lease Area is actively fished for scallops (Figure 3-1). The objective of this monitoring component is to evaluate changes in the density of sea scallops and potential shifts in the spatial distribution of sea scallops within the Empire Wind Lease Area following the construction of the Empire Wind project. These monitoring surveys will be based on seafloor imagery data collected using a plan view camera system. Several long-term fisheries independent scallop surveys utilize similar methods to assess the distribution and density of scallops in the region (UMass Dartmouth School for Marine Science and Technology [SMAST] drop-camera survey and the Habitat Mapping Camera [HabCam] Survey conducted by Coonamesset Farm Foundation). Non-extractive optical-based surveys may provide more accurate estimates of the sea scallop populations compared with dredge surveys, particularly in areas with substantial contributions of recently settled juvenile scallops that evade survey dredges (Rudders 2015).

3.4.5.1 Survey Design

Shifts in the abundance and density of sea scallops in the Empire Wind Lease Area will be assessed using a BACI study design. Similar to other fisheries-independent surveys for scallops in the area, including the UMass Dartmouth SMAST drop-camera survey and the Habitat Mapping Camera (HabCam) Survey conducted by Coonamesset Farm Foundation, this Empire Wind monitoring survey will be conducted annually every summer. Additionally, any potential temporal shifts in the spatial distribution of scallops within the lease area will be evaluated using spatial statistical analyses. Monitoring will include two years of pre-construction data collection, sampling during construction, and for at least two years after construction is completed.

Stations will be distributed systematically in a grid design across the Empire Wind lease area and reference area, which will be the same area selected for the trawl survey (see Section 3.4.1). The sequencing of surveys (trawl and scallop PV surveys) will ensure PV stations will not occur in areas that were recently trawled. A power simulation study was conducted for a BACI design and analysis contrasting scallop abundance between an impact area and reference area. A description of the components of the statistical power analysis are described in Attachment A, which, although specific to the trawl survey, the fundamental elements of the power analysis apply to this BACI designed scallop study, as well. The only major deviation from the trawl survey power analysis methods was the simulation model used. Since changes in density (i.e., scallop counts) will be assessed for the scallop surveys, a GLM with Poisson errors was used. In brief, the statistical power analysis relates the effect size (the measure of change the study design and modelling approach will be used to estimate), the power (the probability of rejecting the null hypothesis when the difference in the data exceeds a threshold effect size), alpha (the Type I error rate), and the sample size (the number of sites, replicates, and time periods sampled). Given, three of these elements, the fourth can be estimated. Thus, this power simulation study was used to explore various sample sizes within specified power and effect sizes.

Estimates of mean scallop density, standard error, coefficient of variation (CV) (%), and the number of stations sampled in 2012 within the New York Bight wind energy areas (i.e., wind energy area #4 was the Empire Wind Lease Area) were provided by Kevin Stokesbury (recently detailed in Stokesbury et al. 2022). These scallop data were collected using a drop camera approach as described in Bethoney and Stokesbury (2018), at stations located within a 5.6 km^2-grid systematic sampling design.

A symmetrical BACI design was tested in this power analysis, with the design variables, determined using Stokesbury data, specified in Table 3-8. Power curves were generated to evaluate how the power for the BACI interaction contrast within a saturated model varies as a function of the variation in scallop density (CV), the effect size (% change between Empire Wind Lease Area site relative to the reference site), the sample size (count of stations in each area during each survey time period), and using a two-tailed alpha of 0.10 (assuming two years of pre-construction and two-years of post-construction monitoring) (Figure 3-11). When analyzing for changes in relative density, achieving a statistical power of at least 0.8 is intended, which is generally considered to be the minimum standard for scientific monitoring (Cohen 1992). This ensures that the monitoring will have a probability of at least 80% of detecting an effect of the stated size when it is actually present.

A sample size of at most 60 stations for each area will be targeted per sampling event at the start of the monitoring. Given the lease area is 321 km^2, this sampling effort (60 stations) equates to about one station every 5.6 km (stations within a 5.6 km^2 grid). Based on the results of the power analysis (Figure 3-11), this level of sampling is expected to have at least 80% power to detect a 50% temporal and/or spatial change in scallop density for moderate coefficient of variation (CV) estimates (0.4 - 0.6). This power analysis will be re-visited after the first year of data collection at the Empire Wind Lease Area and reference area. The observed CV values will be evaluated to determine whether sampling intensity needs to be modified to achieve the desired level of statistical power. If a higher CV is observed (≥0.4) and a smaller change needs to be detected (15%-33%) then additional sampling will be required to maintain a statistical power of 0.8.

Table 3-8. Design Variables for Empire Wind Scallop Survey Power Simulation Study

Set study design variables	
	• Impact Areas = 1 impact area
	• Reference Areas = 1 reference area
	• Frequency = one season per year
	• Number of years Before impact = 2 • Number of years After impact = 2
Variables used in the power analysis	
	• Number of station replicates (random) per season in each area (n): 20 to 110 (16 – 3 km^2 grid, for 325 km^2)
	• Effect Sizes (ES): -15%, -33%, -40%, -50% and 0% (for Type I error*)
	• CVs: 0.15, 0.4, 0.6, 0.8, 1.0

- A two-tailed α = 0.10

*Probability of rejecting the null hypothesis in error because the true difference is small (i.e., < Δ_M)

3.4.5.2 Sampling Methods

At each station, a plan view camera system will be deployed to capture downward facing images of the seafloor. At least eight images will be collected at each station to capture within station variability given the narrower field of view (~0.5 to 1 m^2) relative to the field of view obtained from the drop camera surveys conducted by SMAST. An Ocean Imaging® Model DSC24000 plan view underwater camera system with two Ocean Imaging® Model 400-37 Deep Sea Scaling lasers attached to a steal frame will be used to collect plan view images of the seafloor surface. The PV underwater camera system consists of a Nikon® D7100 or D7200 DSLR camera encased in a pressure housing, a 24 VDC autonomous power pack, a 500 W strobe, and a bounce trigger. A weight is attached to the bounce trigger with a stainless-steel cable so that the weight hangs below the camera frame; the scaling lasers project two red dots that were separated by a constant distance (26 cm) regardless of the field of view of the PV system. The field of view can be changed by increasing or decreasing the length of the trigger wire and, thereby, the camera height above the bottom when the picture is taken. As the PV camera system is lowered to the seafloor, the weight attached to the bounce trigger contacts the seafloor prior to the camera frame reaching the seafloor and triggers the PV camera. Obtaining a clear image of the seafloor is dependent on the water column turbidity and the length of the trigger wire. A tradeoff exists between obtaining a larger field of view by using a longer trigger wire and a highly resolved image given the turbidity conditions, which may limit the distance from the seafloor that the camera can be to obtain a clear image.

3.4.5.3 Statistical Analysis

The BACI design for this survey plan allows for the scallop density to be compared between the before and after construction periods in the two treatment types (reference and Lease Area), using appropriate statistical modeling. Additionally, the spatial distribution and potential temporal shifts in that spatial distribution will be examined using spatial statistical approaches. The use of a reference area will ensure that larger regional changes in sea scallop populations will be captured and delineated from potential effects of the proposed project.

The first two years of the scallop PV survey will be used to characterize the pre-construction sea scallop abundance, density, and spatial distribution within the Lease Area and reference area. For the pre-construction monitoring, the results presented in annual reports will focus on descriptive and quantitative comparisons of the scallop abundance and spatial distribution. An exploratory analysis of spatial temporal changes in scallop density from baseline to post-construction years will be examined to determine if the scallop distribution within the Lease Area has changed between years. A surface trend analysis will be utilized to isolate broad patterns from local patterns, spatio-temporal kriging will be used to explore the spatial and temporal structure of data at baseline and post-construction periods. Lastly, the primary spatial autocorrelative process (clustering, repulsion patterns in scallop density) will be examined.

The primary monitoring objective to be addressed with the PV image scallop survey will be to determine whether scallop density or spatial distribution shifts over time. The monitoring objectives can be framed using the following hypotheses:

- $H_{\emptyset}$-Changes in scallop densities and scallop spatial distributions in both the reference and impact areas will be statistically indistinguishable between time periods (before and after).
- H_1-Changes in scallop densities and scallop spatial distributions will not be the same at the reference and impact areas between time periods (before and after; two-tailed).

In this BACI design, there are multiple years within each time period and a single site within each treatment (reference and Lease Area). A GLM framework will be used to describe the data and estimate the 90% CI on the BACI contrast. At a minimum, treatment type (reference and Lease Area) will be evaluated as a covariate in the model, but the modeling framework could be expanded to include other relevant covariates such as temperature, depth, salinity, the distance to the nearest turbine foundation. The interaction contrast that will be tested is the difference between the temporal change (i.e., average over the post-operation period minus the average over the pre-operation period) at the wind farm and the average temporal change at the reference area. A statistically significant impact would be indicated by a 90% CI for the estimated interaction contrast that excludes zero. Using a 90% CI allows 95% confidence statements for the lower or upper bound (e.g., if the lower bound of the 90% CI for the mean is greater than 0, this indicates 95% confidence that the mean exceeds 0).

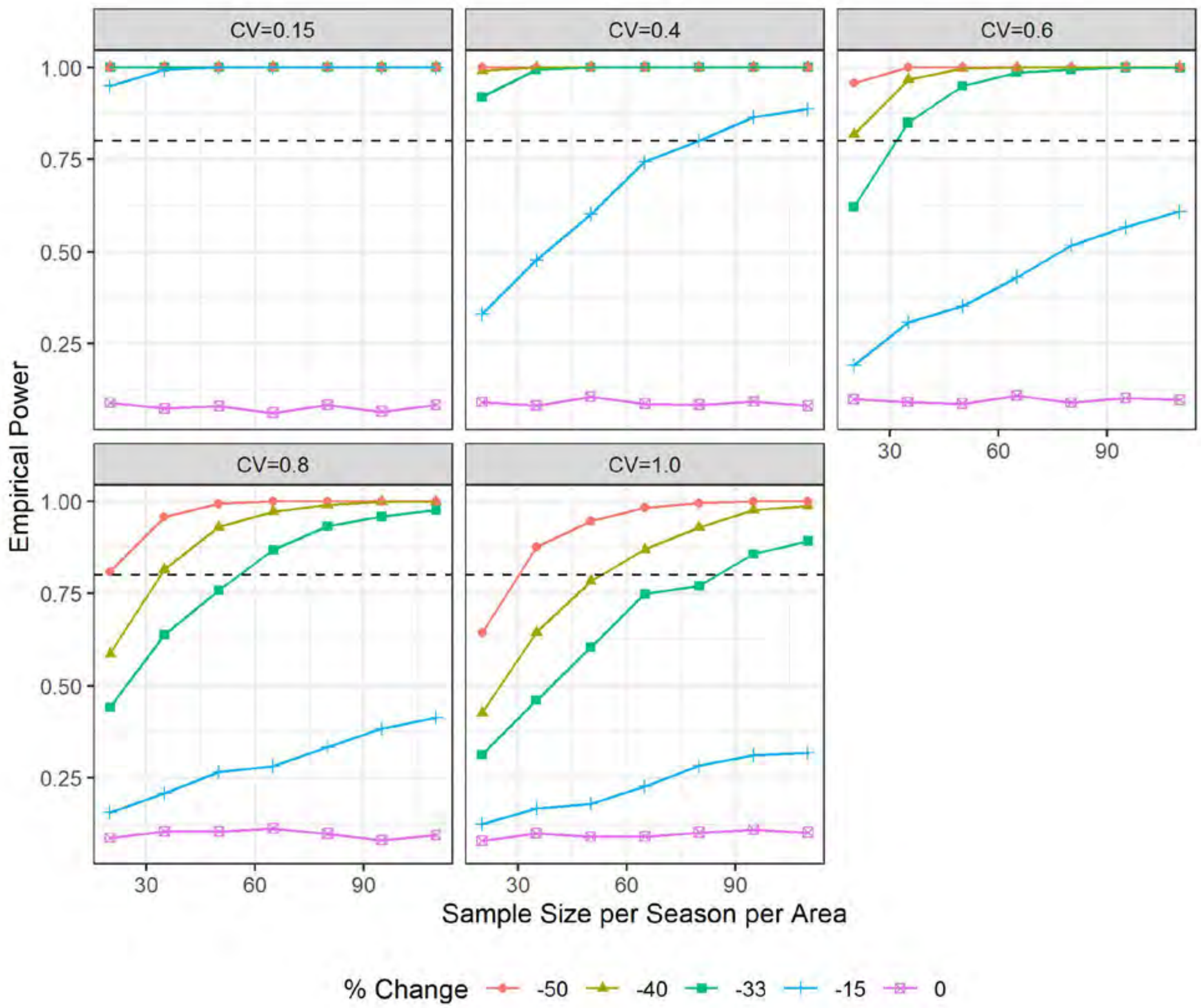

Figure 3-11. Power curves for the BACI interaction contrast within a saturated model for a range of variance (CV), effect sizes (negative % change) and sample sizes in each area per survey time point (n), and using a two-tailed alpha = 0.10. The 0% change illustrates the type I error.

4.0 BENTHIC MONITORING

4.1 EMPIRE WIND BENTHIC HABITAT OVERVIEW

The benthic habitat associated with the Empire Wind Project is described in detail in the COP (Volume 2b, Section 5.5, Equinor 2021) and COP Appendix T (Tetra Tech 2022). Several project-specific benthic and geophysical surveys have been conducted to support the benthic characterization across the Project Area including the two cable route corridors and the Lease Area. These surveys have used several sampling techniques to assess existing benthic habitat characteristics. These techniques span spatial scales, including benthic imagery and grab sampling surveys (described in the COP Appendix T, Tetra Tech 2022) and geophysical survey campaigns (synthesized in COP Appendix H, Marine Site Investigation Report, Gardline 2022).

In addition, existing regional data were compiled, synthesized, and presented in the COP (Volume 2, Section 5.5; Equinor 2021), which includes the BOEM-funded benthic resources data collection, geophysical data collection, modeling, and technical report, Battista et al. 2019, which focused on the Empire Wind Lease Area. Here we provide a summary of the data and interpretations described in detail in the references cited above.

4.1.1 Empire Wind Lease Area

The Empire Wind Lease Area seafloor is predominantly flat with low rugosity and slope (COP Appendix H, Gardline 2022; Battista et al. 2019). The water depths range from about 26 m in the western portion of the Lease Area to about 43 m in the eastern portion of the Lease Area. Generally, the Lease Area exhibits little natural variability with regards to the benthic habitat, consisting mainly of softbottom habitat. The majority of the Lease Area is characterized as rippled sand or mega-rippled sand (in the eastern portion of the Lease) with high occurrence of faunal beds (Battista et al. 2019). The sediments in the Lease Area are composed primarily of sand with shell fragments and shell hash, with some areas of sand with small gravels (i.e., pebbles) and shell fragments (COP Appendix T, Tetra Tech 2022) (Figure 4-1 top panel).

The most commonly observed benthic taxa at the Lease Area during the image-based surveys were benthic-dwelling epifauna, and specifically the common sand dollar (*Echinarachnius parma*) (Battista et al. 2019; and project-specific benthic survey, COP Appendix T, Tetra Tech 2022) (Figure 4-1 bottom panel). Sand dollars were reported to be present at 90% of the 300 stations sampled, and often in high densities, particularly in the eastern portion of the Lease Area (Battista et al. 2019). The dominance of sand dollars in this region is consistent with reports from other regional benthic studies (Malek et al. 2014; Guida et al. 2017). Aside from sand dollars (echinoderms), other benthic groups observed were annelids, molluscs (e.g., moon snails), and crustaceans (e.g, hermit crabs and amphipods) (Figure 4-1 bottom panel). The project-specific benthic characterization survey in the Lease Area also reported high-occurrences of these benthic biota (COP Appendix T, Tetra Tech 2022). The majority of the stations sampled at the Lease Area during the project-specific benthic survey were characterized as Coastal and Marine Ecological Classification Standard (CMECS) Biotic Groups Small Surface-Burrowing Fauna and Mobile Crustaceans on Soft Sediments based on the sieved infauna samples, and Sand Dollar Beds based on the seafloor imagery data (COP Appendix T, Tetra Tech 2022).

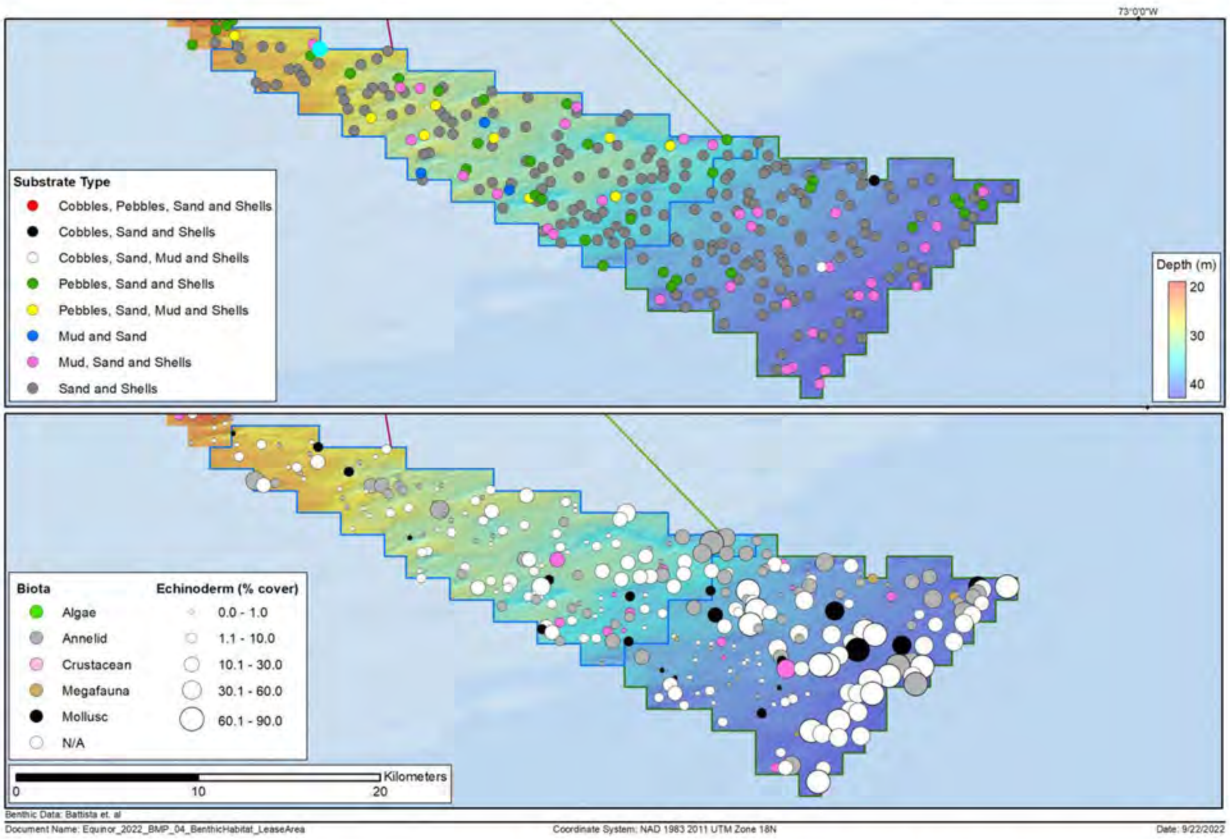

Figure 4-1. Summary of the benthic habitat at the Empire Wind Lease Area including bathymetry, substrate type (top), and biota (bottom), as originally described in Battista et al. 2019

4.1.2 Empire Wind Export Cables

The Empire Wind Project includes two separate export cables: EW 1 and EW 2 (Figure 1-1). The EW 1 export cable transits away from the Lease Area along its northeastern boundary and continues north-northwest across the Ambrose and Nantucket traffic separation schemes towards New York Harbor. The EW 1 runs parallel to the Ambrose Channel as it enters Lower New York Bay, transits through the narrows on the eastern side and makes landfall in Brooklyn, NY. The EW 2 export cable route extends away from the Lease Area at the center of northern boundary. This export cable route transits north-northwest towards Long Island, NY. There are several route alternatives currently being considered at the landfall in Oceanside, NY for the EW 2 route.

Two project-specific benthic characterization surveys were conducted along the export cable routes, which are summarized in the COP (Volume 2b, Section 5.5, Equinor 2021) and detailed results are provided in Appendix T (TetraTech, 2022 and INSPIRE 2019). Additionally high-resolution geophysical data were collected along the entirety of these two route corridors, results of which are reported in the COP (Appendix H, Marine Site Investigation Report, Gardline 2022). Here we provide a summary of the benthic conditions along both EW 1 and EW 2 cable routes (Figure 4-2).

The benthic habitat along EW 1 is generally characterized as softbottom with sediment types ranging from silt/clay to pebbles. The majority of the EW 1 within federal waters was characterized using sediment profile imagery as medium sand, fine sand, or very fine sand; fine-scale sediment layering with layers of coarser grains over finer sediments was frequently documented (Figure 4-2, left). One station located due north of the western-most corner of the Lease Area consisted of pebbles/granules over sand. The portion of the EW 1 export cable route in NY state waters transitioned from fine sand at the state waters boundary to an area of coarse and medium sand at the entrance of New York Bay. In lower New York Bay and through the narrows, the sediments along EW 1 corridor were silt/clay and very fine sand. The dominant CMECS Biotic Group observed in plan view imagery was mainly small and large tube-building fauna (Figure 4-2, right). Sand Dollar Beds, Attached Hydroids, and Mobile Crustaceans were observed in the area due north of the western-most portion of the Lease Area. Mussel Beds and Attached Mussels were observed at the stations within lower New York Bay and off Coney Island.

The benthic habitat along EW 2 is generally characterized as softbottom (Figure 4-2, left). Sediment types ranged from silt/clay to pebbles along EW 2, with fine-scale sediment layering consisting of coarser grains overlying finer grains observed in SPI imagery. High densities of sand dollar beds were observed along the offshore portion of the EW 2 (Figure 4-2, right). This benthic community transitioned to tube-building and surface burrowing infauna near shore along the EW 2 (Figure 4-2, right).

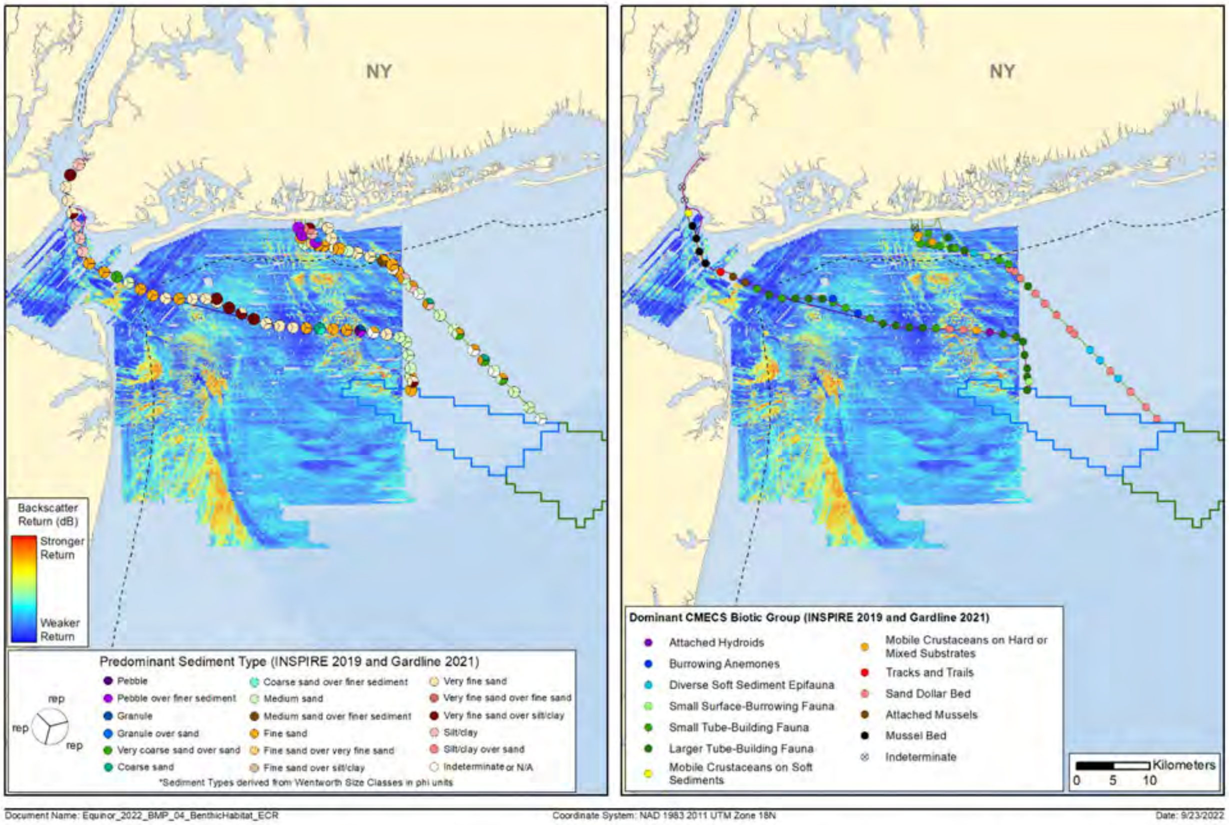

Figure 4-2. Summary of benthic habitat along the Empire Wind Export Cable corridors including sediment type (left), and CMECS Biotic Group (right), originally reported in INSPIRE 2019 and Gardline 2021 (both reports included in the COP Appendix T (TetraTech 2022)

4.2 BENTHIC MONITORING OBJECTIVES AND HYPOTHESES

Installation and operation of offshore wind projects can temporarily disturb existing benthic habitats and introduce new habitats. The level of impact and recovery from disturbance can vary depending on existing habitats at the site (Wilhelmsson and Malm 2008; HDR 2020). Physical disturbance associated with cable and foundation installation can temporarily affect sediments, resulting in mortality or injury of existing fauna. The introduction of novel hard substrata (wind turbine generator [WTG] foundations, scour protection layers, and cable protection layers) can lead to extensive biological growth on the introduced surfaces with complex patterns analogous to depth zonation as observed along shoreline intertidal to subtidal gradients (artificial reef effect, Petersen and Malm 2009; Reubens et al. 2013b; Degraer et al. 2020). Depending on the community composition and density, this biological epifaunal growth may lead to substantial shifts in the transfer of energy from the water column to other compartments of the ecosystem including the surrounding sediments and upper trophic levels.

Observations from existing offshore wind projects lead to three prevailing hypotheses related to benthic effects relevant to the proposed Empire Wind Project:

1. Introduction of novel surfaces (foundations, scour protection, and cable protection layers) will develop epifauna that vary with depth and change over time. *[Hard Bottom-Novel Surfaces]* (as reviewed in Langhamer 2012).

2. The artificial reef effect (epifaunal colonization) associated with the offshore wind structures will lead to enrichment (fining and higher organic content) of surrounding soft bottom habitats resulting in shifts in benthic function (increased organic matter processing). [*Structure-associated – Organic Enrichment*] (e.g., Lefaible et al. 2019; Ivanov et al. 2021).

3. Physical disturbance of soft sediments during cable installation will temporarily disrupt the function of the infaunal community, community function is expected to return to pre-disturbance conditions. [*Cable-associated – Physical Disturbance*] (e.g., Kraus and Carter 2018).

The consequences of these predicted effects may affect the role of soft and novel hard bottom habitats in providing food resources, refuge, and spawning habitat for fish and shellfish species (Reubens et al. 2014; Krone et al. 2017). The focus of the benthic monitoring will be on determining if there are unexpected changes to the benthic ecosystem associated with the development of the wind farm. Specifically, the monitoring will focus on documenting potential adverse outcomes associated with each of these three hypotheses including:

1. Dominance of non-native species relative to native species (Novel Hard Bottom Monitoring),

2. Evidence of impairment associated with organic enrichment on the seafloor surrounding the novel structures, and

3. Delayed recovery from physical disturbance along the export cable routes.

This operational monitoring plan is organized according to these three hypotheses (and potential adverse outcomes) associated with the Empire Wind Project. The plan describes the overall approach to tracking changes in both the novel hard bottom and soft bottom habitats associated with the Project development and operation. This monitoring plan is not designed to answer research questions about specific causes and effects on individual species but rather is aimed at monitoring potential changes associated with the benthic habitats of the Empire Wind Project. A comprehensive outline of the benthic monitoring plan, including the hypotheses, sampling schedule, and general approach for each monitoring component is provided in Table 4-1. The planned statistical analyses are summarized by survey type in Table 4-2.

Table 4-1. Summary of the Benthic Monitoring Plan Including Hypotheses, Approach, and Sampling Schedules for Each Component

Novel Hard Bottom

WTG/OSS Foundations, Scour and Cable Protection

Hypothesis: epifaunal community will vary with water depth (zonation with light and tide); successional development of epifaunal community over time

Approach: Use ROV/stereo camera to measure changes in % cover, identify key or dominant species, focus on documenting non-native species, estimate volume (biomass), compare across water depths

Design: stratified random selection of WTG foundations within water depth contour strata; both OSS foundations sampled [same foundations as Structure-associated Organic Enrichment Surveys]; selection of export cable protection areas to be determined following cable burial risk assessment

Y0 – late summer/early fall after construction
Y1- ROV/stereo camera late summer/early fall
Y2- ROV/stereo camera late summer/early fall
Y3- ROV/stereo camera late summer/early fall
Y5 – ROV/stereo camera late summer/early fall

Soft Bottom Habitats

Structure-associated Organic Enrichment

Hypothesis: epifaunal growth on foundations will result in sediment fining and higher organic content in surrounding soft bottom, this will support deposit feeding benthic invertebrates. Effects will decrease with increasing distance from structure foundation.

Approach: Use SPI/PV, sediment grab samples (organic matter characterization, grain size) to measure changes in benthic function over time and with distance from foundations, focus on documenting any evidence of impairment (Beggiatoa, methane, zero aRPD depth)

Design: stratified random selection of foundations within water depth contour strata [same foundations as Novel Hard Bottom surveys]; BAG design at each selected foundation:
2 radial transects at each foundation –

- 2 stations on scour protection (SPI/PV),
- 0-10m (SPI/PV + sediment samples)
- 15-25 m (SPI/PV)
- 40-50 m (SPI/PV + sediment samples)
- 90-100 m (SPI/PV)
- 190-200 m (SPI/PV)
- 900m (SPI/PV + sediment samples)

Pre seabed prep – within 6 mo prior to construction
Y0 – late summer/early fall after construction
Y1 – late summer/early fall
Y2 – late summer/early fall
Y3 – late summer/early fall
Y5 – late summer/early fall

Cable-associated Physical Disturbance

Hypothesis: After initial physical disturbance during construction, soft sediment community function is expected to return to pre-conditions; effects will decrease with increasing distance from cable

Approach: Use SPI/PV to measure changes in benthic function over time and with distance from cable centerline; focus on documenting any delayed recovery following disturbance.

Design: stratified random selection of cable segments within benthic habitat and depth strata; BAG at each selected cable segment, triplicate transects perpendicular from cable centerline – 16 stations along each transect with varying distances from cable

Pre seabed prep – within 6 mo prior to construction
Y0 – late summer/early fall after construction
Y1 – late summer/early fall
Y2 – late summer/early fall

Table 4-2. Summary of Planned Statistical Analyses for the Benthic Monitoring Surveys at Ocean Wind

Survey	Novel Hard Bottom Monitoring	Structure-associated Organic Enrichment	Cable-associated Physical Disturbance
Monitoring Plan Section	4.3	4.4	4.5
Area	Empire Wind Leases and Export Cable Segments with Cable Protection	Empire Wind Leases	Export Cable Routes
Design Type	Stratified Random	BAG	BAG
Design Overview	WTG foundations: random samples (WTGs) stratified by depth range; single season. Substation foundations will also be sampled. Segments of export cable where cable protection materials were used.	Impact only (no reference sites); stns at distances ranging from ~10 m to ~900 m from foundations; 2 directions from each foundation along prevailing current; single season	Impact only (no reference sites); stns at distances ranging from ~5 m to ~1 km from cable; ≥ 3 transects within each habitat stratum.
Number of Replicates	4 replicate WTGs per depth stratum; 2 OSS foundations; 4 replicate export cable segments with protection (locations TBD)	4 replicate WTGs per depth stratum; 2 OSS foundations;	3 replicate transects per habitat type
Sampling Effort	2 OSS jacket + [2 depth ranges x 4 WTGs] = **~10 structures** 4 segments of protected cable	~ 10 structures x 2 transects x 8 stations = **160 SPI/PV stations**	3 habitat strata x 3 transect replicates x 16 stations along each replicate transect = **144 SPI/PV stations**
Design details	**Sampling frame =** turbine foundations **Observational unit** = imaged quadrat (at systematically sampled depth intervals within frame) **Response variable** = macrobiotic cover, relative abundance of native vs non-native, presence of sensitive taxa and species of concern **Error variance** = among image quadrats at the same depth- and distance-direction (WTGs provide replication)	**Sampling frame** = turbine foundations with mobile sediment classes up/down current **Observational unit** = SPI/PV station (WTGs randomized first survey event, then fixed throughout study; stations randomized every survey; replicate images are subsamples) **Response variable** = mean or max per station depending on metric. **Error variance** = among stations at the same distance-direction (WTGs provide replication)	**Sampling frame** = soft bottom areas of export cable routes **Observational unit** = SPI/PV station (transects randomized first survey event, then fixed throughout study; stations randomized every survey; replicate images are subsamples) **Response variable** = mean or max per station depending on metric. **Error variance** = among stations at the same distance-direction (transects provide replication)

Survey	Novel Hard Bottom Monitoring	Structure-associated Organic Enrichment	Cable-associated Physical Disturbance
Metrics of Interest	**ROV/stereo-camera**: cover (macrobiota, relative abundance of native vs. invasive). **Photogrammetry**: Estimate of biomass/biovolume	**SPI**: aRPD, Successional Stage, penetration, methane, grain size major mode, *Beggiatoa* **PV**: cover (macrobiota, shells, cobble), presence/absence of sensitive or invasive species **Sediment Grab:** percent organic matter, total organic carbon, total nitrogen, C:N	**SPI**: aRPD, Successional Stage, penetration **PV**: cover (macrobiota, shells, cobble), presence/absence of sensitive or invasive species
Hypothesis framework	Introduction of novel surfaces will develop epifauna (specifically focused on documenting non-native species, sensitive taxa, species of concern) that vary with depth and change over time.	The artificial reef effect associated with novel structures will lead to enrichment (fining and organic matter content) of surrounding seafloor leading to shifts in benthic function (differences in aRPD depths, bioturbation depths, infaunal successional stage, grain size)	Physical disturbance during cable installation will disrupt benthic function, effects expected to decrease with distance from export cable and over time
Post-Construction Statistical Methods	Fit a parametric generalized model (e.g., GLM, GLMM or GAM) or non-parametric regression tree that best describes the data. Compare the temporal profiles across spatial gradients. Calculate similarity between stations; graphically depict relationships between stations from different years, directions, or distances with nMDS.	Fit a parametric generalized model (e.g., GLM, GLMM or GAM) or non-parametric regression tree that best describes the data. Compare the temporal profiles across spatial gradients. Calculate similarity between stations; graphically depict relationships between stations from different years, directions, or distances with nMDS.	Fit a parametric generalized model (e.g., GLM, GLMM or GAM) or non-parametric regression tree that best describes the data. Compare the temporal profiles across spatial gradients. Calculate similarity between stations; graphically depict relationships between stations from different years, directions, or distances with nMDS.

4.3 NOVEL HARD BOTTOM MONITORING – WTG FOUNDATIONS AND CABLE PROTECTION

Hypothesis 1: Introduction of novel surfaces (foundations, scour protection, and cable protection layers) will develop epifauna that vary with depth and change over time. *[Hard Bottom – Novel Surfaces]* (as reviewed in Langhamer 2012).

The hard bottom monitoring will include an examination of three types of novel surfaces: WTG foundations (including associated scour protection layers), export cable protection layers, and the OSS foundations. The primary objective of the novel hard bottom survey is to measure changes (over time and water depths) to the nature and extent of macrobiotic cover of novel hard bottom associated with the Empire Wind Project. The focus of this monitoring will be to document the potential presence and relative dominance of non-native species within the epifaunal communities. Macrofaunal percent cover, identification of species (to the lowest possible taxonomic unit [LPIL]), and the relative abundance of native and non-native organisms will be documented using a Remotely Operated Vehicle (ROV) and stereo camera surveying approach. Distinguishing non-native organisms may require physical sampling for accurate identification, which will be facilitated by a sampling arm attached to the ROV or by validation with eDNA analyzed in samples collected as part of the Fisheries Monitoring Surveys.

It is expected that the epifaunal community that colonizes the WTG foundations will vary with water depth, dictated by the availability of light and tides, similar to zonation patterns commonly observed at coastal rocky intertidal habitats. Previous studies in Europe and at the Block Island Wind Farm (BIWF) found biological growth led to dense accumulations of filter feeding mussels on the turbine foundations, with amphipods, tunicates, sponges and sea anemones in the deeper segments of the structures (De Mesel et al. 2015; HDR 2020; Wilber et al. 2021; Hutchison et al. 2020). Other studies have also tracked and documented vertical zonation of epibenthic communities along the surface of wind turbine structures (Bouma and Lengkeek 2012; Hiscock et al. 2002; HDR 2020). At any given depth of the offshore wind structure, the epifaunal species composition is expected to develop successionally, with rapid opportunistic organisms pioneering the site and being replaced by more long-lived established species.

4.3.1 Technical Approach – Stereo Camera Imagery

To accomplish the objectives of the novel hard bottom monitoring, we will collect high-definition (HD) video imagery and ultra-high definition (UHD) stereo imagery using a compact ROV. This imagery will be used to document epifaunal community characteristics on the novel hard surfaces (WTG foundations and scour protection layers, OSS jacket, cable protection layers). The compact ROV will be equipped with a surface differential positioning system, an Ultra Short Baseline (USBL), and motion and depth sensors. The ROV will host 1) one downward facing UHD stereo camera to observe and capture high-resolution images of the seafloor surface, 2) one forward facing UHD stereo camera to collect data on vertical surfaces and avoid collisions, and 3) one HD video camera.

The focus of the UHD stereo imagery analysis will be biological features (e.g., percent cover of encrusting epifauna), identifying any non-native organisms, sensitive taxa, species of concern, presence of refuge, and quantifying the biomass of the dominant members of the epifaunal communities. The focus of the HD video will be to provide quantitative details of habitat characteristics and quality, including categorical levels for the presence of fish and decapods, and surrounding substrata (sediment type), and the percent cover of emergent fauna.

Images provide a data rich record of benthic communities. However, images flatten the landscape, which can introduce bias, limit identification, and distort quantitative analyses. By building 3D models from images, i.e., photogrammetry, we can overcome these challenges, which will allow for quantitative detection of changes at target sites (e.g., Bruno et al 2013). Photogrammetry is the process in which imagery is interpreted to provide detailed information about the physical objects observed in space. Specifically, photogrammetry generates high-resolution, photo-realistic 3D models from static images captured from multiple perspectives.

Although photogrammetry with single-camera systems cost less and integrate with low cost and free software (e.g., Agisoft Metashape and Meshromo), these systems require invasive and sometimes destructive methods including scene preparation for calibration (e.g., the placement of coded targets). Therefore, we will use a stereo-camera system. Stereo cameras do not require scene preparation because they are scaled by specific manufacturer's calibration of the two cameras with each other. Stereo-camera systems are not new. For example, Done reconstructed a habitat scale 3D model of a coral reef, using a stereo camera, over forty years ago (Done 1981). Compared to single camera systems, few researchers use stereo cameras to monitor ecological change because, until recently, commercial vendors did not offer these types of these systems for subtidal work. Now, commercial vendors manufacture stereo cameras systems and support their use in offshore, subtidal habitats to monitor equipment and environmental impacts for multiple energy industries.

We will collect UHD images at depth intervals along the turbine foundations and discrete areas of the cable protection layers will capture high-resolution images. The data will include the photographs, the calibrated 3D products, including a dense point cloud with color, a mesh, and a textured mesh. Preliminary tests yielded models with sub mm accuracy. We will use the point cloud and mesh in quantitative analysis, and we will use the textured mesh for communication.

By digitally reconstructing segments of the foundations and cable protection at predefined depth intervals, the resulting model can be analyzed for quantitative variables including percent cover, standing biomass, and abundance of individual taxa of interest (as reviewed in Marre et al. 2019). Collecting imagery and constructing spatial photogrammetric models of the structures soon after construction will provide initial reference conditions that can be used to track biological changes over time following subsequent years of data collection (i.e., change analysis).

Using the 3D model, we can also evaluate the abundance of refugia by calculating rugosity. We will evaluate the presence of refugia by quantifying three-dimensional complexity in the reconstructed 3D model. We will calculate three-dimensional complexity, i.e., rugosity (f_r), as $f_r = A_t/A_g$, where A_t is the true surface area of a complex object and A_g is the geometric surface area of a 3D convex hull wrapping the complex object. Larger values indicate more refugia, and values closer to 1 indicate fewer refugia. We will calculate A_t and A_g from the reconstructed 3D models from 10 sub-sampled chunks for each each replicate area, e.g., in python or meshlab. This analysis is comparable to the traditional field methods for rugosity using a transect tape and chain, however, using a virtual 3D model, we can collect more and better data in 3D versus in 2D.

Biological data obtained through photogrammetry can be used to estimate ecological functions including secondary production, and physiological rates such as biodeposition associated with the epifaunal community. These biological processes have implications to the transfer of energy to higher trophic levels and to the sediments at the base of the novel structures. This approach will provide an estimate of the increase in standing stock biomass at the basal trophic levels where filtering feeding epifauna (e.g., blue mussels, sea squirts) exist. This information can inform ecosystem models that seek to understand how these changes to the basal trophic level may alter food web dynamics, objectives that are beyond the scope of this monitoring plan.

The following parameters will be measured as part of the hard bottom analysis.

UHD stereo images:

- Community assemblages
    - Percent cover of encrusting or colonial taxa
    - Number of solitary taxa
- Species identification to the lowest possible taxonomic level
    - non-native species
    - species of concern (Guida et al. 2017)
    - sensitive species (e.g., slow growing species)
    - ecologically valuable taxa (e.g., biogenic structure-forming taxa such as emergent fauna)

HD Video:

- CMECS Substrate Group and Subgroup
- CMECS Biotic Subclass and Group
- Presence of fish, identified to lowest possible taxonomic level

3D model reconstructed from UHD stereo images:

- Rugosity
- Volume

4.3.2 Survey Design

ROV stereo camera surveys will monitor novel hard bottom habitats within subareas of the Empire Wind Project. For each selected area, we collect UHD images with a stereo camera following vendor-specific protocol. For example, we will likely collect images with auxiliary lights, with at least 50% overlap for all survey lines, with ~1 m stand-off distance, in a lawnmower pattern. Furthermore, we will render a live sparse point cloud to identify and fill gaps in the model by collecting additional images, if this service is provided by the vendor.

Replicated WTG foundations will be selected using a stratified random design, as described below. Both OSS foundations will be selected for monitoring at the same intervals as described for the WTG foundation surveys. Selection of cable protection areas for monitoring will be dependent on where cable protection is used, information that is not currently known. Segments of the export cable that is armored using cable protection material, will be selected randomly considering environmental factors including water depth, natural benthic habitat of the surrounding seafloor, and distance from shore as explanatory variables. For analysis, we will analyze select images and sections of the 3D models as described below. Segments of the export cable that is armored using cable protection material, will be selected randomly considering environmental factors including water depth, natural benthic habitat of the surrounding seafloor, and distance from shore as explanatory variables.

For the WTG foundation monitoring program, a stratified random design, with water depth ranges as strata, will be used to select the novel WTG structures that will be monitored. The same WTG foundations selected for this novel hard bottom survey will be monitored as part of the soft sediment enrichment survey (see Section 4.4). This will help facilitate synthesis between the degree of enrichment in the surrounding soft sediments and the epifaunal community composition and density colonizing the novel structures at any given time and location. The same WTG foundations selected for this novel hard bottom survey will be monitored as part of the BRUV surveys (see Section 3.4.2). This will aid in drawing inferences between epifaunal colonization with habitat use by mobile vertebrates.

The Empire Wind Project Lease Area will be divided into two strata based on depth (<35 m [shallow] and >35 m [deep]). Four replicate WTGs will be randomly selected within each of the two depth strata for sampling. These replicate WTGs will be scanned and sampled during each survey event (Table 4-1). The hard bottom monitoring will occur in late summer/early fall for each survey. The initial baseline survey will occur during the first late summer/early fall following construction (Y0). The survey will then be repeated annually for the next three years (Y1, Y2, Y3) and again five years after construction (Y5).

4.3.3 Statistical Analyses

The planned statistical analyses are summarized by survey type in Table 4-2.

For the *Novel Hard Bottom Monitoring* dataset collected at WTG foundations and scour protection layers, OSS jacket, cable protection layers, data analysis will include exploratory multivariate approaches (e.g., non-metric Multidimensional Scaling [nMDS]) to identify patterns among responses (community composition; relative abundance of sensitive taxa, species of concern, non-native species, and ecologically valuable taxa; rugosity, and volume) and predictors (e.g., depth; distance from the turbine; time since construction). Covariates in the model for the turbine foundation dataset will include direction (categorical); variability among turbines will provide site-wide random error. For individual metrics that are consistently measured across tubines, parametric or non-parametric regression (e.g., generalized modeling such as GLM or GAM; or regression trees) will be applied if the data prove to be sufficient and appropriate for these tools.

Additionally, graphical methods and descriptive statistics will be used to assess changes in the community composition and relative abundance over time and as a function of depth, and distance and direction from the novel structures (e.g., turbines). These graphical techniques may help to elucidate the spatial scale at which the greatest changes in benthic habitat quality occur.

4.4 STRUCTURE-ASSOCIATED ORGANIC ENRICHMENT

Hypothesis 2: The artificial reef effect (epifaunal colonization) associated with the offshore wind structures will lead to enrichment (fining and higher organic content) of surrounding benthic habitats resulting in shifts in benthic function (increased organic matter processing). [*Soft Bottom – Structure-associated*] (e.g., Lefaible et al. 2019; Ivanov et al. 2021).

The *Structure-associated Organic Enrichment* monitoring will include an examination of two offshore wind components: WTG foundations and the OSS foundations. The overall objectives of this component of the benthic monitoring program are to measure potential changes in the benthic function of the benthic habitats surrounding these novel structures over time, and to assess whether benthic function changes with distance from the base of the foundations. The focus will be on monitoring for and documenting any evidence of impairment associated with organic enrichment on the seafloor surrounding the foundations (e.g., *Beggiatoa,* methane presence, zero aRPD depth [no oxygen penetrating into the sediment]).

It is expected that the epibenthic community that colonizes the novel structures will supply organic matter to the sediments below through filtration, biodeposition, and general deposition of detrital biomass. This organic material sourced from the biological activity of the epibenthic community on the novel structures will likely alter the infaunal community activity, increasing sediment oxygen demand (SOD) and promoting the activity of deep-burrowing infauna. Based on benthic monitoring results in other offshore wind farms, the effects of the foundation on the surrounding soft sediment habitat are expected to decrease with increasing distance from the foundation (as reviewed in Degraer et al. 2020 and modeled in De Borger et al. 2021).

Benthic functioning of the soft bottom habitats at the base of the novel foundations will be captured using sediment profile and plan view (SPI/PV) imagery, sediment grain size analysis, and organic matter characterization. These approaches will be employed at varying frequencies and spatial resolution as described below. The SPI/PV imagery will provide an overall integrated assessment of the physical parameters (grain size major mode) and biological factors (bioturbation depths, aRPD depths, methane production). At some stations, the SPI/PV imagery will be supplemented by sediment grab samples analyzed for grain size, percent bulk organic matter, and total organic carbon and nitrogen content, which will provide insight into shifts in the organic matter loading to the sediments and the quality of the organic matter in the sediments (carbon to nitrogen ratio).

4.4.1 Technical Approach – SPI/PV

SPI/PV will be used as the primary monitoring approach for the *Structure-associated Organic Enrichment* monitoring surveys. The SPI and PV cameras are state-of-the-art monitoring tools that capture benthic ecological functioning within the context of physical factors. The PV system captures high-resolution imagery over several meters of the seafloor, while the SPI system captures the typically unseen, sediment–water interface in the shallow seabed. Coupled SPI/PV imagery provides an integrated, multi-dimensional view of the benthic and geological condition of seafloor sediments and can be used to characterize the function of the benthic habitat, physical changes, and recovery from physical disturbance following the construction and during operation of the Empire Wind Project. Additionally, PV data will be used to characterize surficial geological and biotic (epifaunal) features of hard bottom areas within the sampling area (e.g., scour protection layers at the base of the foundations) but will not replace the dedicated novel hard bottom monitoring survey (Section 4.3).

SPI/PV imagery provides spatial and contextual information, such as oxygen penetration depths (apparent redox potential discontinuity [aRPD] depth), infaunal bioturbation depths, and small-scale grain size vertical layering that are critical pieces to assessing the ecological functioning of soft sediment habitats. Specifically, ecological functions related to organic matter processing, secondary production, and the forage-value of the benthic community are of particular importance when assessing impacts of offshore wind structures on soft sediment habitats (see Attachment B for more details). Taxonomic analysis of sediment grab samples provides information on the benthic community composition and infaunal abundances, but without making substantial inferences to relate presence and counts to biological activity and further ecological value or function, the sediment grab approach is severely limited in its ability to assess impacts of offshore wind development on soft sediment functioning. Further, given the inherently dynamic and patchy nature of infaunal populations, benthic species count data generally requires extensive replication, substantial transformations for normalization, and overextending inferences to relate species composition to function. SPI/PV imagery provides an effective snapshot of the overall ecological health and condition of the sediments as reflected and integrated over time and space by the continuous activity of the infaunal and epifaunal communities present (Germano et al. 2011). It is this holistic community activity, not necessarily the identity of community members, that requires careful assessment to determine impacts of offshore wind development on benthic habitats. Attachment B provides detailed justification for the use of SPI/PV imagery approach to meet these monitoring objectives and more detailed descriptions of several of the parameters that will be obtained during SPI/PV image analysis.

The SPI/PV system will collect quantitative data on measurements associated with physical and biological changes related to benthic function (bioturbation and utilization of organic material) that might result from construction and operation of the Empire Wind Project. SPI/PV and the parameters derived from these images are standard tools for assessing the response to disturbance and enrichment (Germano et al. 2011). Seafloor geological and biogenic substrates captured in SPI/PV imagery will be described using the Coastal and Marine Ecological Classification Standard (CMECS; FGDC 2012). Triplicate images will be collected and analyzed at each station.

The following parameters will be measured during SPI and PV image analysis:

- CMECS Substrate Group and Subgroup
- gravel size measurements (predominant, minimum, maximum), where applicable
- CMECS Biotic Class and Subclass
- aRPD depth (See Attachment B)
- maximum bioturbation depth
- infaunal successional stage (See Attachment B)
- methane presence/absence
- grain size major mode
- presence, frequency, size of surficial features such as bedforms (e.g., sand ripples)
- presence of sensitive taxa (e.g., slow growing species) and ecologically valuable taxa (e.g., biogenic structure-forming taxa such as emergent fauna) (See Attachment B)

Results from the three replicate images at each station will be aggregated to provide a summary value for each metric by station. Depending on the metric type, this will include mean, maximum, or predominant (categorical variables) (e.g., predominant CMECS Substrate Subgroup, maximum infaunal successional stage, maximum and median feeding void depth, and mean aRPD depths).

4.4.2 Technical Approach – Sediment Sampling

Sediment samples will be collected and analyzed for grain size distribution and organic matter characteristics. Sediments are expected to become more organically enriched over time and closer to the foundation structures as detrital material originating from the epifaunal community activity (e.g., biodeposition) falls to the surrounding seafloor. The level of organic enrichment and organic matter loading will be assessed by analyzing sediment samples for bulk percent organic matter and total organic carbon and nitrogen content. The percent organic matter of the sediments (measured as loss-on-ignition) is expected increase over time and decrease with distance from the structure. In addition to the quantity of organic matter in the sediments, the quality of sediment organic matter is important to consider when assessing shifts in benthic function. The quality of sediment organic matter will be assessed by analyzing sediment samples for organic carbon and total nitrogen content. The organic carbon to nitrogen ratio (C:N) of sediments provides insight into the quality or lability of the organic matter (i.e., how available it is to be decomposed or consumed). Finally, it is expected that the sediment grain size will become finer over time and closer to the foundation structures. This will be measured using both SPI/PV imagery (grain size major mode) and physical sediment samples analyzed for grain size distribution.

4.4.3 Survey Design

The *Structure-associated Organic Enrichment* monitoring will be conducted using a BAG survey design to determine the spatial scale of potential impacts on benthic habitats at the Empire Wind Lease Area. The same WTG foundations selected for the Novel Hard Bottom monitoring (Section 4.3) will be selected for the *Structure-associated Organic Enrichment* monitoring. The Empire Wind Project Lease Area will be divided into two strata based on depth (<35 m [shallow] and >35 m [deep]). Four replicate WTGs will be randomly selected within each of the two depth strata for sampling. The surrounding seafloor of these replicate WTG foundations will be surveyed during each survey event (Table 4-1).

At each replicate WTG foundation and the two OSS, a BAG survey design will be used for statistical evaluation of the spatial and temporal changes in the surrounding benthic habitat (Underwood 1994; Methratta 2020). Data will be collected before and after installation and operation of Empire Wind at stations oriented along a gradient from select foundations (Figure 4-3). This BAG design is based on an understanding of the complexities of habitat distribution at Empire Wind (COP Appendix T, Tetra Tech 2022), and an analysis of benthic monitoring results from European wind farms and the RODEO study at BIWF (HDR 2020; Coates et al. 2014; Dannheim et al. 2019; Degraer et al. 2018; Lefaible et al. 2019; Lindeboom et al. 2011). The proposed BAG survey design eliminates the need for a reference area, as this design is focused on sampling along a spatial gradient within the area of interest rather than using a control location that may not be truly representative of the conditions within the area of interest (Methratta 2020). This design also allows for the examination of spatial variation within the wind farm and does not assume homogeneity across sampling stations (Methratta 2020).

The pre-construction benthic survey will be conducted in late summer or early fall (August to October) prior to the start of construction to document benthic habitats prior to disturbance (baseline). The next survey will occur during the first late summer/early fall following construction (Y0). The survey will then be repeated annually for the next three years (Y1, Y2, Y3) and again five years after construction (Y5). All surveys will be conducted in the same seasonal time frame, which will be during late summer or early fall to capture peak biomass and diversity of benthic organisms in alignment with previous studies (Deepwater Wind South Fork 2020; HDR 2020; NYSERDA 2017; Stokesbury 2013, 2014; LaFrance et al. 2010, 2014).

Benthic habitats in the northwest Atlantic are generally stable with little seasonality in the absence of physical disturbance or organic enrichment (Steimle 1982; Reid et al. 1991; Theroux and Wigley 1998; HDR 2020).

Data on the mean currents near Empire Wind Lease Areas will be used to establish up current and down current transects extending from each selected WTG foundation. Two belt transects (25 m wide) of benthic stations will be established, one up current and the other down current of the selected turbine locations (Figure 4-3). Pre-construction transects will begin at the center point of the planned foundation with two stations at equal intervals up to the maximum planned extent of the scour protection area and then at intervals of 0-10 m, 15-25 m, 40-50 m, 90-100 m, 190-200 m, and 900 m extending outward from the edge of the scour protection area (Figure 4-3). Post-construction transects will repeat this design at the same turbines and the same sampling distance intervals. These distances were chosen based on recent research indicating that effects of turbines on the benthic environment occur on a local scale (e.g., Lindeboom et al. 2011; Coates et al. 2014; Degraer et al. 2018; HDR 2019; Lefaible et al. 2019). SPI/PV imagery will be collected at every station. Physical sediment samples will be collected at the following stations beyond the scour protection layer (i.e., in soft sediments): 0-10 m, 40-50 m, and 900 m. The lower sampling effort for the physical sediment samples relative to the SPI/PV stations is due to the fact that the sediment sample data (organic matter content) will be ground truthing the information obtained from the SPI/PV imagery.

4.4.4 Statistical Analyses

The planned statistical analyses are summarized by survey type in Table 4-2.

For the *Structure-associated Organic Enrichment* dataset collected at the base of the selected WTG foundations (BAG design), data analysis will include exploratory multivariate approaches (e.g., non-metric Multidimensional Scaling [nMDS]) to identify patterns among responses (SPI/PV metrics, e.g., aRPD, successional stage, feeding voids, presence of methane or *Beggiatoa*) and predictors (e.g., quantitative or categorical epifaunal/epifloral cover estimates on the turbine foundations; and distance from the turbine). Covariates in the model for the turbine foundation dataset will include water depth (continuous) and direction (categorical); variability among turbines will provide site-wide random error. For individual metrics that are consistently measured across stations (e.g., aRPD depth, sediment organic matter content), parametric or non-parametric regression (e.g., generalized modeling such as GLM or GAM; or regression trees) will be applied if the data prove to be sufficient and appropriate for these tools.

Additionally, graphical methods and descriptive statistics will be used to assess changes in the SPI/PV metrics and sediment sample data over time and as a function of distance and direction from the novel structures (e.g., turbines). These graphical techniques may help to elucidate the spatial scale at which the greatest changes in benthic habitat quality occur.

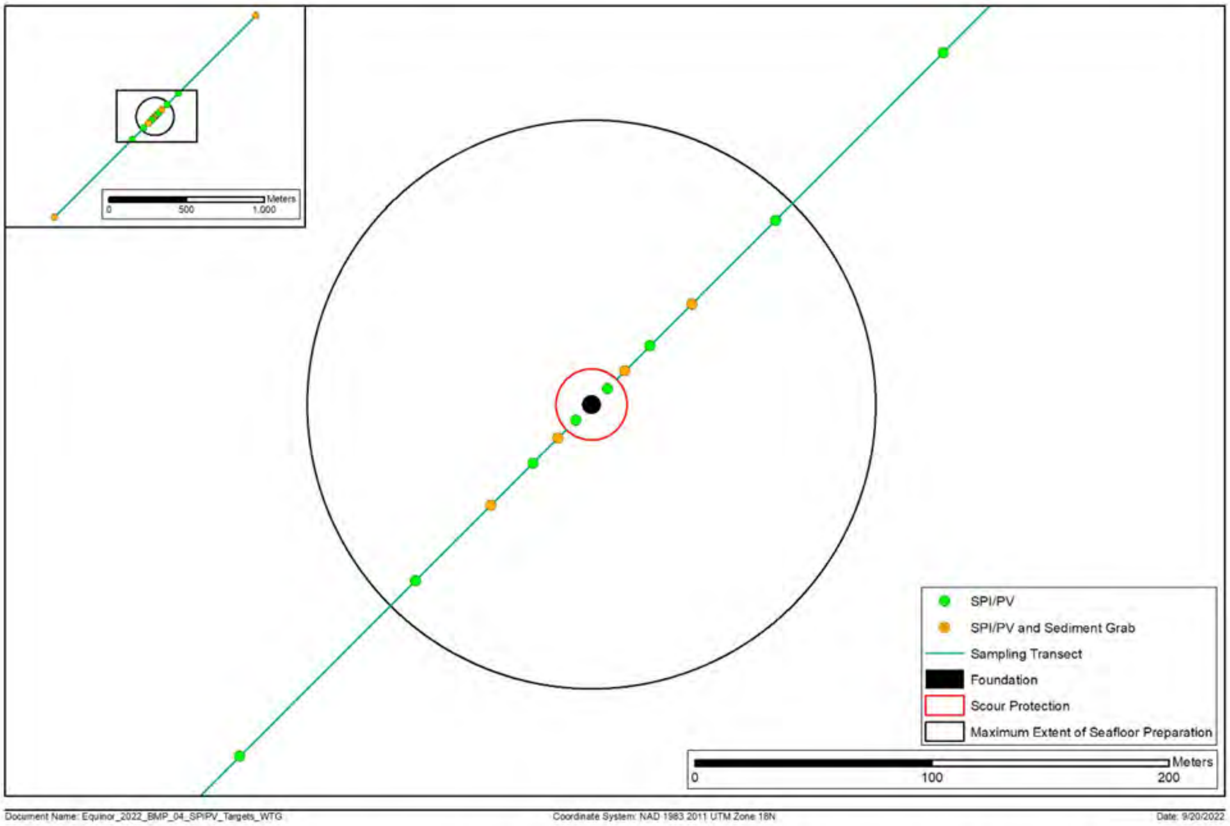

Figure 4-3. Conceptual diagram illustrating the Before-After Gradient design of the *Structure-associated Organic Enrichment* survey design, SPI/PV and sediment grab station locations on the seafloor surrounding each selected foundation. The transect orientation will be based on prevailing water currents in the area, to capture upstream and downstream effects.

4.5 CABLE-ASSOCIATED PHYSICAL DISTURBANCE – SOFT SEDIMENTS

Hypothesis 3: Physical disturbance of soft sediments from cable installation (including seafloor preparation) will temporarily disrupt the function of the infaunal community, community function is expected to return to pre-disturbance conditions. [*Soft Bottom – Cable-associated*] (e.g., Kraus and Carter 2018).

The objective for the *Cable-associated Physical Disturbance* monitoring along the Empire Wind export cables is to examine the effects of installation and operation of the export cables on the benthic habitat over time and along a spatial gradient with distance from the cable centerlines. This component of the benthic monitoring will include focused surveys along the export cable corridors. The focus of this monitoring will be on documenting any delayed recovery of the benthos following the physical disturbance associated with cable construction. Note that monitoring epifaunal growth on any cable protection material along segments of the export cables is described within the novel hard bottom component of this monitoring plan (see Section

4.3). A separate monitoring plan will be developed that focuses on the cable corridors within New York State waters.

The primary effect of cable installation is physical disturbance of the sediment resulting in sediment resuspension and temporary loss of infauna. Effects of installation and operation of the cable are expected to be roughly equivalent along the length of the cable within similar benthic habitat types. Other independent variables that may influence the benthic effects of and recovery from cable installation include levels of fishing activity (e.g., bottom trawling, clam dredging), installation methodology, and natural bottom sediment transport from tides, waves, and currents. These variables will be considered during data analysis and interpretation. The sampling design is intended to estimate effects along a spatial gradient away from the cable and will not estimate mean changes along the entire export cable routes. Any potential impacts of the cable on soft bottom habitats are expected to decrease over time after installation and with distance from the export cable centerline.

4.5.1 Technical Approach – SPI/PV

SPI/PV will be the primary tool used to document any changes to the small-scale physical characteristics and benthic community function following cable installation. A general summary of the rationale and value of using SPI/PV is provided in Attachment B.

4.5.2 Survey Design

A stratified random survey design will be used to select sampling frames along the export cables, stratified by habitat type. This monitoring plan provides a general overview of the design that can be adjusted when engineering and construction plans are finalized. Within each sampling frame, SPI/PV data will be collected using a BAG design, like that proposed for the seafloor surrounding the foundations (Section 4.4) (Underwood 1994; Methratta 2020). Details describing the BAG design approach and its value in evaluating potential temporal and spatial changes following construction are provided in the Section 4.4, above.

The soft bottom survey sample design will focus on sampling at representative sections of the export cables based on benthic habitat types as informed by the initial benthic characterization of the planned export cable corridors (INSPIRE 2019; COP Appendix T, Tetra Tech 2022). Sampling locations will be selected randomly, stratified by these habitats. At triplicate locations (each approximately 1 km apart) within each habitat type sampling stratum, a 25-m wide belt transect will be positioned perpendicular to the cable route (three replicate transects per habitat stratum) (Figure 4-4). Along each transect, a total of 16 stations will be sampled. At each station, triplicate SPI/PV images will be collected and analyzed. Near the centerline these stations will be distributed roughly 10 m apart and the distance intervals between stations will increase with distance from the centerline (Figure 4-4). The selected sampling locations and sampling intervals relative to the cable will remain fixed for the duration of the survey. The exact locations of the sampling frames will be selected after cable installation is completed; Figure 4-4 provides a conceptual diagram of the planned sampling design along the export cable corridors. Sampling along the export cables will occur prior to construction (within 6 months), within the first calendar year post installation (Y0), one year post-installation (Y1), and two years post-installation (Y2).

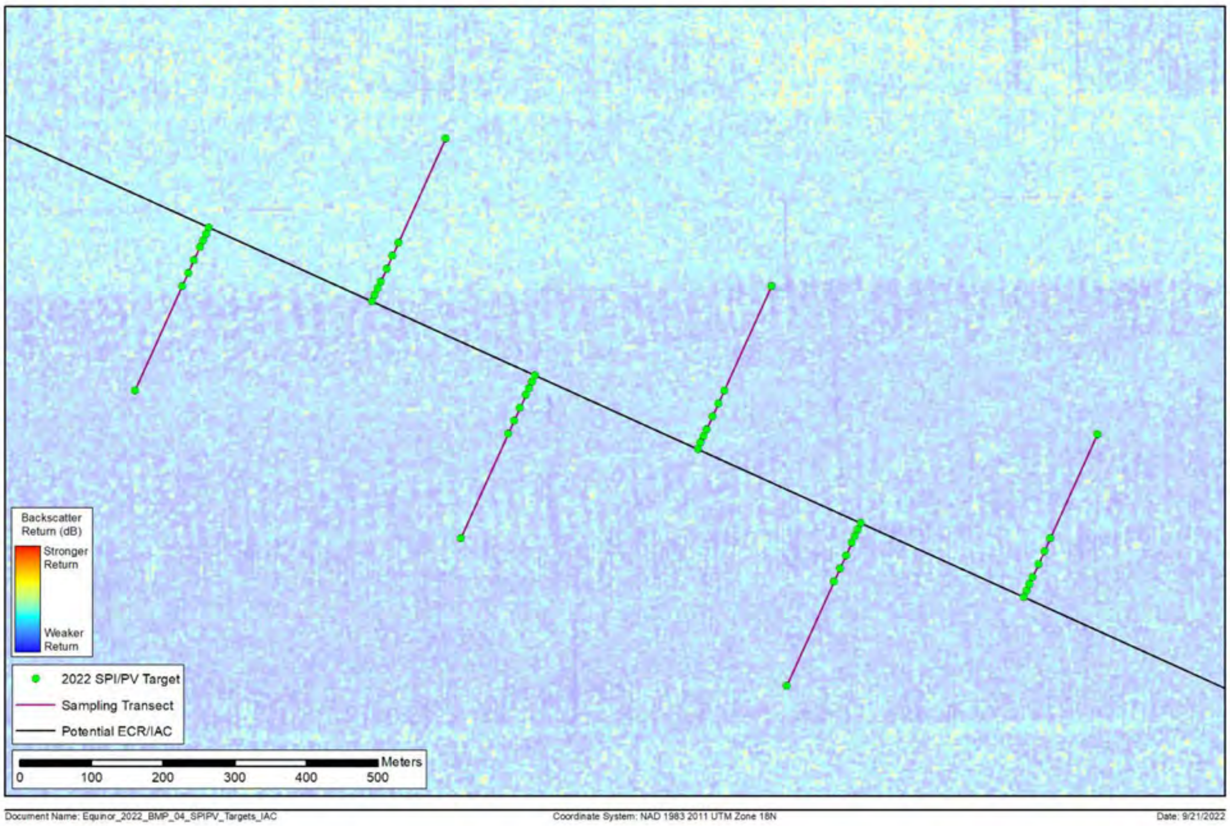

Figure 4-4. Conceptual diagram illustrating the Before-After Gradient design *of Cable-associated Physical Disturbance* survey design.

4.5.3 Statistical Analyses

The planned statistical analyses are summarized by survey type in Table 2.

For the *Cable-associated Physical Disturbance* dataset collected along the selected export cable segments (BAG design), data analysis will include exploratory multivariate approaches (e.g., nMDS) to identify patterns among responses (SPI/PV metrics, e.g., aRPD, successional stage, feeding voids, sediment grain size layering) and predictors (e.g., distance from the cable, water depth). Covariates in the model for the export cable dataset will include habitat type (categorical) and direction (categorical); variability among transects will provide site-wide random error. For individual metrics that are consistently measured across stations (e.g., aRPD), parametric or non-parametric regression (e.g., generalized modeling such as GLM or GAM; or regression trees) will be applied if the data prove to be sufficient and appropriate for these tools.

Additionally, graphical methods and descriptive statistics will be used to assess changes in the SPI/PV metrics over time and as a function of distance and direction from the export cable centerline. These graphical techniques may help to elucidate the spatial scale at which the greatest changes in benthic habitat condition occur.

5.0 DATA MANAGEMENT, REPORTING, AND DATA SHARING

The fisheries and benthic monitoring data will be managed by INSPIRE Environmental, with the exception of data described in Sections 3.3.3 and 3.3.4 which will be housed and maintained by Monmouth University. Data may be shared with state and federal agencies and other stakeholders upon request. Data will be prepared and disseminated annually and will undergo rigorous quality control and assurance audits prior to release.

Proper data management and traceability are integral to analysis and accurate interpretation and reporting. The surveys described in this monitoring plan will follow a rigorous system to inspect data throughout all stages of collection, processing, and analysis. This data management system will provide a high level of confidence in the accuracy of the data being reported. Data management will include methods for data collection, data storage and archiving, quality assurance/quality control (QA/QC) audits, distribution and dissemination protocols and best practices, and analyses. Metadata will be developed for each survey dataset which will include descriptions of data fields, data processing, QA/QC procedures, etc.

Annual reports will be prepared upon the conclusion of each year of sampling for each survey type. These reports will be shared with state and federal resource agencies. A final synthesis report will be prepared for each survey after the final year of sampling has concluded. This report will evaluate the survey findings during the pre- and post-construction survey time periods. The project team will disseminate annual results to agencies through an in-person meeting or webinar to solicit questions or feedback on the survey results, protocols, etc. The team will also host an in-person workshop to review results of monitoring efforts with members of the fishing industry.

In order to obtain data derived from this monitoring plan, stakeholders must submit a formal request to Empire Offshore Wind, LLC. A brief proposal will be required that states the purpose of the request, a description of the data requested (e.g., survey type, timeframe, species of interest), a list of collaborators and their affiliations, if applicable, and a description of the anticipated products of the work (e.g., manuscripts, fisheries stock assessments). Data access protocols will be developed to provide conditions for requesting monitoring data. Any data requested will be disseminated provided the criteria outlined in the data access protocols are met. Data will be sent to the requesting party electronically in most cases and any exceptions will be dealt with on a case-by-case basis with the party or parties seeking access. Empire Offshore Wind LLC will amend the above data sharing protocols as needed in accordance with current data sharing efforts and guidance being developed through ROSA.

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EMPIRE WIND FISHERIES AND BENTHIC MONITORING PLAN

ATTACHMENTS

Prepared for:

equinor

Empire Wind
Stamford Office
600 Washington Blvd
Suite 800
Stamford, CT 06901

Prepared by:

INSPIRE ENVIRONMENTAL

INSPIRE Environmental
Newport, Rhode Island 02840

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Attachment A - Power Analysis for Trawl Survey of Longfin Squid

1.0 Introduction

For the trawl survey, a symmetric BACI design is planned for the Empire Wind (EW) project area, with one impact and one control or reference area. The EW trawl survey will use NOAA-derived survey gear and NEAMAP sampling protocols and will focus primarily on longfin squid, though it is expected to also capture other benthic and pelagic fish and invertebrate species. This power analysis addresses only longfin squid catch.

This Attachment covers two topics:

1. A review of existing trawl survey datasets in the vicinity of EW project area, including data from the NEFSC trawl survey (Politis et al. 2014) and data collected in the reference areas during the BIWF trawl survey (Wilber et al. 2020). These datasets were evaluated to establish the proximate range of a meaningful effect size in measuring change over time, as well as reasonable ranges for inter-annual and intra-annual variability (i.e., the coefficient of variation [CV]) to use in the power analyses.

2. A power simulation study for a BACI design and analysis contrasting fish/invertebrate biomass between an impact area and control area. Effect sizes and CVs were derived from the NEFSC and BIWF trawl survey datasets (topic 1 above).

2.0 Power Analysis Elements

A statistical power analysis requires specification of the following:

- Study design specifics (e.g., number of replicates, number of sites, number of seasons/sampling events, sampling duration before and after construction), and their structure (e.g., random trawls as independent replicates within each site and sampling event, or fixed trawls nested within sites and repeatedly sampled over time).

- The statistical model, which is determined by the study design (previous bullet) and characteristics of the data (e.g., catch data as biomass might be modeled with a generalized linear or additive model with normal errors and a log-link; catch data as counts might be modeled with a generalized linear or additive model with Poisson errors, or with a negative binomial if the count data are over-dispersed; presence/absence data might be modeled with logistic regression and binomial errors).

A statistical power analysis relates the following four elements; given three of these elements, the fourth can be estimated:

- **Effect size (Δ)** is a measure of change in the data that the study design and modelling approach will be used to estimate. Statistical analysis of this OSW monitoring data from the BACI design will focus on the BACI interaction contrast between period and location, and is specified as a contrast between the temporal change at the Impact site to the temporal change at the Control site, with responses averaged across seasons and years within each period. The effect size herein is expressed as a proportional change between periods of the mean catch per tow at the Impact site relative to the mean catch per tow at the Control site. For example, an effect size of –0.33 (-33%) could represent a 33% decrease in catch at the impact site and no change at the control site (0.67/1 -1); or a 50% decrease at the impact site and a 25% decrease at the control site (0.5/0.75-1); or a 20% decrease at the impact site and 20% increase at the control (0.8/1.2-1); other similar combinations that yield a 67% ratio of relative change. In the context of statistical power analysis, a threshold effect size (Δ_M) is specified and the probability this difference would be statistically significant at the designated α, is the power (power = 1-β, where β is the type II error). Outside of statistical power analysis, observed effect size is simply a way of summarizing the metric of interest that can be compared across studies, and is not inherently tied to statistical significance or statistical power. In fact, the observed effect sizes for reference areas are used to establish what constitutes a meaningful threshold effect size (Δ_M) for impact studies.

- **Power (1-β**, where β is the Type II error**)** is the probability of rejecting the null hypothesis when the difference in the data exceeds a threshold effect size (Δ_M). In the BACI design setting, it is the probability of finding the interaction BACI contrast to be statistically significantly different from zero when an effect of size Δ_M is operating on the data.

- **Alpha (α)** is the Type I error, or the probability of rejecting the null hypothesis in error because the true difference is small (i.e., $< \Delta_M$). The value α is typically fixed, at 0.05 or 0.10 (95% or 90% confidence). For power estimated through simulations, α is estimated as the percent of significant outcomes when the effect size imposed on the data was 0. For this study, a target $\alpha = 0.10$ was used for the two-tailed null hypothesis which allows us to say whether results are significantly greater than or less than zero (the one-tailed hypotheses), with 95% confidence ($\alpha = 0.05$) on each side.

- **Sample size** encompasses the number of sites, replicates, and time periods that are sampled and determines the degrees of freedom for the statistical tests. In this analysis, the overall design was set (i.e., 1 impact site and 1 control site; 2 years of monitoring before and after construction, with sampling only in the fall of each year) and sample size refers to the number of tows per season in each area. Precision for the annual estimates can be improved by appropriate survey timing (i.e., surveys are timed to not miss the seasonal peaks in biomass/abundance), using consistent survey methods, and greater replication (tows per season, years per period, or areas per location). All else being equal, as replication increases, the precision estimates for the model parameters increase. This will result in higher power for a specific effect size, or a smaller detectable effect size for a specific level of power.

3.0 Review Existing Datasets

3.1 NEFSC

Station level catch data from the NEFSC trawl survey was provided by Phil Politis. The NEFSC (Politis et al. 2014) trawl dataset was used to establish 1) a proximate range of meaningful effect sizes that could be considered for measuring change over time, and 2) the expected distributional form for the longfin squid catch as biomass and reasonable variance estimates. The NEFSC dataset was screened to only include:

- tows from Stratum 1010, which includes the location for the EW project (Figure A1).
- Longfin squid catch.

This NEFSC survey design included seven to eight (random) 20-minute replicate tows in survey stratum 1010 in Fall (mid-September to early October) in the years 2010 to 2019, with replicate tows for each season generally occurring over two to four separate days which spanned a period of less than a week to 24 days, depending on the year. This dataset provides an adequate representation of the spatial variance among tows during each survey event (i.e., the within-season variability) for this approximately 8,750 km^2 stratum, and estimates of natural levels of inter-annual changes in catch. The survey planned for EW will be within a smaller area (322 km2) and limited to Fall with optimal timing informed by historical commercial landing information, examination of regional fisheries independent survey data, and stakeholder input. For comparison to the NEFSC trawl survey, monthly data from the Block Island Wind Farm (BIWF) otter trawl survey were also reviewed (Section 3.2) to determine the extent to which the seasonal NEFSC trawl survey captured intra-annual biomass peaks for longfin squid. Given that biomass and abundance can vary substantially throughout the course of the year within the proposed project area, it is important to ensure that this intra-annual variability is accounted for when estimating the expected variance for the species of interest in the seasonal trawl survey.

The tows in the NEFSC dataset are at a lower spatial density than what is planned for the EW trawl survey. We expect the NEFSC estimates of spatial variance to be conservatively high relative to the variance expected from the EW monitoring, because the EW survey will occur over a smaller spatial area, so less spatial heterogeneity may be expected amongst replicate tows. The EW trawl survey will maintain the same spatial sampling densities within the impact and the reference area (i.e., the two areas will be the same size, and predominantly within the boundaries of Stratum 1010).

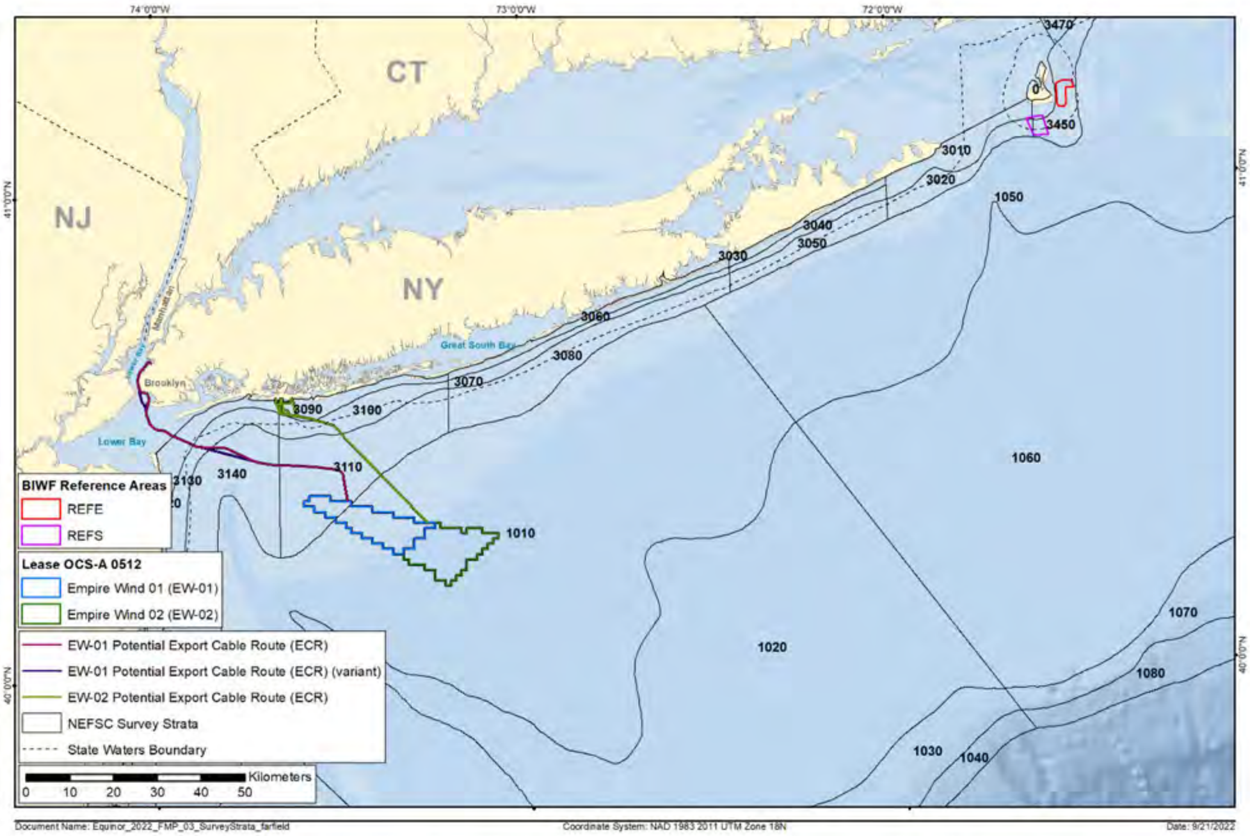

Figure A1. Map of NEFSC strata and the Empire Wind project area. Trawl survey data sampled in stratum 1010 from 2010-2019 were used in the analysis. The reference sites used in the BIWF Trawl survey (REFE and REFS) are also indicated for reference.

Table A1. Seasonal Summary by Year of Longfin Squid Catch (biomass, kg) in the NEFSC Trawl Survey (Politis et al., 2014) sampled in Stratum 1010

	Fall Survey			Spring Survey			
Year	# of Tows	Mean Catch (kg/tow)	StDev of Catch (kg/tow)	# of Tows	Mean Catch (kg/tow)	StDev of Catch (kg/tow)	% of Annual Catch caught in Fall
2010	8	18.6	19.0	8	0	0	100%
2011	7	4.6	4.0	7	0	0	100%
2012	7	16.6	22.9	7	3.2	2.5	84%
2013	7	3.5	2.3	7	0.02	0.03	100%
2014	7	33.7	11.2	6	0.03	0.05	100%
2015	7	17.1	10.8	7	0.01	0.04	100%
2016	7	9.9	8.0	7	1.2	1.3	89%
2017	0[1]	na	na	7	0.12	0.17	na
2018	7	7.7	9.0	5	0	0	100%
2019	7	10.9	9.3	7	0.43	0.81	96%

[1] There was no fall survey in 2017.

Fall was the dominant season for Longfin squid, both in the NEFSC survey (Table A1, Figure A2), and at BIWF (Figure A3).

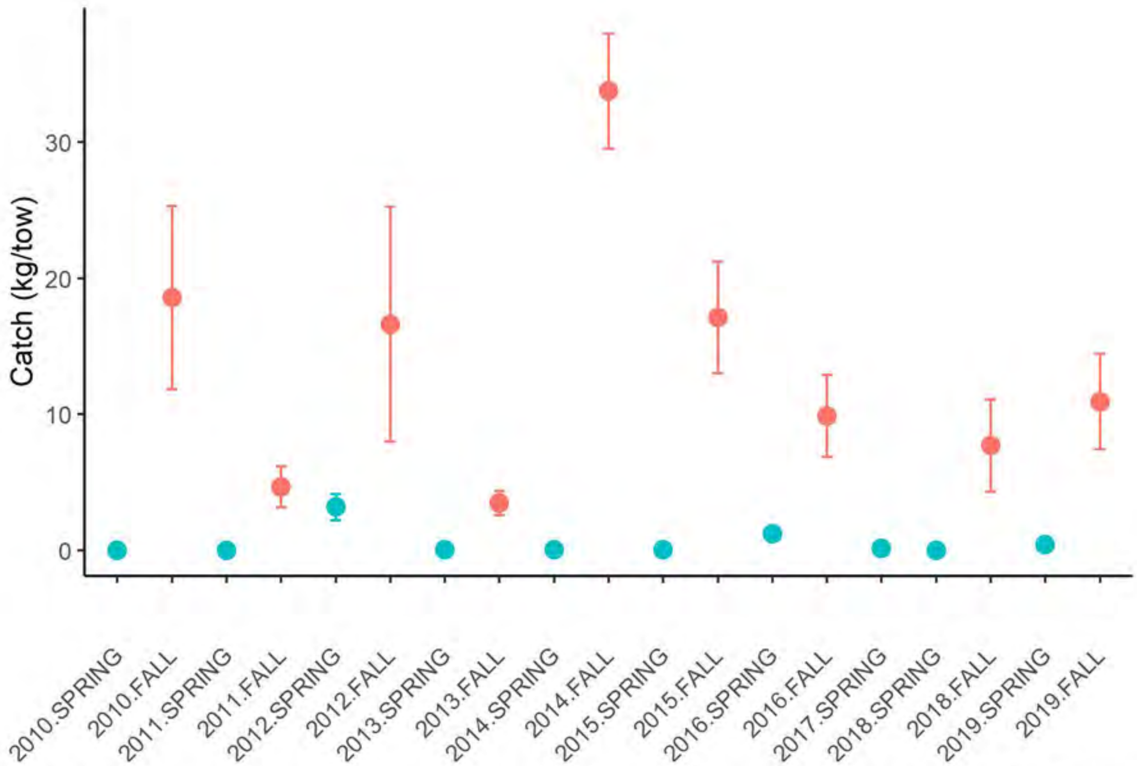

Figure A2. Mean and standard error of the seasonal longfin squid catch per tow (kg) sampled in stratum 1010 during the NEFSC seasonal trawl survey from 2010 through 2019. Blue represents spring surveys, and orange represents fall surveys.

3.2 Block Island Wind Farm Trawl Survey Data

Intra-annual variation in catch rates (kg/tow) were examined for longfin squid from the monthly trawl survey that occurred over seven years at the two reference areas used in the Block Island Wind Farm (BIWF) monitoring. The monthly BIWF trawl survey data were reviewed to determine the extent to which the NEFSC trawl survey data summaries, which are limited to a short window during fall, may miss intra-annual biomass peaks. The monthly mean longfin squid catch from seven years at the two reference areas are plotted in Figure A3 . September-October appeared to be the peak for REFE, while at REFS the much more muted peak occurred during November-December.

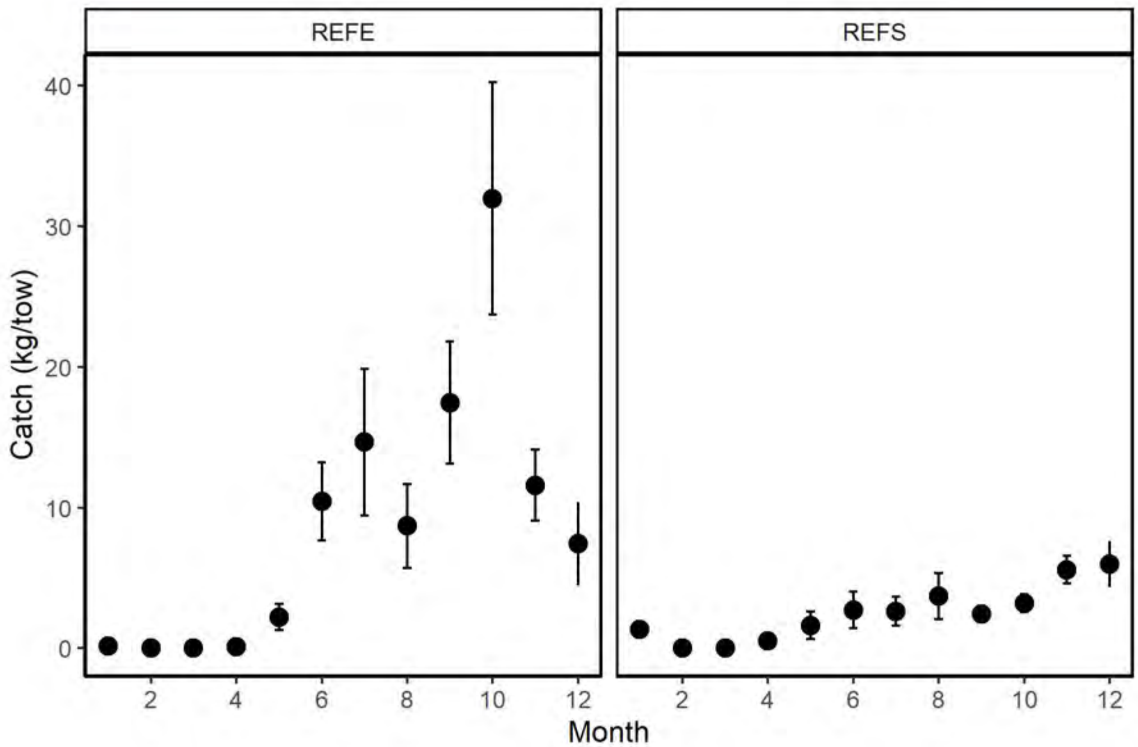

Figure A3. Monthly mean biomass (kg) averaged over seven years (from October 2012 to September 2019) for longfin squid from the eastern reference area (REFE) and southern reference area (REFS) from the BIWF trawl survey monitoring.

3.3 Effect Sizes

Using the NEFSC and BIWF reference datasets, the relative change in mean annual biomass (averaged across seasons) between subsequent 2-year time periods, was calculated as:

$$\%ES = \left(\bar{X}_{2,3} - \bar{X}_{0,1}\right)/\bar{X}_{0,1} \times 100 \qquad \text{[Eq. 1]}$$

where

$\bar{X}_{0,1}$ = The two year Fall mean in years i and $i+1$.

$\bar{X}_{2,3}$ = The two year Fall mean in years $i+2$ and $i+3$.

For [Eq. 1] in the NEFSC dataset i= 2010 through 2015, and due to no fall sample results in 2017, 2014/2015 were compared to 2016/2018). This yields six contrasts of two adjacent two-year averages for fall. For the seven-year BIWF reference area datasets, the surveys run from October 2012 through September 2019. So i= (Oct) 2012 through (Sept-Oct) 2015, and the annual means were calculated from data from September and/or October within each calendar year (the months were subsampled from the continuous time series). This yields five contrasts of two adjacent two-year running averages of September-October means (with only October used in year 1 and only September used in year 7).

The ranges of relative percent change from these extant datasets provide context for generating realistic effect sizes to be used in the power calculations. Results are summarized for longfin squid in the two datasets in Table A2 and Figure A4. The effect sizes [Eq. 1] have a natural lower bound of -100%, and an unlimited upper bound.

Table A2. Summary of relative effect sizes (Eq. 1) observed for longfin squid from NEFSC dataset and BIWF Reference area dataset.

	Longfin Squid				
Data Source	**Minimum**	**1st Quartile**	**Median**	**3rd Quartile**	**Maximum**
NEFSC (n=6 contrasts)	-65%	-30%	-21%	53%	153%
BIWF REFE (n=5 contrasts)	-65%	-40%	-20%	27%	29%
BIWF REFE (n=5 contrasts)	-50%	-48%	-6%	34%	39%

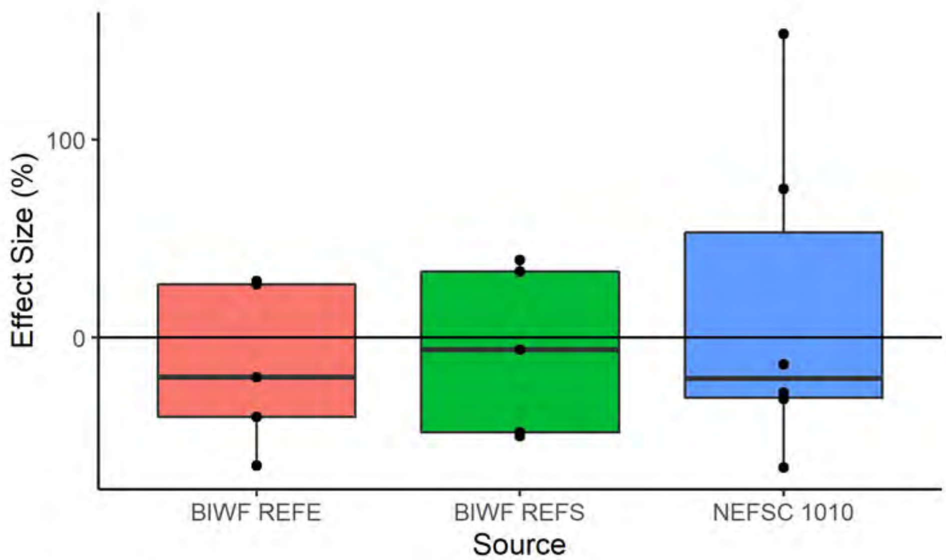

Figure A4. Boxplots showing the distribution of relative effect sizes (Eq. 1) for longfin squid for NEFSC dataset (2010 – 2018) and BIWF reference area datsets (October 2012 – September 2019).

The results shown in Figure 2 and Figure A4 demonstrate that substantial inter-annual sampling variability has occurred for longfin squid over the past 10-12 years, the sampling variability on a multi-year time scale may be larger when survey data are analyzed on a localized spatial scale due to spatial-temporal interactions. The data suggest that it may be meaningful to attempt to detect effect sizes on the order of ±40-50% or larger for longfin squid.

3.4 Coefficient of Variation

Catch (kg) per tow is naturally bounded by zero and the distribution tends to be skewed with most catches around the median value and large catches in a few tows, approximating a lognormal distribution. The NEFSC Stratum 1010 biomass data for fall catches of Longfin squid fit this description. For the lognormal distribution, the standard deviation (SD) is proportional to the mean and the coefficient of variation (CV = SD/mean) on the original scale is used to summarize variability in catch rates independent of the mean. A summary of the seasonal CV values for the NEFSC dataset is shown in Table A3. For conservative sample size estimates in the power analyses (Section 4.0), the CV values used captured approximately the median to maximum CV values across years (0.8 to 1.4).

Table A3. Summary of seasonal relative variance estimates for catch (biomass, kg) of longfin squid caught in the NEFSC fall trawl survey (Politis et al. 2014) in Stratum 1010 from 2010 to 2019

		Coefficients of Variation (CVs) among Fall Trawls Summarized across Years				
Source	**# of Years with Fall Catch**	**Minimum**	**1st Quartile**	**Median**	**3rd Quartile**	**Maximum**
NEFSC Stratum 1010	9	0.33	0.67	0.85	1.02	1.38

4.0 Power Analysis

4.1 The Study Design and Model

A symmetrical BACI design was tested in this power analysis, with the design variables as specified in Table A4. For a limited scenario (i.e., a single CV), power was simulated for a BACI design with one impact and one control area.

Table A4. Design for Empire Wind trawl survey power simulation study

Set study design variables
• Impact Areas = 1 impact area
• Control Areas = 1 control/reference area
• Habitat Strata = 1
• Frequency = one season per year
• Number of years Before impact = 2 • Number of years After impact = 2
Variables used in the power analysis
• Number of replicate (random) trawls per season in each area (n): 5 to 15
• Effect Sizes (ES): -33%, -40%, -50%, -70% (Section 3.3) and 0% (for Type I error)
• CVs: 0.6, 0.8, 1.0, 1.2, 1.4 (Section 3.4)
• A two-tailed α = 0.10

For a saturated model that estimates the mean catch (kg) for each season, year, and location, the BACI interaction contrast is described as

$$(\bar{X}_{Impact,Before} - \bar{X}_{Impact,After}) - (\bar{X}_{Control,Before} - \bar{X}_{Control,After}) \qquad \text{[Eq. 2]}$$

where

$\bar{X}_{Impact,Period}$	=	The two-year log-scale mean biomass per tow (kg) from the Impact area, for Fall season in all years of the *Period* (Before or After).
$\bar{X}_{Control,Period}$	=	The two-year log-scale mean biomass per tow (kg) from the Control area, for Fall season in all years of the *Period* (Before or After).

4.2 Simulation methods

The power analysis used a simulation approach to generate significance values for a range of seasonal CV estimates and effect sizes, and a range of sample sizes (Table A4). The effect size, ES, was imposed on each year during the After period. Note that proportional changes on the original scale become additive changes on the log-scale; consequently, log-scale changes are a function only of the effect size and do not depend on the mean value. Calculations were scripted in R version 4.0.5 (R Core Team 2021), utilizing packages *dplyr* (Wickham et al. 2019), *lme4* (Bates et al, 2015), *emmeans* (Lenth 2021), and *EnvStats* (Millard 2013); figures were generated using *ggplot2* (Wickham 2016). The R code is included as an addendum to this Attachment.

For a given CV, ES, and sample size (n), the following steps were performed m=1000 times:

1. From a log-normal distribution with mean μ and CV, simulate *n* values of catch data for each year of the Before period, for both Impact and Control areas.
2. Repeat step 1 for each year of the After period for the control area.
3. Repeat step 1 for each year of the After period for the Impact area, but with a reduced mean equal to (1+ES)μ.
4. Fit a GLM to the simulated biomass data, where the dependent variable was the catch per trawl, coefficients were estimated for 8 groups (i.e., a saturated model, one estimate for each area-year), and a Gamma error distribution with a log-link was used. Based on residual diagnostics and model fit for a small set of simulated data sets, the Gamma error distribution was found to provide the best fit.
5. Calculate the BACI interaction contrast based on multi-year means, and save the p-value.
6. Repeat Steps 1-5 for 1000 simulation replicates.

7. Count the number of simulations for which the detection outcome from step 5 had a p-value < nominal alpha. The reported power results use a nominal alpha that achieves approximately a 10% rejection rate for no effect (ES=0).

Repeat Steps 1-7 for each combination of CV, ES, and n.

4.3 Results

Estimates of type I error (false positives) were calculated as the proportion of the simulated "no effect" datasets in which the BACI interaction contrast was rejected at $\alpha = 0.10$. For a nominal $\alpha = 0.10$, the empirical type I error rate had a tendency to be inflated (between 10% and 20% and 15% on average). When the empirical type I error was greater than 10%, this means that the test procedure was overly sensitive, i.e., rejecting more cases than it should. There was an inverse relationship between magnitude of CV and empirical type I error, with higher type I error rates occurring when relative variance of simulated data was lower. This may reflect a poorly specified model (e.g., inappropriate error distribution) for the simulated data sets with higher variance. For this approximation of power, the nominal alpha was adjusted to achieve an empirical type I error rate of approximately 10%, and this alpha level was applied to all test results to estimate both the type I error and the empirical power (Table A5, Figure A5).

Table A5. Simulated power for the BACI interaction contrast within a saturated GLM (see text) for a range of variance (CV), effect sizes (% change), and sample sizes (n) per area per year, using a design with one impact and one control area. Empirical power results are based on nominal two-tailed α levels which achieved an empirical type I error of approximately 10%. Results with power 80% and above are shaded.

% Change	Sample Size (n)	CV=0.6	CV=0.8	CV=1.0	CV=1.2	CV=1.4
Nominal alpha:		*0.08*	*0.07*	*0.06*	*0.05*	*0.04*
0	5	10%	11%	11%	10%	12%
0	7	11%	10%	11%	10%	11%
0	9	9%	12%	9%	11%	10%
0	11	10%	9%	10%	9%	8%
0	13	11%	10%	10%	7%	9%
0	15	9%	8%	7%	9%	8%
-33%	5	31%	23%	21%	20%	14%
-33%	7	36%	28%	22%	19%	17%
-33%	9	41%	30%	22%	20%	16%
-33%	11	46%	34%	23%	19%	18%
-33%	13	51%	36%	26%	23%	18%
-33%	15	56%	39%	29%	23%	20%
-40%	5	42%	31%	27%	21%	21%
-40%	7	48%	38%	29%	23%	20%
-40%	9	56%	42%	31%	24%	23%
-40%	11	65%	45%	33%	28%	22%
-40%	13	71%	50%	38%	29%	22%
-40%	15	75%	53%	40%	32%	24%
-50%	5	58%	46%	36%	28%	28%
-50%	7	73%	54%	39%	34%	29%
-50%	9	81%	58%	44%	37%	33%
-50%	11	83%	67%	51%	39%	34%
-50%	13	90%	71%	54%	45%	34%
-50%	15	94%	76%	58%	49%	38%
-70%	5	94%	81%	70%	59%	52%
-70%	7	98%	90%	78%	64%	59%
-70%	9	100%	95%	85%	75%	62%
-70%	11	100%	96%	89%	79%	68%
-70%	13	100%	99%	94%	83%	74%
-70%	15	100%	99%	95%	89%	79%

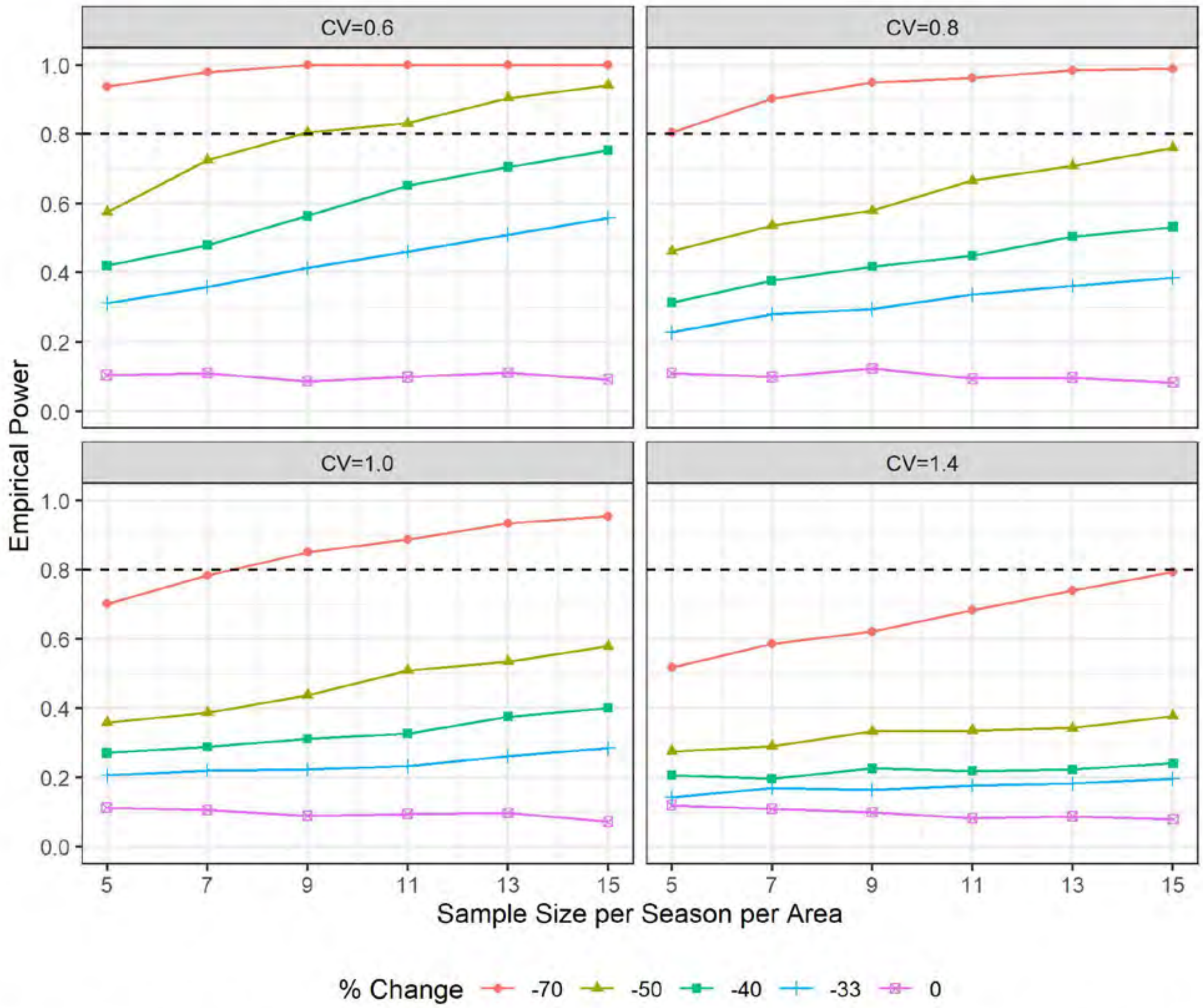

Figure A5. Power curves for the BACI interaction contrast within a saturated GLM (see text) for a range of variance (CV), effect sizes (% Change) and seasonal sample sizes in each area (n), using a nominal α that achieves a type I error rate of 0.10 where the results for 0% change illustrate the type I error.

5.0 Summary and Conclusions

- Data from regional trawl surveys indicate that longfin squid in the region have generally exhibited moderate to high levels of natural variability.
- Given the underlying variability (inter-annual and intra-annual) in catch rates that will likely be exhibited in the EW trawl survey, it does not appear to be practical to attempt to document effect sizes less than 50% for longfin squid.
- For moderate CV estimates for longfin squid (e.g., 0.6 – 0.8), a seasonal sampling intensity of more than 15 tows/area would yield > 80% power to detect an effect size of approximately 50% or greater.
- This power analysis will be re-visited after the first year of the EW trawl survey. The observed CV values will be evaluated to determine whether sampling intensity needs to be modified to achieve the desired level of statistical power.

6.0 References

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Addendum – R Script for the Statistical Power Simulation.

```
###########################################################################
# R code to simulate power for contrast-BACI approach for Empire Wind
## libraries
library(tidyverse)
library(EnvStats)        #for rlnormAlt
library(ggplot2)
library(emmeans)

################# SIMULATE BACI DESIGN AND TEST OF COMPLEX INTERACTION (planned contrast)
# Areas:
#       Two areas: 1 impact and 1 ref
# Population means and applying percent change:
#    pop1 = baseline distribution is lognormal(mean, CV); one season
#       - applies to both impact and reference in each of the BEFORE years
#       - applies to reference in each of the AFTER years (i.e., reference remains stable over time)
#    pop2 = distribution altered by the percent change (PC)
#       - mean.pop2 = (1-PC)*mean.pop1
#       - applies to impact area in each of the AFTER years
# Seasonality
#       - only 1 season is sampled
# Balanced design, i.e., n samples from each season, year, and area
# MODEL fit as glm(response ~ grp.pd.seas.yr, family=Gamma(link=log))
#       This is a fully saturated model; most conservative because it uses up most degrees of freedom
# LINEAR CONTRAST averages the logscale differences of means using emmeans function
#
# Notes about how this formulation of the problem is more generic than it appears:
#       - applying the same mean to each year within each period is equivalent to saying that
#         the assumed mean is the grand mean across years.
#       - if the reference is not stable over time, and instead changes between the BEFORE and
#         AFTER periods, then the % change applied to impact area is relative to the % change
#         at reference.
#######################

## set up scenarios:
 PC.vec <- c(.7, .5, .4, .33, 0)      #these are % decreases
 cv.vec <- c(0.6, 0.8, 1, 1.2, 1.4)
n.vec <- seq(5,15,2)
n.sims <- 1000
foo.num <- as.numeric(rep(NA,n.sims*length(PC.vec)*length(cv.vec)*length(n.vec)*1))
baciContr.pwrsim <- data.frame(expand.grid(PC=PC.vec,
samp.size=n.vec, cv=cv.vec, mean=20, sim=1:n.sims),
baci1ref.p1=foo.num, baci1ref.p2=foo.num, baci2ref.p1=foo.num,
baci2ref.p2=foo.num, pit1ref.p1=foo.num, pit1ref.p2=foo.num, pit2ref.p1=foo.num,
pit2ref.p2=foo.num) %>% as_tibble()
#note p1 results are for glm(Gamma(log link)), p2 for lm(log(catch))
 baciContr.pwrsim <- arrange(baciContr.pwrsim, PC, samp.size, cv, mean, sim)
```

```
#set total number of seasons sampled before, each area (seasons/year * #years)
 b <- 1*2
#set total number of seasons sampled after, each area
 a <- 1*2
#set number of controls:          #calculate results for both 1 and 2 controls.
 n.c <- 2
my.mean <- 20            #does not affect outcome.
## loop it:
for (m in 1:length(cv.vec)) {               #alternative cv values
 this.cv <- cv.vec[m]
 for (k in 1:length(PC.vec)) {              #effect sizes
  this.PC <- PC.vec[k]
  for (j in 1:length(n.vec)) {              #sample sizes
   this.n <- n.vec[j]
   #create a design matrix:
   foo.data.df <- data.frame(expand.grid(location=c("CtrlA", "CtrlB","Impact"),
period=c("Before","After"), year=1:2, season=c("fall"),
rep=1:this.n), value=as.numeric(rep(NA,this.n*(b+a)*(n.c+1))))
   foo.data.df <- arrange(foo.data.df, location, period, year, season, rep)
   foo.data.df$grp.pd.seas.yr <- factor(with(foo.data.df,
        paste(substring(location,1,5),period,season,year)))
 ### SIMULATE DATA
  for (i in 1:n.sims){
   foo.data.df$value[foo.data.df$period=="Before"] <-
rlnormAlt((n.c+1)*(b)*this.n, mean=my.mean, cv=this.cv)
   foo.data.df$value[foo.data.df$period=="After" & (foo.data.df$location=="CtrlA" |
        foo.data.df$location =="CtrlB")] <-
rlnormAlt(n.c*(a)*this.n, mean=my.mean, cv=this.cv)
   foo.data.df$value[foo.data.df$period=="After" & foo.data.df$location=="Impact" ] <-
rlnormAlt((a)*this.n, mean=my.mean*(1-this.PC), cv=this.cv)

### fit saturated glm
  #comparisons with 1 ref:
   foo1.glm <- glm(value ~ 0 + grp.pd.seas.yr, data=subset(foo.data.df, location!="CtrlB"),
family=Gamma(link="log"))
   foo1.t2 <- emmeans(foo1.glm, ~ grp.pd.seas.yr)
   #double check that contrast coefficients give the desired contrast!
   foo1.contr2 <- contrast(foo1.t2, list(baci.contrast=0.5*c(rep(c(rep(1,a), rep(-1,b)), 1), rep(-1,a),
        rep(1,b))))
  #comparisons with 2 ref:
   foo2.glm <- glm(value ~ 0 + grp.pd.seas.yr, data=foo.data.df, family=Gamma(link="log"))
   foo2.t2 <- emmeans(foo2.glm, ~ grp.pd.seas.yr)
   foo2.contr2 <- contrast(foo2.t2, list(baci.contrast=0.5*c(rep(c(rep(1/n.c,a), rep(-1/n.c,b)), n.c), rep(-
        1,a), rep(1,b))))
###grab p-value for interaction contrast and add to baciContr.pwrsim:
  baciContr.pwrsim$baci1ref.p2[baciContr.pwrsim$mean == my.mean & baciContr.pwrsim$cv == this.cv
        & baciContr.pwrsim$PC == this.PC & baciContr.pwrsim$samp.size == this.n &
        baciContr.pwrsim$sim==i] <- as.data.frame(foo1.contr2)$p.value
```

```
 baciContr.pwrsim$baci2ref.p2[baciContr.pwrsim$mean == my.mean & baciContr.pwrsim$cv == this.cv
        & baciContr.pwrsim$PC == this.PC & baciContr.pwrsim$samp.size == this.n &
        baciContr.pwrsim$sim==i] <- as.data.frame(foo2.contr2)$p.value
}}}}

finalBaci.pwrsim <- baciContr.pwrsim

#summarize simulated power (here alpha = 0.10)
baciContr.pwrsim.10.summ <- finalBaci.pwrsim %>% group_by(mean, cv, PC, samp.size) %>%
 summarize(count=n(), Power.1ref.glm = sum(baci1ref.p2 <= 0.1)/count,
  Power.2ref.glm = sum(baci2ref.p2 <= 0.1)/count)
 #separate factor variable for the facet labels (mean.cv):
 baciContr.pwrsim.10.summ$cv.factor <- factor(baciContr.pwrsim.10.summ$cv,
levels=c(0.6, 0.8, 1.0, 1.2, 1.4),
labels=c("CV=0.6", "CV=0.8", "CV=1.0", "CV=1.2", "CV=1.4"))

##### ADJUST NOMINAL ALPHA TO ACHIEVE EMPIRICAL ALPHA OF 10%
# observed alpha different from nominal alpha for the glms.
# recalibrate results to get observed closer to 0.1
 foo.nomalpha <- finalBaci.pwrsim %>% filter(PC==0) %>% group_by(mean, cv) %>%
summarize(nominal.alpha1ref.glm = quantile(baci1ref.p2, 0.1),
 nominal.alpha2ref.glm = quantile(baci2ref.p2, 0.1))
 foo.nomalpha
 #  mean   cv nominal.alpha1ref.glm nominal.alpha2ref.glm
 #1   20  0.6          0.0796             0.0816
 #2   20  0.8          0.0691             0.0672
 #3   20  1.0          0.0641             0.0597
 #4   20  1.2          0.0547             0.0581
 #5   20  1.4          0.0419             0.0447
 #note this summarizes across all samp.size values.
 # there is an inverse relationship between relative variance and empirical alpha.
 finalBaci.pwrsim <- left_join(finalBaci.pwrsim, foo.nomalpha)
# Apply adjusted nominal alpha to all glm results:
 baciContr.pwrsim.AlphaMOD.summ <- finalBaci.pwrsim %>%
  group_by(mean, cv, PC, samp.size) %>%
  summarize(count=n(), Power.1ref.glm = sum(baci1ref.p2 <= round(nominal.alpha1ref.glm,2))/count,
   Power.2ref.glm = sum(baci2ref.p2 <= round(nominal.alpha2ref.glm,2))/count)
 #separate factor variable for the facet labels:
 baciContr.pwrsim.AlphaMOD.summ$cv.factor <- factor(baciContr.pwrsim.AlphaMOD.summ$cv,
levels=c(0.6, 0.8, 1.0, 1.2, 1.4),
labels=c("CV=0.6", "CV=0.8", "CV=1.0", "CV=1.2", "CV=1.4"))

##plot power curves with modified nominal alpha
# skip 25% ES and CV=1.2
ggplot(subset(baciContr.pwrsim.AlphaMOD.summ,PC != 0.25 & cv.factor != "CV=1.2"),
  aes(x=samp.size, y=Power.1ref.glm, colour=factor(-PC*100),
shape=factor(-PC*100)), facets=~cv.factor) +
  facet_wrap(~cv.factor)+
```

```
  geom_point() + geom_line() +
  geom_hline(yintercept=0.8, colour="black",linetype="dashed")+
  theme_bw() + theme(legend.position="bottom") +
  scale_y_continuous(limits=c(0,1), breaks=seq(0,1,.2))+
  scale_x_continuous(limits=c(5,15), breaks=seq(5,15,2))+
  labs(colour="% Change", shape="% Change", x="Sample Size per Season per Area", y="Empirical
        Power")
ggsave("GLM power curves, MODified alpha , saturated baci.png", width=7, height=6, units="in")
####################################################

##output for appendix table
foo <- baciContr.pwrsim.AlphaMOD.summ %>% filter(PC != 0.25) %>%
 pivot_wider(id_cols=(PC:samp.size), names_from="cv", values_from="Power.1ref.glm")
write.csv(foo, "foo.csv")
```

Attachment B - Sediment Profile and Plan View Imagery to Assess Shifts in Benthic Ecological Functions

Sediment Profile and Plan View Imagery to Assess Shifts in Benthic Ecological Functions

SPI/PV is an effective tool in assessing changes in benthic function of soft sediments in response to offshore wind development. Ecologically important benthic functions of soft sediment communities on the outer continental shelf of the northwest Atlantic include (1) the provision of biogenic structures as habitat, (2) the facilitation of organic matter processing (carbon and nutrient cycling), and (3) the provision of food to upper trophic levels (secondary production). These ecosystem functions are detectable using data obtained from SPI/PV imagery as described in more detail below.

Biogenic Habitats

SPI/PV is an effective means to assess the presence and relative distribution of biogenic structure-forming fauna in soft sediment environments. Common emergent fauna in this environment includes cerianthids (burrowing anemone). Other biogenic structure-forming organisms in this environmental context include mussels, tube-building amphipods and polychaetes including sabellid worms, that can serve to bind sediments and create reefs. Biogenic structure-forming organisms are often difficult to capture using traditional sediment grab sampling as they are able to effectively evade collection. Also, sediment grab collection is destructive sampling, which should be avoided in areas with sensitive benthic organisms. High-resolution SPI and PV imaging can non-invasively identify and quantify these emergent and structure-forming fauna. The presence and densities of these emergent and structure-forming fauna can be obtained using the SPI/PV approach, and any changes in spatial distributions in response to offshore wind development can be detected through this proposed monitoring survey design.

Benthic Organic Matter Processing

SPI/PV is an effective means to assess the degree of, and changes to, organic matter processing and cycling in soft sediments. Benthic communities in soft sediments serve an important role in facilitating organic matter processing and cycling. The ability of soft sediment communities to process organic matter delivered from the water column is highly dependent on the benthic community activity, specifically bioturbation, bioirrigation, and sediment mixing by shallow and deep-burrowing organisms. These infaunal activities deliver oxygenated water to the sediment column, facilitating aerobic respiration of organic matter. The degree of organic matter processing can be assessed by measuring the depth of oxygen penetration into the sediment column, which can be done through SPI analysis (apparent redox discontinuity [aRPD] depth). Other indicators of benthic organic matter processing include infaunal succession stage, feeding voids, methane, and presence of *Beggiatoa*. Of these, the successional stage and aRPD depth have the strongest predictive power for benthic functional response to physical disturbance and organic enrichment (Germano et al. 2011) and will be the key metrics used during the soft bottom surveys. Because the epifaunal growth on the novel wind turbine structures is likely to increase the delivery of organic matter to the sediments below, organic matter processing and sediment respiration is likely to increase in these adjacent soft sediments, causing a decrease in the depth of oxygen penetration into the sediment column (aRPD depth). SPI is an effective approach in assessing this change in organic matter processing with distance from the turbine as SPI analysis can accurately assess and detect changes in aRPD depths and bioturbation depths.

The aRPD depth is a measure of the depth within the sediment column where dissolved oxygen concentrations are depleted. This depth is dependent on several factors but is largely determined by the amount of organic matter load to the sediments (organic matter decomposition consumes oxygen) and the amount of bioturbation by macrofaunal organisms (bioturbation mixes oxygen from surface waters deep into the sediments). With SPI analysis, the aRPD depth is described as "apparent" because of the potential discrepancy between where the sediment color shifts and the complete depletion of dissolved oxygen concentration occurs. In sandy sediments that have very low sediment oxygen demand (SOD), the sediment may lack a visibly reduced layer even if a redox potential discontinuity (RPD) is present. Because the determination of the aRPD requires distinction of optical contrast between oxidized and reduced particles, it is difficult, if not impossible, to determine the depth of the aRPD in well-sorted sands of any size that have little to no silt or organic matter in them. When using SPI technology on sand bottoms, estimates of the mean aRPD depths are often indeterminate with conventional white light photography. It is expected that as sediments surrounding the WTGs will increase in organic enrichment and fines, the aRPD will become more 'apparent' and provide a quantitative measure of enrichment. The aRPD has been shown to be a sensitive and specific indicator of hypoxic conditions experienced over the preceding 1 day to 4 weeks (Shumchenia and King 2010), and to be correlated to concurrent *in situ* dissolved oxygen concentrations (Sturdivant et al. 2012).

There has been considerable research conducted on the effects of bioturbation on sediment geotechnical and geochemical properties as well as on sediment diagenesis (Ekman et al. 1981; Nowell et al. 1981; Rhoads and Boyer 1982; Grant et al. 1982; Boudreau 1986, 1994, 1998; Sturdivant and Shimizu 2017). Additional research has focused on the rates of contaminant flux in sediments (Reible and Thibodeaux 1999; François et al. 2002; Gilbert et al. 2003) and the two parameters that primarily affect the rate of benthic fluxes: erosion and bioturbation (Reible and Thibodeaux 1999). The depth to which sediments are bioturbated, or the biological mixing depth, can be an important parameter for understanding and predicting nutrient or contaminant flux from the sediments to the water column (and vice versa). The biological mixing depth is also a useful indicator for the degree of organic enrichment in sediments. Burrow depth has been shown to be reduced under hypoxic conditions and burrowing fauna respond quickly (within an hour) to sediment accretion and erosion (Sturdivant et al. 2012; Sturdivant and Shimizu 2017). While the aRPD depth is one potential measure of biological mixing depth, it is quite common in sediment profile images to see evidence of biological activity (burrows, voids, or actual animals) well below the mean aRPD. Biogenic particle mixing depths can be estimated by measuring the maximum and minimum depths of imaged fauna, burrows, or feeding voids in the sediment column. In this study, the minimum and maximum linear distances from the sediment surface to feeding voids and the maximum linear distance to the deepest feature of biological activity will be measured. The latter parameter represents the maximum observed particle mixing depth of head-down feeders, mainly polychaetes.

Benthic Secondary Production and Food Provisioning

Soft sediment benthic communities can be important prey to upper trophic levels. Although SPI/PV imagery does not provide estimates of biomass or detailed taxonomic identification, these measurements do not necessarily relate to the value of any given benthic community as prey resource. Regional and interannual variability in biomass and species composition does not reflect changes in prey availability or value in the ecosystem. This natural variability is not likely to be ecologically meaningful. SPI/PV imagery can provide information on the level of succession of benthic community present after a physical (or chemical) disturbance. SPI/PV provides a more holistic assessment of benthic functioning that captures the relationship between infauna and sediments compared with infaunal abundance assessments using sediment grab sampling (Germano et al. 2011). Although infaunal abundance and density measurements are not generated from SPI/PV analysis, other metrics that will be collected as part of the benthic biological assessment include lists of infaunal and epifaunal species, the percent cover of attached biota visible in PV images, presence of sensitive and non-native species, and the infaunal successional stage (Pearson and Rosenberg 1978; Rhoads and Germano 1982; Rhoads and Boyer 1982). The successional stage has a strong predictive power for benthic functional response to physical disturbance (Germano et al. 2011) and will be the key metrics used during this set of soft bottom monitoring surveys.

Infaunal successional stage describes the biological status of a benthic community and is useful in quantifying the biological recovery after a disturbance (physical or organic enrichment-related). Organism–sediment interactions in fine-grained sediments follow a predictable sequence of development after a major disturbance (Pearson and Rosenberg 1978; Rhoads and Germano 1982; Rhoads and Boyer 1982). This continuum is divided subjectively into four stages: Stage 0, indicative of a sediment column that is largely devoid of macrofauna, occurs immediately following a physical disturbance or in close proximity to an organic enrichment source; Stage 1 is the initial recolonizing by tiny, densely populated polychaete assemblages; Stage 2 is the start of the transition to head-down deposit feeders; and Stage 3 is the mature, equilibrium community of deep-dwelling, head-down deposit feeders. The presence of feeding voids in the sediment column is evidence of an active Stage 3 community. If the frequency of physical disturbance is high, which is generally the case in naturally dynamic benthic habitats such as the sandy environment of the outer continental shelf, the benthic community successional stage will remain low at Stage 1 or 2 (Germano et al. 2011).

Physical Benthic Characteristics and Dynamics

Evidence of physical sediment characteristics and dynamics, important factors associated with benthic functioning, can be readily gleaned from paired SPI and PV imagery. Specifically, parameters such as sediment grain size, CMECS Substrate Group and Subgroup, gravel sizes and distributions, presence and characteristics of small-scale bedforms (e.g., ripples) are measurements that can be obtained from SPI/PV. This imagery provides concurrent information about the physical conditions of the benthic habitat that directly relate to the species inhabiting the area and the community ecological function.

Coupling SPI and PV paired imagery allows for the assessment of benthic functioning over a spatial scale of several square meters at each station. PV images provide a larger field-of-view than SPI images, or sediment grab samples, and provide valuable information about the landscape ecology and sediment topography in the area where the pinpoint "optical core" of the SPI is taken. Distinct surface sediment layers, textures, or structures detected in SPI can be interpreted considering the larger context of surface sediment features captured in the PV images. The scale information provided by the underwater lasers allows for accurate organismal density counts and/or percent cover of attached epifaunal colonies, sediment burrow openings, larger macrofauna and/or fish which are missed in the SPI cross section. A field of view is calculated for each PV image and measurements are taken of specific parameters outlined in the survey workplan.

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Appendix I. Supplemental Information

I.1. Climate and Meteorology

Conditions that affect the weather and climate in an area include wind velocity, air temperature, and precipitation. Long-term averages of these conditions produce the regional climate. Extreme meteorological conditions are produced in the Mid-Atlantic region of the United States during tropical and extra-tropical storms. Over the open ocean, meteorological characteristics are fundamentally influenced by oceanographic conditions and are therefore sometimes jointly discussed as “metocean” conditions. In temperate regions such as the Mid-Atlantic, several metocean conditions are highly seasonal and driven by both atmospheric and oceanic circulation patterns. Daily variability in meteorological conditions will drive fluctuations in wind farm power production and associated stresses on the WTGs, while long-term performance may be estimated based on the climatic conditions.

I.1.1 Regional Climate Overview

The Atlantic seaboard is classified as a mid-latitude climate zone based on the Köppen Climate Classification System. This larger region, which encompasses the Mid-Atlantic region, is characterized by mostly moist subtropical conditions, generally warm and humid in the summer with relatively mild winters (BOEM 2021). Prevailing winds at the middle latitudes over North America occur mostly west to east (“westerlies”) and contribute to seasonal variability along the Atlantic seaboard (NJDEP 2010).

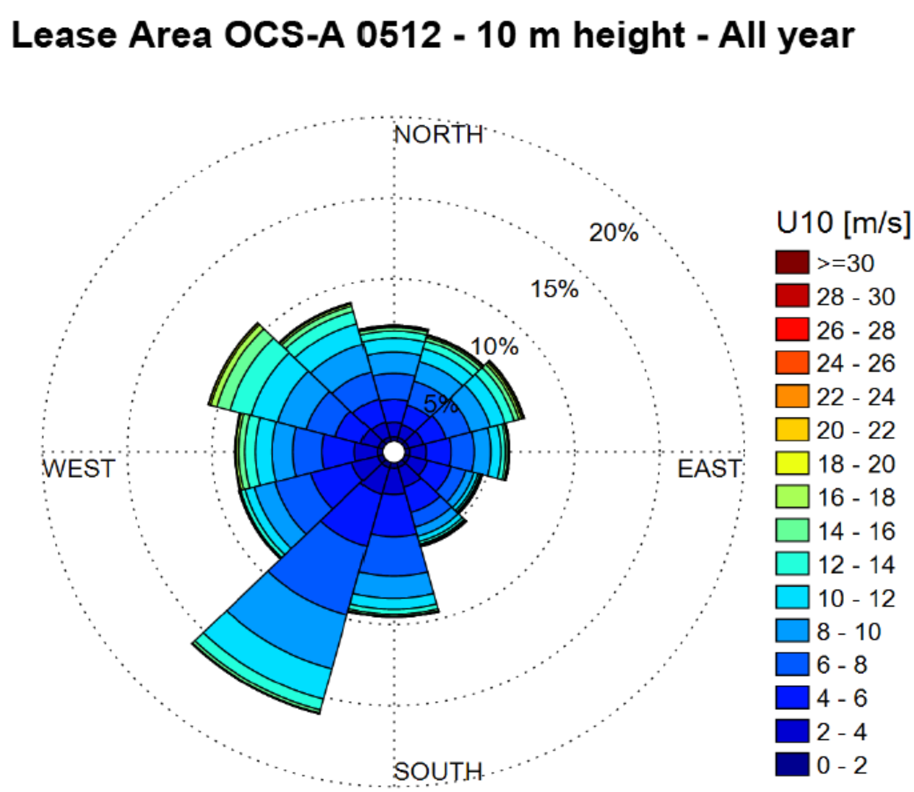
Consistent with the larger Mid-Atlantic region, the climate across New York state can be described as humid and continental (New York State Climate Action Council 2010). The New York Bight region along New York state’s southern coast experiences four distinct seasons with cold air temperatures during the winter months. Areas along the Atlantic coast, including the New York Bight, are especially prone to coastal storms and their associated effects, including heavy precipitation, high winds, and coastal flooding (New York State Climate Action Council 2010). Coastal storms are common in the vicinity of the Lease Area and include hurricanes and tropical storms during the warmer months (July to September), and northeasters or “nor’easters” (extratropical storms in which the winds in coastal areas blow from the northeast) during the cooler months (October to April). Extreme rainfall and flooding associated with storm events contribute to erosion of New York state’s coastal wetland areas and inland areas adjacent to the shoreline (New York State Climate Action Council 2010).

The North Atlantic Oscillation (NAO) also affects climate in the Northwest Atlantic on the scale of decades (NJDEP 2010; Townsend et al. 2004). The NAO is calculated as the wintertime pressure difference between the high-pressure system over the Azores Islands and the low-pressure system over Iceland (NJDEP 2010; Townsend et al. 2004). Shifts in the ratio of these pressures contribute to warmer or cooler average winters. Since the late 1970s, warmer NAO conditions have persisted on average (NJDEP 2010; Townsend et al. 2004). The NAO may be influenced by the El Niño-Southern Oscillation, which is a large-scale, multi-year fluctuation in sea surface temperatures in the Pacific Ocean (NJDEP 2010). The NAO may also be correlated with an 11-year solar cycle (IPCC 2021).

The U.S. Northeast region is currently subject to climate changes associated with global warming that are primarily attributed to human activities, especially the production of heat-trapping (i.e., “greenhouse”) gases (Dupigny-Giroux et al. 2018; Hayhoe et al. 2018; IPCC 2021). These regional changes include an average winter-spring increase in air temperature of 1.67 °F (increase of 0.93 °C) between 1940 and 2014. By 2035, the Northeast region is expected to be 3.6 °F (2 °C) warmer on average than during the pre-industrial era (Dupigny-Giroux et al. 2018). The Northeast region has also seen a 55 percent increase in the number of heaviest 1-percent precipitation events between 1958 and 2016 (Dupigny-Giroux et al. 2018). Severe storms have become more frequent and more intense. Storm flood heights driven by hurricanes in New York City have increased by more than 3.9 feet (1.2 meters) over the last thousand years (Dupigny-Giroux et al. 2018). Due to predicted increases in average global temperatures, the frequency and intensity of extreme regional weather events such as heat waves, strong winds, and heavy precipitation are expected to increase in the coming decades (New York State Climate Action Council 2010; Dupigny-Giroux et al. 2018).

I.1.2 Winds

Winds during the summer are typically from the southwest and flow parallel to the shore, while winds in the winter months are typically from the northwest and flow perpendicular to the shore. Spring and fall are more variable, with wind currents from either the southwest or northeast (Schofield et al. 2008). Empire has been collecting wind data, along with other directional wave and meteorological condition information, from a floating metocean buoy for 2 years. This metocean data will be used to inform final siting and design of the Projects (Empire 2022). Empire has also performed a preliminary metocean analysis using data from January 2000 through October 2019. This analysis shows that annual average wind speeds in the Lease Area at 33 feet (10 meters) AMSL range between 9.8 feet per second (3 meters per second [m/s]) and 23 feet per second (7 m/s) (Empire 2022 citing Kjeller Vindteknikk 2020). Winds in the Project area are predominantly from the south to southwest and the northwest (COP Appendix I; Empire 2022) as depicted on Figure I-1.



Source: COP Appendix I; Empire 2022
Note: Lease Area OCS-A 0512 is modeled at 40.28, -73.31 (latitude, longitude)

Figure I-1 All-Year Wind Rose at 33 Feet (10 Meters) AMSL for Lease Area OCS-A 0512 for the Period 2002–2019

In addition to the wind data presented above, representative data for wind speed and wind direction are publicly available from NOAA's National Data Buoy Center for the Long Island buoy (Buoy No. 44025) (NOAA 2021a) and the New York Harbor Entrance buoy (Buoy No. 44065) (NOAA 2021b). The Long Island buoy is within the Lease Area at coordinates of 40.251, -73.164 (latitude, longitude) and is 30 nm south of Islip, New York. The New York Harbor Entrance buoy is approximately 8 miles west of the Lease Area at coordinates of 40.369, -73.703.

The most recent data available from the New York Harbor Entrance buoy are for the period of January 2015 through December 2020. The maximum wind speed[1] recorded during this period was 47.4 miles per hour (mph) (21.2 m/s) in 2018, with average wind speeds from 11.2 to 15.7 mph (5 to 7 m/s) across these 6 years (Table I-1). Using 2017 as an example year to consider seasonal averages, the maximum wind speed was recorded in the spring of 2017 at 47.0 mph (21 m/s), although the highest average seasonal wind speed of 16.8 mph (7.5 m/s) occurred in the winter of 2017 (Table I-2). The average wind direction for all seasons between 2015 and 2020 was from the southwest. In other years, higher maximum wind speeds have occurred in summer and fall months due to tropical cyclones. For example, a maximum sustained wind speed of 51.4 mph (23.0 m/s) and gusts up to 70.5 mph (31.5 m/s) were recorded at the New York Harbor Entrance buoy on August 4, 2020, in association with Hurricane Isaias (NOAA 2021b).

Data from the Long Island buoy (Buoy No. 44025) in the Lease Area are available for the period of October 1975 through December 2008. The Long Island buoy measured similar conditions as the New York Harbor Entrance buoy with a maximum wind speed of 51.0 mph (22.8 m/s) in 1991, and average wind speeds from 11.2 to 18.9 mph (5.0 to 8.4 m/s) across the 34 years recorded (NOAA 2021a).

Table I-1 Annual Average and Maximum Wind Speed and Direction at New York Harbor Entrance Buoy (Buoy No. 44065) from January 2015 to December 2020

Year	Average Wind Speed		Maximum Wind Speed		Average Wind Direction
	mph	m/s	mph	m/s	Degrees from True North
2015	14.1	6.3	41.6	18.6	202 (Southwest)
2016	14.5	6.5	45.0	20.1	200 (Southwest)
2017	14.3	6.4	47.0	21.0	198 (Southwest)
2018	14.1	6.3	47.4	21.2	191 (Southwest)
2019	14.1	6.3	42.9	19.2	192 (Southwest)
2020	13.9	6.2	51.4	23.0	196 (Southwest)

Source: NOAA 2021b
Note: NOAA buoy measurements for wind speed are averaged over an 8-minute period.

Table I-2 Seasonal Average and Maximum Wind Speed and Direction at New York Harbor Entrance Buoy (Buoy No. 44065) in 2017

Season	Average Wind Speed		Maximum Wind Speed		Average Wind Direction
	mph	m/s	mph	m/s	Degrees from True North
Winter	16.8	7.5	44.3	19.8	223.9 (Southwest)
Spring	14.5	6.5	47.0	21.0	187.0 (South)
Summer	11.4	5.1	30.4	13.6	183.5 (South)

[1] NOAA buoy measurements for wind speed are averaged over an 8-minute period. Higher speeds are recorded for 5- to 8-second gusts.

Season	Average Wind Speed		Maximum Wind Speed		Average Wind Direction
	mph	m/s	mph	m/s	Degrees from True North
Fall	15.2	6.8	39.1	17.5	197.8 (Southwest)

Source: NOAA 2021b
Note: NOAA buoy measurements for wind speed are averaged over an 8-minute period.

I.1.3 Air Temperature and Precipitation

NOAA's National Centers for Environmental Information, formerly the National Climatic Data Center, defines distinct climatological divisions to represent areas that are nearly climatically homogeneous. Locations within the same climatic division are considered to share the same overall climatic features and influences. The site of the Proposed Action is within the New York coastal division or New York Climate Division 4 (NOAA National Centers for Environmental Information 2021a).

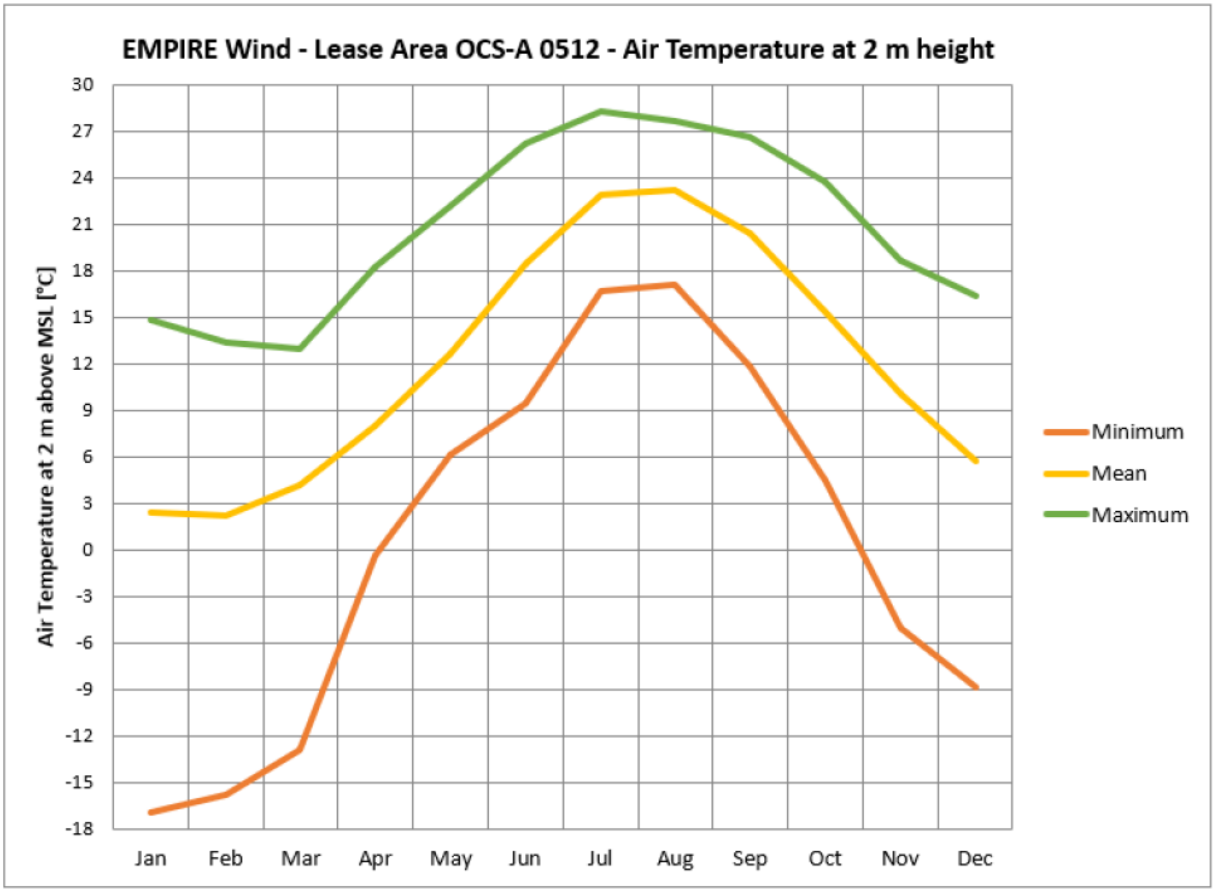
The mean average annual air temperature in the coastal division of New York was 51.4 °F (10.8 °C) between 1895 and 2021 (NOAA National Centers for Environmental Information 2021b). The seasonal mean ranged from 31.9 °F (-0.1 °C) in winter (December through February) to 70.8 °F (21.6 °C) in summer (June through August) (NOAA National Centers for Environmental Information 2021b).

Air temperature information is also available from NOAA's National Data Buoy Center Long Island buoy (Buoy No. 44025) and New York Harbor Entrance buoy (Buoy No. 44065). This information is presented in Table I-3 and shows air temperatures near the Lease Area ranging from 35 °F to 75 °F (1.67 °C to 23.90 °C), with the higher temperatures during the summer months (Empire 2022 citing NOAA 2018b, 2018c). Minimum, mean, and maximum air temperatures occurring over the Lease Area at 2 meters AMSL from the period between 2002 and 2019 are shown graphically on Figure I-2.

Table I-3 Average Air Temperature at NOAA Buoys in the Study Area

Month	Average Air Temperature in °F (°C)	
	Buoy Number 44065 (2008–2018)	Buoy Number 44025 (2007–2018)
January	35.01 (1.67)	37.98 (3.32)
February	36.66 (2.59)	38.70 (3.72)
March	39.58 (4.21)	41.49 (5.27)
April	46.65 (8.14)	47.03 (8.35)
May	56.71 (13.73)	55.33 (12.96)
June	66.04 (18.91)	65.46 (18.59)
July	73.92 (23.29)	73.29 (22.94)
August	75.02 (23.90)	73.98 (23.32)
September	69.69 (20.94)	68.61 (20.34)
October	59.94 (15.52)	60.53 (15.85)
November	49.10 (9.50)	51.06 (10.59)
December	42.13 (5.63)	43.77 (6.54)

Sources: Empire 2022 citing NOAA 2018b, 2018c



Source: Empire 2022 citing Kjeller Vindteknikk 2020

Figure I-2 Minimum, Mean, and Maximum Air Temperature at 2 Meters AMSL at Lease Area OCS-A 0512

Precipitation in the New York coastal region primarily takes the form of rain and snow. The mean annual precipitation for the coastal region of New York between 1895 and 2021 was 44.89 inches (114.0 centimeters) (NOAA National Centers for Environmental Information 2021c). During the same period, the mean monthly precipitation ranged from 3.40 inches (8.6 centimeters) in February to 4.19 inches (10.6 centimeters) in March (NOAA National Centers for Environmental Information 2021c). A summary of monthly and annual mean temperature and precipitation data collected for the New York coastal division between 1895 and 2021 is presented in Table I-4.

Table I-4 Mean Temperatures and Precipitation for New York Coastal Division, 1895 to 2021

Month	Average Mean Temperature		Maximum Mean Temperature		Minimum Mean Temperature		Total Mean Precipitation	
	°F	°C	°F	°C	°F	°C	Inches	cm
January	30.3	-0.9	38.0	3.3	22.6	-5.2	3.6	9.1
February	30.8	-0.7	38.7	3.7	22.8	-5.1	3.4	8.6
March	38.4	3.6	46.6	8.1	30.1	-1.1	4.2	10.7
April	47.9	8.8	57.0	13.9	38.8	3.8	3.9	9.9
May	58.1	14.5	67.6	19.8	48.7	9.3	3.8	9.7

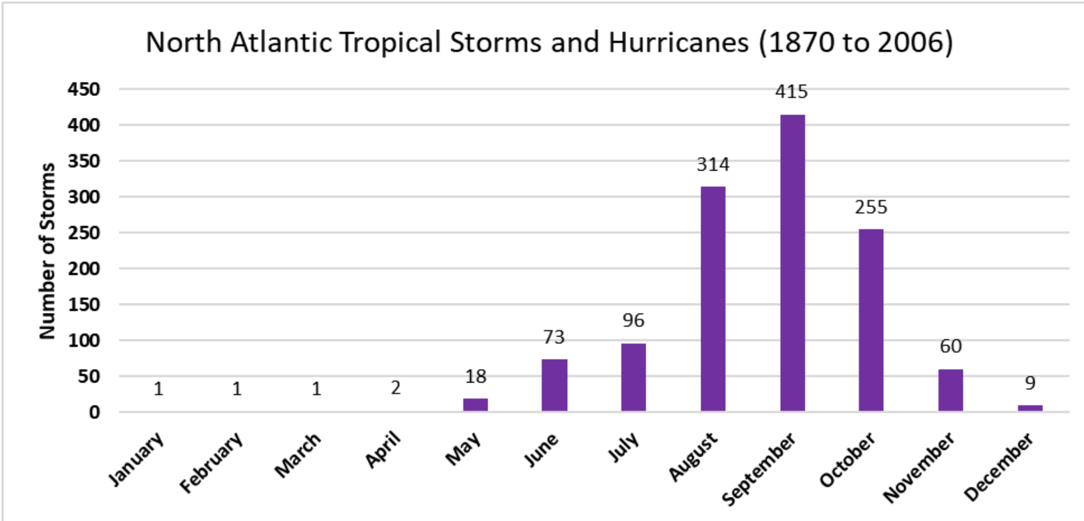
Month	Average Mean Temperature		Maximum Mean Temperature		Minimum Mean Temperature		Total Mean Precipitation	
	°F	°C	°F	°C	°F	°C	Inches	cm
June	67.4	19.7	76.6	24.8	58.2	14.6	3.5	8.9
July	73.1	22.8	81.9	27.7	64.3	17.9	3.7	9.4
August	71.8	22.1	80.3	26.8	63.2	17.3	4.1	10.4
September	65.3	18.5	74.2	23.4	56.4	13.6	3.6	9.1
October	54.8	12.7	63.8	17.7	45.7	7.6	3.6	9.1
November	44.4	6.9	52.4	11.3	36.3	2.4	3.8	9.7
December	34.6	1.4	42.0	5.6	27.1	-2.7	4.0	10.2
Annual	**51.4**	**10.8**	**59.9**	**15.5**	**42.9**	**6.0**	**44.9**	**114.0**

Source: NOAA National Centers for Environmental Information 2021b, 2021c
cm = centimeters

I.1.4 Extreme Storm Events

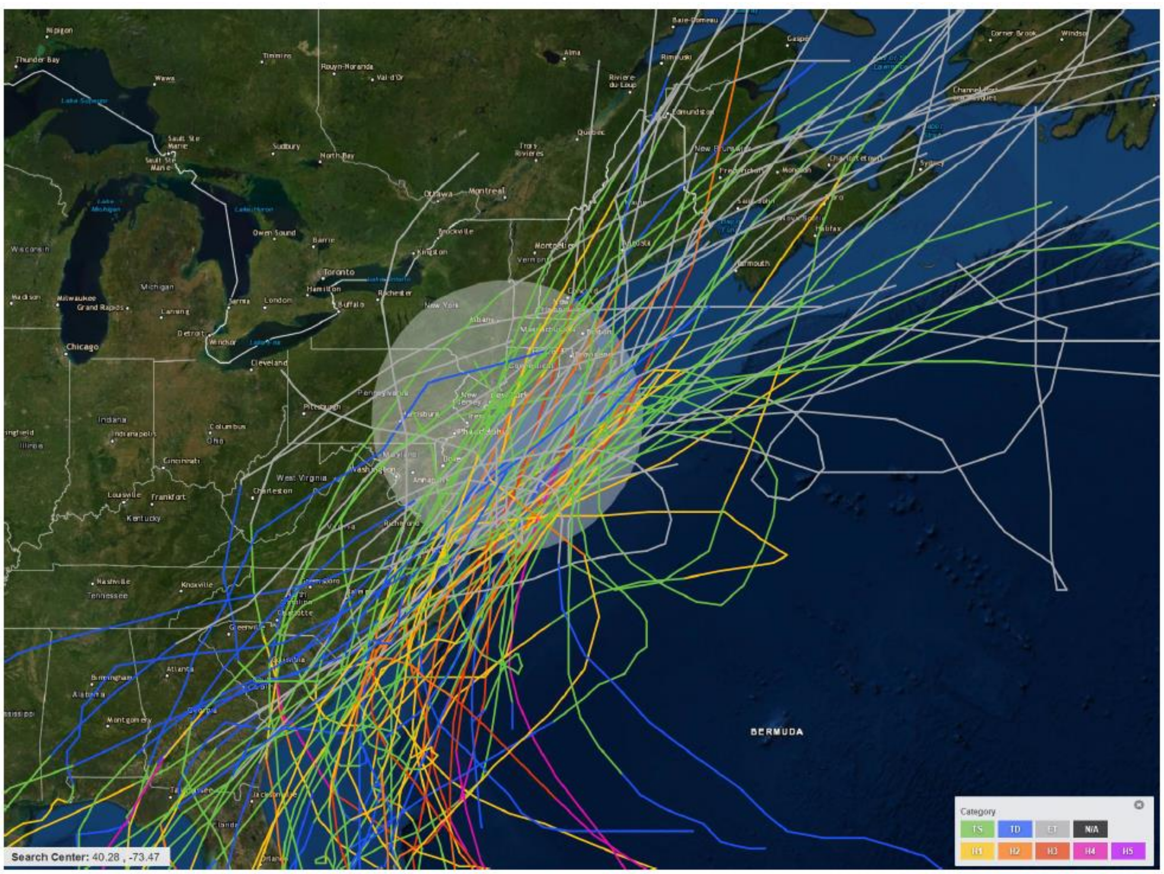
Strong weather events in the Lease Area include, but are not limited to, hurricanes and tropical storms in the warmer months and nor'easters during the winter months. The number of tropical storms, including hurricanes, generally reaches a peak during the period from August to early October (COP Appendix I; Empire 2022). This is consistent with the peak period for tropical cyclones throughout the North Atlantic basin (Figure I-3) (McAdie et al. 2009). Such storms that travel along the coastline of the eastern United States have the potential to affect the Project area with high winds and severe flooding.

Figure I-4 and Figure I-5 identify the hurricane tracks surrounding the Lease Area between 1950 and 2019 (COP Appendix I; Empire 2022). The category for each storm is designated by a color for each segment of its track on Figure I-4 and Figure I-5. Table I-5 lists each of the hurricanes affecting the Lease Area and the corresponding maximum storm categories as the hurricane occurred within 200 nm (370 kilometers) of the Lease Area for the corresponding period (NOAA 2021c). Most historical hurricanes affecting the Lease Area are Category 1, but storms as powerful as Category 3 hurricanes have passed nearby the Lease Area. The New York State ClimAID assessment determined that intense hurricanes are likely to increase in frequency over the 21st century for New York City and Long Island (New York State Climate Action Council 2010).



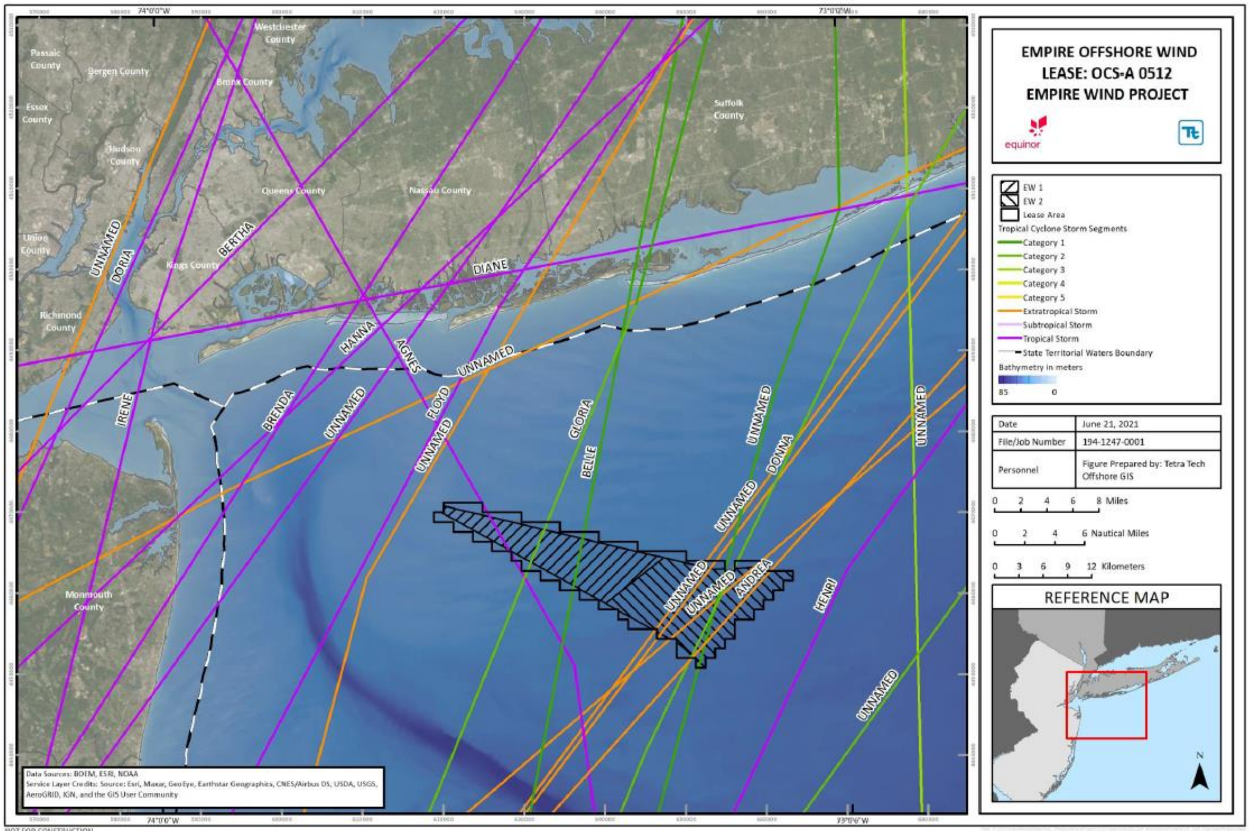
Source: McAdie et al. 2009

Figure I-3 Total Number of North Atlantic Basin Tropical Storms and Hurricanes per Month from 1870 to 2006



Source: COP Appendix I; Empire 2022

Figure I-4 Tracks of Hurricanes between 1950 and 2019 within a 200-nm (370-kilometer) Radius around Lease Area OCS-A 0512



Source: Empire 2022

Figure I-5 Hurricane Track Lines in the Project Area

Table I-5 Hurricanes with Tracks Passing within 200 nm of the Lease Area between 1950 and 2019

Storm Name	Year	Maximum Storm Category within 200 nm of Lease Area
Arthur	2014	Category 1 Hurricane
Sandy	2012	Category 2 Hurricane
Irene	2011	Category 1 Hurricane
Earl	2010	Category 1 Hurricane
Gustav	2002	Category 1 Hurricane
Floyd	1999	Category 1 Hurricane
Bonnie	1998	Category 1 Hurricane
Edouard	1996	Category 1 Hurricane
Emily	1993	Category 3 Hurricane
Bob	1991	Category 3 Hurricane
Charley	1986	Category 1 Hurricane
Gloria	1985	Category 2 Hurricane
Belle	1976	Category 2 Hurricane
Gerda	1969	Category 3 Hurricane
Doria	1967	Category 1 Hurricane

Storm Name	Year	Maximum Storm Category within 200 nm of Lease Area
Gladys	1964	Category 1 Hurricane
Alma	1962	Category 1 Hurricane
Esther	1961	Category 3 Hurricane
Donna	1960	Category 2 Hurricane
Daisy	1958	Category 2 Hurricane
Ione	1955	Category 1 Hurricane
Edna	1954	Category 3 Hurricane
Carol	1954	Category 3 Hurricane
Carol	1953	Category 1 Hurricane
Barbara	1953	Category 1 Hurricane
Dog	1950	Category 2 Hurricane
Able	1950	Category 2 Hurricane

Source: NOAA 2021c
Notes: The Lease Area was represented by a point with the following coordinates: latitude 40.28, longitude -73.47.
Hurricane categories are identified as 1 through 5 based on the Saffir-Simpson scale.

Hurricane Sandy, which occurred in 2012, provides an example of extreme storm conditions that have occurred in the region. In coastal New York, the storm surge created by Hurricane Sandy was more severe than a 100-year extreme event (Empire 2022). In Bergen Point West Reach on the northern side of Staten Island, tide gauges measured a storm surge of 9.56 feet (2.91 meters) and estimated inundation of 9.53 feet (2.9 meters). At the Battery on the southern tip of Manhattan, tide gauges measured storm surges of 9.40 feet (2.87 meters) and estimated inundation of 9.00 feet (2.7 meters) (Blake et al. 2013). Marine observations at NOAA Buoy No. 44025 and NOAA Buoy No. 44065 recorded maximum sustained wind speeds of 49 knots (56.4 mph; 25.2 m/s) and 48 knots (55.2 mph; 24.7 m/s), respectively (Blake et al. 2013).

I.1.5 Potential General Impacts of Offshore Wind Facilities on Meteorological Conditions

A known impact of offshore wind facilities on meteorological conditions is the wake effect. A WTG extracts energy from the free flow of wind, creating turbulence downstream of the WTG. The resulting “wake effect” is the aggregated influence of the WTGs for the entire wind farm on the available wind resource and the energy production potential of any facility downstream. Christiansen and Hasager (2005) observed offshore wake effects from existing facilities via satellite with synthetic aperture radar to last anywhere from 1.2 to 12.4 miles (2 to 20 kilometers) depending on ambient wind speed, direction, degree of atmospheric stability, and the number of turbines within a facility. During stable atmospheric conditions, these offshore wakes can be longer than 43.5 miles (70 kilometers).

Under certain conditions, offshore wind farms can also affect temperature and moisture downwind of the facilities. For example, from September 2016 to October 2017, a study using aircraft observations accompanied by mesoscale simulations examined the spatial dimensions of micrometeorological impacts from a wind energy facility in the North Sea (Siedersleben et al. 2018). Measurements and associated modeling indicated that measurable redistribution of moisture and heat were possible up to 62 miles (100 kilometers) downwind of the wind farm. However, this occurred only when (a) there was a strong, sustained temperature inversion at or below hub height and (b) wind speeds were greater than approximately 13.4 mph (6 m/s) (Siedersleben et al. 2018). Typically, air temperature will decrease with height above the sea surface in the lower atmosphere (i.e., the troposphere), and air will freely rise and disperse up to a “mixing height” (Holzworth 1972; Ramaswamy et al. 2006). A temperature inversion occurs when a warmer overlying air mass causes temperatures to increase with height; a strong inversion inhibits the further rise of cooler surface air masses, thus limiting the mixing height (Ramaswamy et al. 2006). Therefore, the North Sea study suggests that rapidly spinning turbines with hub heights at or above a strong inversion may induce mixing between air masses that would otherwise remain separated, which can significantly affect temperature and humidity downwind of a wind farm.

The mixing height over open waters of the North Atlantic Ocean is typically greater than 1,640 feet (500 meters) AMSL, except over areas of upwelling, where the mixing height may be closer to the sea surface (Holzworth 1972; Fuhlbrügge et al. 2013). Table I-6 presents atmospheric mixing height data from the nearest measurement location to the Project area (Atlantic City, New Jersey). As shown in the table, the minimum average mixing height is 390 meters (1,279 feet), while the maximum average mixing height is 1,218 meters (3,996 feet).

Table I-6 Representative Seasonal Mixing Height Data

Season	Data Hours Included[1]	Atlantic City, NJ Average Mixing Height (meters)
Winter (December, January, February)	Morning: No-Precipitation Hours	624
	Morning: All Hours	617
	Afternoon: No-Precipitation Hours	774
	Afternoon: All Hours	390
Spring (March, April, May)	Morning: No-Precipitation Hours	545
	Morning: All Hours	640
	Afternoon: No-Precipitation Hours	1,196
	Afternoon: All Hours	499
Summer (June, July, August)	Morning: No-Precipitation Hours	511
	Morning: All Hours	566
	Afternoon: No-Precipitation Hours	1,218
	Afternoon: All Hours	695
Fall (September, October, November)	Morning: No-Precipitation Hours	484
	Morning: All Hours	649
	Afternoon: No-Precipitation Hours	988
	Afternoon: All Hours	476
Annual Average	Morning: No-Precipitation Hours	539
	Morning: All Hours	620
	Afternoon: No-Precipitation Hours	1,052
	Afternoon: All Hours	508

Source: USEPA 2021
[1] Missing values are not included.

Díaz et al. (2019) reported that measurements over the Atlantic Ocean between 1981 and 2010 indicated a trend of decreasing strength and thickness of inversion layers, accompanied by a general increase in the mixing height, which is correlated with an increase in sea surface temperatures. Therefore, WTG hub heights are expected to remain well below the typical mixing height and associated temperature inversions over the open ocean in the Mid-Atlantic region. As such, the redistribution of moisture and heat due to rotor-induced vertical mixing, and any associated shifts to the microclimate, would be limited to the immediate vicinity of a wind facility in this region.

Additionally, mixing height affects air quality by acting as a lid on the height to which air pollutants can vertically disperse. Lower mixing heights allow less air volume for pollutant dispersion and lead to higher ground-level pollutant concentrations than do higher mixing heights.

I.2. Demographics, Employment, and Economics

Table I-7 Demographic Trends: 2000, 2010, 2020

Jurisdiction	Population 2000	Population 2010	Population 2020	% Change 2000–2020	% Change 2010–2020
Village of Island Park	4,732	4,675	4,928	4.1%	5.4%
City of Albany	99,658	97,856	99,224	3.7%	1.4%
City of Long Beach	35,462	33,275	35,029	-1.2%	5.3%
Town of Hempstead	755,924	759,917	793,409	5.0%	4.4%
Albany County	294,565	304,204	314,848	6.9%	3.5%
Kings County	2,465,326	2,504,700	2,736,074	11.0%	9.2%
Nassau County	1,334,544	1,339,354	1,395,774	4.6%	4.2%
Nueces County, Texas	313,645	340,223	353,178	12.6%	3.8%
San Patricio County, Texas	67,138	64,804	68,755	2.4%	6.1%
State of New York	18,976,457	19,378,096	20,201,249	6.5%	4.2%

Source: U.S. Census Bureau 2000, 2020

Table I-8 Demographic Data: 2020

Jurisdiction	Population	Population Density (persons per square mile)	Population 18 Years and Over	% of Population 18 Years and Over	% of Population Under 18
Village of Island Park	4,928	11,081	3,983	80.8%	19.2%
City of Albany	99,224	4,636	81,589	82.2%	17.8%
City of Long Beach	35,029	15,796	29,730	84.9%	15.1%
Town of Hempstead	793,409	6,695	620,910	78.3%	21.7%
Albany County	314,848	602	255,875	81.3%	18.7%
Kings County	2,736,074	39,438	2,140,371	78.2%	21.8%
Nassau County	1,395,774	4,905	1,098,884	78.7%	21.3%
Nueces County, Texas	353,178	421	270,056	76.5%	23.5%
San Patricio County, Texas	68,755	99	51,377	74.7%	25.3%
State of New York	20,201,249	429	16,088,135	79.6%	20.4%

Source: U.S. Census Bureau 2020

Table I-9 Age Distribution

Jurisdiction	0–17	18–34	35–64	65+	Median Age
Village of Island Park	18.4%	22.5%	43.6%	15.6%	39
City of Albany	17.8%	37.9%	31.4%	12.9%	31
City of Long Beach	15.4%	23.6%	42.7%	18.4%	45
Town of Hempstead	22.1%	21.5%	40.1%	16.3%	40
Albany County	18.6%	27.8%	37.1%	16.5%	38
Kings County	23.0%	26.6%	36.9%	13.6%	35
Nassau County	21.7%	20.4%	40.5%	17.5%	42
Nueces County, Texas	24.8%	24.6%	36.6%	14.1%	36
San Patricio County, Texas	27.0%	22.4%	36.0%	14.6%	36
State of New York	21.0%	24.0%	39.0%	16.2%	39

Source: U.S. Census Bureau 2019a

Table I-10 Employment and Income Levels

Jurisdiction	Per Capita Income	Total Employment	Unemployment Rate	Percent of Population Living Below Poverty Level
Village of Island Park	$40,304	842	2.5%	2.6%
City of Albany	$29,174	124,954	7.1%	22.9%
City of Long Beach	$53,579	6,035	4.4%	6.7%
Town of Hempstead	$44,958	299,756	4.2%	6.0%
Albany County	$37,635	242,227	4.5%	11.9%
Kings County	$34,173	874,328	6.2%	20.0%
Nassau County	$51,422	647,469	3.9%	5.6%
Nueces County, Texas	$27,740	159,956	5.7%	16.5%
San Patricio County, Texas	$26,054	19,117	5.1%	15.9%
State of New York	$39,326	9,547,776	5.5%	14.1%

Sources: U.S. Census Bureau 2019a, 2019b

Table I-11 Housing Trends: 2020

Jurisdiction	Housing Units	Occupied (%)	Vacant (%)
Village of Island Park	1,851	93.2%	6.8%
City of Albany	48,031	87.8%	12.2%
City of Long Beach	16,771	91.6%	8.4%
Town of Hempstead	260,524	96.1%	3.9%
Albany County	146,131	90.9%	9.1%
Kings County	1,077,654	93.7%	6.3%
Nassau County	476,732	95.5%	4.5%
Nueces County, Texas	151,255	86.4%	13.6%
San Patricio County, Texas	29,424	84.3%	15.7%
State of New York	8,488,066	90.9%	9.1%

Source: U.S. Census Bureau 2020

Table I-12 Housing Vacancy and Value

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Non-Seasonal Vacancy Rate	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
Village of Island Park	1,693	0	108	6.4%	$399,300	$1,689
City of Albany	48,813	153	7,405	15.2%	$179,100	$969
City of Long Beach	15,969	920	1,023	6.8%	$508,800	$1,874
Town of Hempstead	256,561	1,692	10,666	4.2%	$455,700	$1,678
Albany County	141,553	1,896	13,117	9.4%	$222,500	$1,022
Kings County	1,044,493	9,703	76,223	7.4%	$706,000	$1,426
Nassau County	472,572	3,971	21,624	4.6%	$493,500	$1,772
Nueces County, Texas	149,287	4,704	15,132	10.1%	$138,700	$1,017
San Patricio County, Texas	28,226	1,035	4,293	15.2%	$122,100	$975
State of New York	8,322,722	348,027	631,461	7.9%	$313,700	$1,280

Source: U.S. Census Bureau 2019a

Table I-13 Employment of Residents, by Industry

Industry	Village of Island Park	City of Albany	City of Long Beach	Town of Hempstead	Albany County	Kings County	Nassau County	Nueces County, Texas	San Patricio County, Texas	State of New York
Agriculture, Forestry, Fishing and Hunting, and Mining	0.0%	0.3%	0.2%	0.1%	0.3%	0.1%	0.2%	2.6%	5.7%	0.6%
Construction	11.4%	3.2%	6.6%	6.1%	4.3%	5.1%	5.7%	10.4%	13.8%	5.7%
Manufacturing	4.2%	2.8%	3.2%	4.0%	5.0%	3.2%	4.4%	6.3%	8.4%	6.0%
Wholesale Trade	2.5%	1.1%	3.0%	3.0%	1.8%	2.2%	3.3%	2.2%	2.7%	2.3%
Retail Trade	7.0%	10.1%	9.4%	10.1%	10.0%	9.2%	9.7%	11.5%	9.9%	10.2%
Transportation and Warehousing, and Utilities	5.6%	2.8%	4.6%	6.1%	3.4%	6.7%	5.6%	4.7%	5.9%	5.5%
Information	1.2%	2.3%	3.2%	2.8%	2.1%	4.6%	2.9%	1.3%	0.7%	2.9%
Finance and Insurance, and Real Estate and Rental and Leasing	12.7%	5.1%	11.6%	9.4%	7.7%	7.4%	10.5%	5.8%	5.3%	8.0%
Professional, Scientific, and Management, and Administrative and Waste Management Services	11.0%	10.9%	13.6%	11.9%	11.7%	14.1%	12.9%	9.0%	7.5%	12.0%
Educational Services, and Health Care and Social Assistance	19.3%	32.7%	29.2%	29.8%	27.6%	28.4%	29.0%	22.8%	23.0%	27.9%
Arts, Entertainment, and Recreation, and Accommodation and Food Services	15.1%	11.9%	7.5%	7.1%	9.1%	10.1%	7.0%	11.8%	8.7%	9.5%
Other Services, Except Public Administration	6.0%	4.5%	3.4%	4.4%	4.7%	5.1%	4.2%	5.7%	3.2%	4.9%
Public Administration	4.3%	12.3%	4.7%	5.3%	12.3%	3.8%	4.7%	5.9%	5.0%	4.6%

Source: U.S. Census Bureau 2019a

Table I-14 At-Place Employment, by Industry

Industry	Village of Island Park	City of Albany	City of Long Beach	Town of Hempstead	Albany County	Kings County	Nassau County	Nueces County, Texas	San Patricio County, Texas	State of New York
Agriculture, Forestry, Fishing and Hunting	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	1.7%	0.3%
Mining, Quarrying, and Oil and Gas Extraction	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%	2.4%	0.0%
Utilities	0.0%	0.1%	0.0%	0.8%	0.2%	0.5%	0.6%	0.9%	1.2%	0.4%
Construction	12.5%	2.2%	5.4%	4.9%	3.2%	3.9%	4.9%	11.1%	31.2%	4.1%
Manufacturing	0.2%	1.3%	0.2%	1.9%	3.2%	2.2%	2.5%	4.2%	4.4%	4.5%
Wholesale Trade	1.1%	1.4%	3.8%	2.3%	2.8%	2.8%	3.8%	3.3%	1.2%	3.4%
Retail Trade	5.5%	4.1%	13.7%	14.0%	8.2%	8.8%	12.0%	9.8%	10.6%	9.3%
Transportation and Warehousing	0.1%	2.2%	0.9%	3.4%	3.0%	8.8%	2.7%	3.0%	1.8%	3.6%
Information	3.6%	1.3%	1.5%	1.1%	2.1%	1.4%	1.4%	0.8%	0.8%	3.4%
Finance and Insurance	9.4%	5.6%	5.3%	3.7%	5.7%	1.9%	4.4%	2.6%	1.3%	5.4%
Real Estate and Rental and Leasing	1.0%	0.7%	3.3%	1.4%	1.4%	2.3%	1.6%	1.8%	0.7%	2.2%
Professional, Scientific, and Technical Services	1.3%	5.1%	4.1%	5.9%	6.4%	3.0%	6.4%	5.3%	2.9%	7.1%
Management of Companies and Enterprises	0.0%	1.8%	0.1%	0.7%	1.7%	0.3%	1.0%	0.4%	0.4%	1.6%
Administration & Support, Waste Management and Remediation	1.4%	3.3%	1.8%	5.6%	5.1%	4.3%	5.1%	5.2%	2.0%	5.5%
Educational Services	15.6%	6.9%	7.4%	14.2%	8.3%	11.6%	11.4%	10.2%	14.1%	11.0%
Health Care and Social Assistance	22.6%	19.3%	18.1%	18.7%	16.2%	31.4%	24.1%	20.8%	5.7%	18.3%
Arts, Entertainment, and Recreation	1.3%	0.5%	0.8%	2.2%	0.9%	1.2%	1.9%	1.6%	1.2%	1.9%
Accommodation and Food Services	10.6%	3.8%	16.1%	8.4%	6.1%	6.1%	7.6%	11.2%	11.3%	8.0%
Other Services (excluding Public Administration)	7.7%	2.4%	5.4%	5.0%	3.8%	3.4%	4.8%	2.7%	1.6%	3.9%
Public Administration	6.3%	37.9%	12.1%	6.1%	21.7%	6.0%	3.7%	2.5%	3.7%	6.0%

Source: U.S. Census Bureau 2019b

Table I-15 Number of Establishments, By Industry: 2021

Industry	Village of Island Park	City of Albany	City of Long Beach	Town of Hempstead	Albany County	Kings County	Nassau County	Nueces County, Texas	San Patricio County, Texas	State of New York
Agriculture, Forestry, Fishing and Hunting	0	7	2	23	36	83	65	57	18	2,983
Mining, Quarrying, and Oil and Gas Extraction	0	3	0	15	10	24	28	73	12	412
Utilities	0	4	0	23	22	33	67	27	6	839
Construction	11	193	54	1,909	804	3,813	3,876	933	131	43,963
Manufacturing	4	83	15	712	338	2,089	1,591	336	43	21,150
Wholesale Trade	5	104	13	865	422	2,290	1,813	462	43	21,469
Retail Trade	14	424	102	4,090	1,705	11,578	8,077	1,914	290	99,043
Transportation and Warehousing	4	67	17	625	243	1,346	1,052	262	33	13,294
Information	4	135	19	602	328	1,662	1,251	230	29	17,435
Finance and Insurance	7	190	50	1,445	679	2,056	3,118	744	96	31,484
Real Estate and Rental and Leasing	7	171	77	1,126	608	3,891	2,547	794	134	35,067
Professional, Scientific, and Technical Services	5	572	76	3,173	1,463	6,086	6,662	1,067	111	69,799
Management of Companies and Enterprises	0	7	2	91	15	301	198	50	4	1,838
Administration & Support, Waste Management and Remediation	4	112	24	1,181	430	2,291	2,308	437	30	24,670
Educational Services	3	162	22	775	378	1,866	1,478	325	63	18,637
Health Care and Social Assistance	8	497	93	2,424	1,222	6,128	5,166	1,023	120	59,382
Arts, Entertainment, and Recreation	6	107	25	635	298	1,228	1,329	270	31	16,173
Accommodation and Food Services	11	364	111	2,330	1,003	7,093	4,288	1,131	205	58,735
Other Services (excluding Public Administration)	23	693	106	3,608	1,866	9,226	6,726	1,485	256	86,344
Public Administration	5	344	15	383	661	372	683	321	101	18,436
Unclassified	5	342	97	2,390	802	11,815	5,236	890	89	67,253
Total (All Sectors)	126	4,581	920	28,425	13,333	75,271	57,559	12,831	1,845	708,406

Source: ArcGIS Business Analyst 2021

Table I-16 Annual Payroll by Industry ($1,000): 2020

Industry	Albany County	Kings County	Nassau County	New York State
Agriculture, Forestry, Fishing and Hunting	$10,653	$14,043	$6,552	$1,062,904
Mining, Quarrying, and Oil and Gas Extraction	$39,693	$0	$0	$322,656
Utilities	$69,215	$409,411	$469,906	$4,808,912
Construction	$637,392	$1,973,121	$2,418,144	$28,305,328
Manufacturing	$696,731	$849,682	$1,144,903	$29,188,387
Wholesale Trade	$520,212	$1,235,743	$2,054,761	$27,814,772
Retail Trade	$700,201	$2,893,401	$2,779,800	$33,464,878
Transportation and Warehousing	$284,904	$700,358	$972,615	$13,081,012
Information	$430,924	$1,169,921	$793,223	$41,332,226
Finance and Insurance	$1,286,324	$1,567,844	$3,035,636	$129,471,739
Real Estate and Rental and Leasing	$187,430	$961,500	$768,862	$15,449,702
Professional, Scientific, and Technical Services	$1,460,915	$1,986,058	$3,273,562	$85,762,955
Management of Companies and Enterprises	$310,587	$162,906	$763,359	$21,639,905
Administration & Support, Waste Management and Remediation	$446,112	$1,290,984	$1,602,593	$28,518,583
Educational Services	$603,361	$1,465,788	$936,646	$23,113,579
Health Care and Social Assistance	$1,810,463	$10,853,850	$9,491,509	$87,278,334
Arts, Entertainment, and Recreation	$32,836	$497,139	$428,020	$7,776,281
Accommodation and Food Services	$238,288	$1,125,952	$1,051,072	$15,647,467
Other Services (excluding Public Administration)	$366,789	$818,662	$943,867	$15,048,420
Unclassified	$9,916	$190,649	$126,294	$1,783,279
Total (All Private)	$10,142,947	$30,168,669	$33,061,428	$610,871,320

Source: New York State Department of Labor 2020
Note: Dollar value is in $1000s.

Table I-17 Ocean Economy Data

County	Ocean Economy GDP, All Ocean Sectors	Ocean Economy GDP, Tourism and Recreation Sector	Ocean Economy GDP, Living Resources Sector	Total County GDP (Coastal Economy, Employment Data) Total, All Industries	Ocean Economy GDP, as Percent of Total County GDP (%)
Albany	$32,689,00	$0	Suppressed	$34,550,146,168	0.1%
Kings	$2,052,466,000	$1,802,669,000	$167,428,000	$95,011,253,174	2.2%
Nassau	$1,065,093,000	$794,144,000	$55,065,000	$99,424,936,812	1.1%
Nueces	$1,529,501,000	$574,591,000	Suppressed	$20,523,787,223	7.5%
San Patricio	$588,635,000	$60,386,000	$0.00	$2,383,411,637	24.7%

Source: NOAA 2018

Table I-18 Ocean Economy Employment[1]

County	Marine Construction	Living Resources	Offshore Mineral Extraction	Tourism and Recreation	Marine Transportation	Total, All Sectors
Albany	Suppressed	Suppressed	Suppressed	0	594	594
Kings	Suppressed	1412	Suppressed	33,228	1,517	36,157
Nassau	142	493	43	17,392	1,286	19,356
Nueces	Suppressed	Suppressed	2,453	13,488	558	17,507
San Patricio	Suppressed	0	449	1,766	Suppressed	4,607

Source: NOAA 2018
[1] Data for ship and boat building are suppressed for all counties, so are not included in the table.

Table I-19 Race and Ethnicity: 2020[1]

Jurisdiction	Total Population	White (%)	Black (%)	Asian (%)	Other (%)	Hispanic (%)	Total Minority %
Village of Island Park	4,928	55.4%	3.0%	4.1%	4.1%	33.4%	44.6%
City of Albany	99,224	44.7%	29.5%	8.0%	6.2%	11.6%	55.3%
City of Long Beach	35,029	72.9%	5.2%	3.2%	3.5%	15.3%	27.1%
Town of Hempstead	793,409	50.7%	15.9%	7.5%	3.8%	22.0%	49.3%
Albany County	314,848	67.0%	12.9%	7.7%	5.6%	6.9%	33.0%
Kings County	2,736,074	35.4%	26.7%	13.6%	5.4%	18.9%	64.6%
Nassau County	1,395,774	55.8%	10.6%	11.7%	3.5%	18.4%	44.2%
Nueces County, Texas	353,178	30.1%	3.6%	2.2%	2.7%	61.5%	69.9%
San Patricio County, Texas	68,755	38.7%	1.4%	1.2%	3.0%	55.6%	61.3%
State of New York	20,201,249	52.5%	13.7%	9.5%	4.9%	19.5%	47.5%

Source: U.S. Census Bureau 2020
[1] The percentages of White, Black, Asian, and Other categories include Non-Hispanics only.

Table I-20 Educational Attainment for Population 25 Years and Over[1]

Highest Education Attainment	Less than High School	High School or GED	Some College	Bachelor's Degree	Advanced Degree
Village of Island Park	7.7%	41.6%	27.4%	9.9%	13.3%
City of Albany	12.2%	23.0%	25.3%	19.6%	20.0%
City of Long Beach	5.2%	22.8%	23.4%	25.7%	23.0%
Town of Hempstead	10.1%	24.4%	24.4%	23.1%	17.9%
Albany County	7.9%	23.0%	27.4%	21.4%	20.4%
Kings County	17.6%	25.7%	19.2%	22.5%	15.0%
Nassau County	8.6%	22.7%	22.8%	25.3%	20.7%
Nueces County, Texas	17.2%	29.3%	31.7%	14.2%	7.6%
San Patricio County, Texas	20.1%	32.7%	31.6%	11.2%	4.4%
State of New York	13.2%	26.0%	24.3%	20.5%	16.0%

Source: U.S. Census Bureau 2019a
[1] The percentages may not sum to 100 due to rounding.

Table I-21 Economic Value of the Tourism and Recreation Sector

Affected Area	Establishments	Employment	Wages (millions)	GDP (millions)
State of New York	**22,270**	**359,194**	**$12,628.4**	**$29,039.5**
Albany County	N/A	N/A	N/A	N/A
Kings County	3,759	33,229	$899.2	$1,802.7
Nassau County	1,396	17,392	$421.9	$794.1
New York County	9,621	217,305	$9,207.3	$22,187.7
Queens County	1,299	11,581	$277.4	$510.0
Suffolk County	2,741	36,385	$921.1	$1,916.7
State of New Jersey	**7,949**	**96,261**	**$2,201.6**	**$4,299.3**
Monmouth County	1,324	17,767	$369.0	$704.7
Ocean County	1,155	14,049	$288.2	$569.5

Source: National Ocean Economics Program 2018
N/A = not available

Table I-22 Empire's Projected Jobs and Economic Impacts during Construction

Economic Impact		Empire Wind 1	Empire Wind 2	Total
Jobs (FTE)[1]	Direct	180	269	449
	Indirect	60	96	156
	Induced	92	141	233
	Total	332	506	838
Gross State Product (Value added) (in millions of 2020 dollars)	Direct	$152.8	$273.9	$426.7
	Indirect	$54.6	$99.9	$154.5
	Induced	$75.6	$132.2	$207.8
	Total	$283.0	$506.0	$789.0

Economic Impact		Empire Wind 1	Empire Wind 2	Total
Personal Income (in millions of 2020 dollars)	Direct	$114.1	$197.9	$312.0
	Indirect	$37.8	$67.4	$105.2
	Induced	$43.0	$75.2	$118.2
	Total	$194.9	$340.5	$535.4

Source: COP Volume 1, Appendix O; Empire 2022
[1] One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Therefore, two half-time employees would equal one FTE. Only those jobs that Empire would perform in the designated area are included.

Table I-23 Projected Tax Revenues during Construction and Operations and Maintenance

Taxes	Construction		Operations and Maintenance	
	Empire Wind 1	Empire Wind 2	Empire Wind 1	Empire Wind 2
State and Local Taxes	$24.9	$42.6	$48.8	$74.1
Federal Taxes	$38.4	$67.1	$63.0	$95.7
Total Taxes	$63.4	$109.7	$111.8	$169.8

Source: COP Volume 1, Appendix O; Empire 2022

Table I-24 Empire's Projected Jobs and Economic Impacts during Operations and Maintenance

Economic Impact		Empire Wind 1	Empire Wind 2	Total
Jobs (FTE)[1]	Direct	53	80	133
	Indirect/Induced	67	102	169
	Total	120	182	302
Gross State Product (Value added) (in millions of 2020 dollars)	Direct	$215.8	$302.7	$518.5
	Indirect	$158.4	$140.1	$298.5
	Induced	$119.6	$151.7	$271.3
	Total	$493.8	$594.5	$1,088.3
Personal Income (in millions of 2020 dollars)	Direct	$137.9	$208.8	$346.7
	Indirect	$103.4	$96.8	$200.2
	Induced	$68.0	$86.3	$154.3
	Total	$309.3	$391.9	$701.2

Source: COP Volume 1, Appendix O; Empire 2022
[1] One FTE job is the equivalent of one person working full time for 1 year (2,080 hours). Therefore, two half-time employees would equal one FTE. Only those jobs that Empire would perform in the designated area are included.

I.3. Wetlands

Table I-25 NYSDEC-mapped Aquatic Features

Route Feature	NYSDEC Classification	Acres within Footprint/Cable Corridor
EW 2 Landfall A	No NYSDEC-mapped features in footprint[1]	--
EW 2 Landfall B	No NYSDEC-mapped features in footprint[1]	--

Route Feature	NYSDEC Classification	Acres within Footprint/Cable Corridor
EW 2 Landfall C	No NYSDEC-mapped features in footprint[1]	--
EW 2 Landfall E	No NYSDEC-mapped features in footprint[1]	--
EW 2 Route LB-A	No NYSDEC-mapped features in cable corridor	--
EW 2 Route LB-B	No NYSDEC-mapped features in cable corridor	--
EW 2 Route LB-C	No NYSDEC-mapped features in cable corridor	--
EW 2 Route LB-D	Littoral Zone	0.04
EW 2 Route LB-E	No NYSDEC-mapped features in cable corridor	--
EW 2 Route LB-Variant	No NYSDEC-mapped features in cable corridor	--
EW 2 Route LB-F	No NYSDEC-mapped features in cable corridor	--
EW Route 2 LB-G	No NYSDEC-mapped features in cable corridor	--
EW Route 2 LB-H	No NYSDEC-mapped features in cable corridor	
Reynolds Channel Crossing	Littoral Zone Coastal Shoals, Bars, and Mudflats	8.63 0.21
EW 2 Route IP-A	No NYSDEC-mapped features in cable corridor	--
EW 2 Route IP-B	No NYSDEC-mapped features in cable corridor	--
EW 2 Route IP-C	Littoral Zone Coastal Shoals, Bars, and Mudflats Intertidal Marsh	1.07 0.84 0.10
EW 2 Route IP-D	Littoral Zone	0.37
EW 2 Route IP-E	Littoral Zone Coastal Shoals, Bars, and Mudflats Intertidal Marsh	0.47 0.51 0.04
EW 2 Route IP-F	Littoral Zone Coastal Shoals, Bars, and Mudflats Intertidal Marsh	2.74 1.08 1.50
EW 2 Route IP-G	Littoral Zone Coastal Shoals, Bars, and Mudflats Intertidal Marsh High Marsh	3.27 3.99 2.44 0.16
EW 2 Route IP-H	No NYSDEC-mapped features in cable corridor	--
EW 2 Onshore Substation A	No NYSDEC-mapped features in footprint	--
EW 2 Onshore Substation C	No NYSDEC-mapped features[2]	--

Source: COP Volume 2, Table 5.2-3; Empire 2022

Note: The table presents wetland areas within the cable corridor that could be susceptible to potential impacts and not necessarily the area of wetland that would actually be affected during construction and operations. For example, segment IP-C could cross Reynolds Channel via open trench or trenchless (e.g., HDD) methods, which would have very different impacts on wetlands.

[1] The four landfalls have “Adjacent Areas” mapped within the footprint, which are land areas that are adjacent to any of the NYSDEC tidal wetland zone classifications. Adjacent Areas are generally not inundated by tidal waters and extend 300 feet landward of the most landward tidal wetland boundary or to an elevation of 10 feet (refer to New York State regulations Part 661, Tidal Wetlands Land Use Regulation).

[2] Based on the *EW 2 Onshore Substation C Characterization Report* (Tetra Tech 2021), NYSDEC mapping indicates that Reynolds Channel extends into the Onshore Substation C site by a maximum of approximately 40 feet (12 meters); however, a review of aerial imagery indicates that historic alterations to the shoreline, including bulkheading, have resulted in a more artificial and linear bank than portrayed by NYSDEC-mapped boundaries. The result of these shoreline alterations is that the current bank of Reynolds Channel appears to approximately align with the boundary of the EW 2 Onshore Substation C site.

I.4. Commercial and For-Hire Recreational Fisheries

Table I-26 Number of Trips by Commercial Fishing Vessels in the EW 1 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Summer Flounder/Scup/Black Sea Bass	1,676	1,815	1,808	1,218	1,197	1,191	1,199	1,101	1,093	753	**1,305**
Mackerel/Squid/Butterfish	893	1,065	1,300	618	738	671	673	781	723	493	**796**
Monkfish	882	925	831	660	858	811	651	602	532	451	**720**
No Federal FMP	737	854	760	773	635	661	597	664	592	462	**674**
Skates	611	783	806	600	620	615	566	636	589	386	**621**
Sea Scallop	705	1,069	630	412	642	473	605	164	101	87	**489**
American Lobster	655	479	588	576	509	412	405	355	295	231	**451**
Small-Mesh Multispecies	389	427	412	536	443	327	220	360	366	365	**385**
Bluefish	405	597	571	273	341	332	272	368	213	205	**358**
Spiny Dogfish	201	307	174	125	117	153	150	192	129	74	**162**
Jonah Crab	164	124	172	197	159	190	159	142	117	102	**153**
Atlantic Herring	145	94	58	38	30	39	23	20	64	38	**55**
Northeast Multispecies	69	125	84	105	68	16	14	9	17	10	**52**
Surfclam/Ocean Quahog	65	20	0	36	0	18	90	93	0	34	**36**
Golden and Blueline Tilefish	10	13	17	18	15	30	17	17	8	15	**16**
Highly Migratory Species	3	5	8	4	7	3	12	10	19	6	**8**
All FMPs	**7,610**	**8,702**	**8,219**	**6,189**	**6,379**	**5,942**	**5,653**	**5,514**	**4,858**	**3,712**	**6,278**

Source: NMFS 2022b

Table I-27 Number of Commercial Fishing Vessels that Fished in the EW 1 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Monkfish	215	213	191	117	204	169	141	110	115	98	**157**
Sea Scallop	231	251	166	123	226	146	168	89	55	53	**151**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Summer Flounder/Scup/Black Sea Bass	117	143	161	118	136	145	131	126	127	111	**132**
Mackerel/Squid/Butterfish	101	101	124	87	102	121	92	106	107	96	**104**
No Federal FMP	90	99	99	93	96	103	92	92	96	69	**93**
Bluefish	70	90	112	73	86	90	66	86	54	54	**78**
Skates	66	77	70	45	59	62	53	69	73	51	**63**
Small-Mesh Multispecies	51	47	56	59	67	50	41	61	72	69	**57**
American Lobster	45	44	52	38	39	28	28	32	33	27	**37**
Spiny Dogfish	29	38	30	18	19	24	17	23	20	14	**23**
Northeast Multispecies	20	21	27	27	28	9	9	7	9	4	**16**
Atlantic Herring	31	18	17	12	10	14	11	12	14	12	**15**
Jonah Crab	10	15	14	12	12	14	11	13	14	10	**13**
Golden and Blueline Tilefish	9	10	11	11	8	10	13	13	8	6	**10**
Surfclam/Ocean Quahog	11	10	0	5	0	7	12	9	0	12	**7**
Highly Migratory Species	3	5	7	4	6	3	4	5	11	6	**5**
All FMPs	**1,099**	**1,182**	**1,137**	**842**	**1,098**	**995**	**889**	**853**	**808**	**692**	**960**

Source: NMFS 2022b

Table I-28 Number of Trips by Commercial Fishing Vessels in the EW 2 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Summer Flounder/Scup/Black Sea Bass	857	978	1,022	683	807	785	858	755	852	579	**818**
Sea Scallop	776	1,200	891	714	1,047	812	1,229	465	318	271	**772**
Monkfish	777	808	771	704	900	876	833	614	645	477	**741**
Mackerel/Squid/Butterfish	556	614	826	414	541	522	435	505	657	391	**546**
No Federal FMP	337	378	400	482	391	410	344	404	390	298	**383**
Skates	333	451	346	267	354	338	332	347	390	214	**337**
Bluefish	271	381	431	249	325	326	275	390	228	214	**309**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Small-Mesh Multispecies	168	176	206	276	234	205	178	221	329	268	**226**
American Lobster	165	151	205	124	176	158	132	125	118	135	**149**
Spiny Dogfish	100	154	100	49	54	53	28	42	67	15	**66**
Surfclam/Ocean Quahog	43	26	0	0	53	54	144	148	0	82	**55**
Jonah Crab	20	19	6	19	34	66	31	49	44	68	**36**
Atlantic Herring	57	30	29	27	12	33	24	23	67	42	**34**
Northeast Multispecies	36	74	60	46	44	17	18	8	16	7	**33**
Golden and Blueline Tilefish	22	30	27	36	33	46	37	33	24	24	**31**
Highly Migratory Species	3	7	6	4	8	4	16	11	17	10	**9**
All FMPs	**4,521**	**5,477**	**5,326**	**4,094**	**5,013**	**4,705**	**4,914**	**4,140**	**4,162**	**3,095**	**4,545**

Source: NMFS 2022b

Table I-29 Number of Commercial Fishing Vessels that Fished in the EW 2 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	267	286	217	155	272	182	251	188	91	93	**200**
Monkfish	246	236	220	161	251	202	203	155	151	129	**195**
Summer Flounder/Scup/Black Sea Bass	137	145	167	132	160	161	167	151	144	127	**149**
Mackerel/Squid/Butterfish	108	97	129	108	110	129	119	110	119	102	**113**
No Federal FMP	94	83	94	99	93	107	100	93	97	78	**94**
Bluefish	72	86	109	84	91	98	87	89	56	58	**83**
Skates	75	72	65	57	64	65	56	73	83	55	**67**
Small-Mesh Multispecies	59	45	51	72	67	61	66	68	74	66	**63**
American Lobster	46	37	47	39	44	23	23	27	29	29	**34**
Spiny Dogfish	28	31	26	16	13	20	12	15	23	9	**19**
Golden and Blueline Tilefish	16	18	13	22	15	18	24	23	17	11	**18**
Northeast Multispecies	21	22	28	30	26	11	11	7	9	6	**17**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Atlantic Herring	25	15	14	9	9	13	9	14	14	11	**13**
Jonah Crab	7	12	6	10	11	12	7	11	8	8	**9**
Surfclam/Ocean Quahog	12	10	0	0	12	11	15	11	0	14	**9**
Highly Migratory Species	3	7	5	4	7	4	7	6	10	9	**6**
All FMPs	**1,216**	**1,202**	**1,191**	**998**	**1,245**	**1,117**	**1,157**	**1,041**	**925**	**805**	**1,090**

Source: NMFS 2022b

Table I-30 Number of Trips by Commercial Fishing Vessels in the Combined EW 1 and EW 2 WEAs by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Summer Flounder/Scup/Black Sea Bass	2,533	2,793	2,830	1,901	2,004	1,976	2,057	1,856	1,945	1,332	**2,123**
Monkfish	1,659	1,733	1,602	1,364	1,758	1,687	1,484	1,216	1,177	928	**1,461**
Mackerel/Squid/Butterfish	1,449	1,679	2,126	1,032	1,279	1,193	1,108	1,286	1,380	884	**1,342**
Sea Scallop	1,481	2,269	1,521	1,126	1,689	1,285	1,834	629	419	358	**1,261**
No Federal FMP	1,074	1,232	1,160	1,255	1,026	1,071	941	1,068	982	760	**1,057**
Skates	944	1,234	1,152	867	974	953	898	983	979	600	**958**
Bluefish	676	978	1,002	522	666	658	547	758	441	419	**667**
Small-Mesh Multispecies	557	603	618	812	677	532	398	581	695	633	**611**
American Lobster	820	630	793	700	685	570	537	480	413	366	**599**
Spiny Dogfish	301	461	274	174	171	206	178	234	196	89	**228**
Jonah Crab	184	143	178	216	193	256	190	191	161	170	**188**
Surfclam/Ocean Quahog	108	46	0	36	53	72	234	241	0	116	**91**
Atlantic Herring	202	124	87	65	42	72	47	43	131	80	**89**
Northeast Multispecies	105	199	144	151	112	33	32	17	33	17	**84**
Golden and Blueline Tilefish	32	43	44	54	48	76	54	50	32	39	**47**
Highly Migratory Species	6	12	14	8	15	7	28	21	36	16	**16**
All FMPs	**12,131**	**14,179**	**13,545**	**10,283**	**11,392**	**10,647**	**10,567**	**9,654**	**9,020**	**6,807**	**10,823**

Source: NMFS 2022b

Table I-31 Number of Commercial Fishing Vessels that Fished in the Combined EW 1 and EW 2 WEAs by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Monkfish	461	449	411	278	455	371	344	265	266	227	**353**
Sea Scallop	498	537	383	278	498	328	419	277	146	146	**351**
Summer Flounder/Scup/Black Sea Bass	254	288	328	250	296	306	298	277	271	238	**281**
Mackerel/Squid/Butterfish	209	198	253	195	212	250	211	216	226	198	**217**
No Federal FMP	184	182	193	192	189	210	192	185	193	147	**187**
Bluefish	142	176	221	157	177	188	153	175	110	112	**161**
Skates	141	149	135	102	123	127	109	142	156	106	**129**
Small-Mesh Multispecies	110	92	107	131	134	111	107	129	146	135	**120**
American Lobster	91	81	99	77	83	51	51	59	62	56	**71**
Spiny Dogfish	57	69	56	34	32	44	29	38	43	23	**43**
Northeast Multispecies	41	43	55	57	54	20	20	14	18	10	**33**
Atlantic Herring	56	33	31	21	19	27	20	26	28	23	**28**
Golden and Blueline Tilefish	25	28	24	33	23	28	37	36	25	17	**28**
Jonah Crab	17	27	20	22	23	26	18	24	22	18	**22**
Surfclam/Ocean Quahog	23	20	0	5	12	18	27	20	0	26	**15**
Highly Migratory Species	6	12	12	8	13	7	11	11	21	15	**12**
All FMPs	**2,315**	**2,384**	**2,328**	**1,840**	**2,343**	**2,112**	**2,046**	**1,894**	**1,733**	**1,497**	**2,049**

Source: NMFS 2022b

Table I-32 Number of Commercial Fishing Vessel Trips in the EW 1 WEA by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	739	730	867	740	724	680	499	400	430	336	**615**
Belford, New Jersey	639	699	767	510	460	460	558	506	373	0	**497**
Freeport, New York	383	407	321	237	199	205	207	198	157	104	**242**
Point Lookout, New York	219	471	335	141	155	64	0	0	0	0	**139**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	184	140	88	39	140	62	89	65	58	44	**91**
Cape May, New Jersey	79	151	107	65	92	118	98	63	58	36	**87**
Point Judith, Rhode Island	46	70	76	58	121	106	50	52	129	64	**77**
Barnegat, New Jersey	84	91	61	78	61	97	75	41	44	0	**63**
Montauk, New York	25	75	55	10	21	23	0	28	50	20	**31**
Brooklyn, New York	67	91	63	0	0	0	0	82	0	0	**30**
Newport News, Virginia	25	62	42	35	24	16	16	13	11	7	**25**
Shark River, New Jersey	126	33	32	0	0	0	0	0	17	0	**21**
Hampton, Virginia	0	0	32	0	0	31	40	37	0	20	**16**
Atlantic City, New Jersey	9	5	8	4	7	6	46	46	0	11	**14**
Beaufort, North Carolina	0	0	4	0	4	14	13	24	25	17	**10**
Other Ports	116	47	92	26	49	28	15	39	44	24	**48**
All Ports	**2,741**	**3,072**	**2,950**	**1,943**	**2,057**	**1,910**	**1,706**	**1,594**	**1,396**	**683**	**2,005**

Source: NMFS 2022b

Table I-33 Number of Commercial Fishing Vessels that Fished in the EW 1 WEA by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	107	78	57	30	92	42	63	45	32	27	**57**
Point Pleasant, New Jersey	62	80	59	48	63	49	50	39	38	30	**52**
Cape May, New Jersey	59	65	51	32	47	44	34	22	12	13	**38**
Point Judith, Rhode Island	22	29	26	27	40	32	25	24	34	29	**29**
Barnegat, New Jersey	25	27	20	19	19	26	19	16	15	0	**19**
Newport News, Virginia	16	37	28	21	20	12	14	9	7	7	**17**
Belford, New Jersey	19	18	17	16	14	14	14	15	16	0	**14**
Hampton, Virginia	0	0	19	0	0	19	22	24	0	11	**10**
Montauk, New York	9	9	13	6	7	7	0	8	10	7	**8**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Beaufort, North Carolina	0	0	4	0	4	10	11	18	16	11	**7**
Point Lookout, New York	11	18	17	8	10	3	0	0	0	0	**7**
Freeport, New York	13	8	8	5	7	4	7	6	4	4	**7**
Shinnecock, New York	13	10	4	6	5	3	0	0	0	3	**4**
Chincoteague, Virginia	0	0	0	11	6	0	0	9	6	7	**4**
Atlantic City, New Jersey	4	4	4	3	6	4	5	4	0	4	**4**
Shark River, New Jersey	6	4	5	0	0	0	0	0	3	0	**2**
Stonington, Connecticut	6	0	0	0	3	3	3	0	0	3	**2**
Hampton Bay, New York	0	3	0	0	3	0	0	4	4	3	**2**
Wanchese, North Carolina	0	3	0	0	6	0	5	3	0	0	**2**
Brooklyn, New York	5	4	4	0	0	0	0	3	0	0	**2**
Other Ports	19	8	12	0	7	4	3	4	3	0	**6**
All Ports	**396**	**405**	**348**	**232**	**359**	**276**	**275**	**253**	**200**	**159**	**290**

Source: NMFS 2022b

Table I-34 Number of Commercial Fishing Vessel Trips in the EW 2 WEA by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	455	559	683	642	687	717	729	528	554	454	**601**
New Bedford, Massachusetts	223	177	127	57	218	96	169	160	89	67	**138**
Cape May, New Jersey	96	178	158	102	184	148	149	88	68	50	**122**
Point Lookout, New York	187	409	311	134	126	0	0	0	0	0	**117**
Barnegat, New Jersey	162	148	85	123	122	171	143	75	133	0	**116**
Point Judith, Rhode Island	64	87	87	112	154	144	125	96	168	111	**115**
Freeport, New York	229	213	170	87	60	57	0	0	0	0	**82**
Belford, New Jersey	66	123	121	51	72	0	89	72	82	0	**68**
Montauk, New York	32	87	68	28	26	34	17	43	68	30	**43**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Atlantic City, New Jersey	26	18	9	22	73	59	61	72	41	24	**41**
Newport News, Virginia	35	70	58	47	39	30	20	25	13	15	**35**
Hampton, Virginia	0	0	47	28	15	51	56	47	14	28	**29**
Shinnecock, New York	58	29	12	20	10	15	13	5	6	17	**19**
Beaufort, North Carolina	3	0	4	0	15	28	23	24	45	24	**17**
Hampton Bay, New York	0	4	0	3	17	0	48	12	41	12	**14**
Chincoteague, Virginia	4	0	28	20	17	10	0	16	14	9	**12**
Other Ports	89	38	57	13	38	31	35	23	17	8	**35**
All Ports	**1,729**	**2,140**	**2,025**	**1,489**	**1,873**	**1,591**	**1,677**	**1,286**	**1,353**	**849**	**1,601**

Source: NMFS 2022b

Table I-35 Number of Commercial Fishing Vessels that Fished in the EW 2 WEA by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	128	100	78	40	123	62	103	103	45	39	**82**
Point Pleasant, New Jersey	69	80	65	56	69	54	49	45	47	40	**57**
Cape May, New Jersey	62	72	68	40	55	47	48	36	18	19	**47**
Point Judith, Rhode Island	27	30	27	38	43	37	46	42	38	38	**37**
Barnegat, New Jersey	33	29	25	24	24	30	24	22	24	0	**24**
Newport News, Virginia	24	37	35	25	23	21	17	21	9	13	**23**
Hampton, Virginia	0	0	23	11	10	27	25	28	9	14	**15**
Beaufort, North Carolina	3	0	4	0	11	20	20	18	27	18	**12**
Belford, New Jersey	16	13	12	13	12	0	9	11	13	0	**10**
Montauk, New York	9	11	13	11	7	8	6	7	11	8	**9**
Chincoteague, Virginia	4	0	14	11	9	7	0	10	8	9	**7**
Shinnecock, New York	16	11	4	6	7	3	4	3	3	5	**6**
Point Lookout, New York	9	14	15	7	8	0	0	0	0	0	**5**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Atlantic City, New Jersey	4	6	4	6	8	9	5	3	4	3	**5**
Stonington, Connecticut	6	4	6	0	5	4	6	3	0	5	**4**
Hampton Bay, New York	0	3	0	3	4	0	6	4	5	6	**3**
Wanchese, North Carolina	6	4	0	0	8	0	9	4	0	0	**3**
Freeport, New York	8	5	6	4	4	3	0	0	0	0	**3**
New London, Connecticut	6	6	5	4	0	3	4	0	0	0	**3**
Ocean City, Maryland	0	0	0	0	0	5	3	4	5	0	**2**
Other Ports	23	6	6	5	8	8	6	4	8	0	**7**
All Ports	**453**	**431**	**410**	**304**	**438**	**343**	**387**	**364**	**269**	**217**	**362**

Source: NMFS 2022b

Table I-36 Number of Commercial Fishing Vessel Trips in the Combined EW 1 and EW 2 WEAs by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	1,194	1,289	1,550	1,382	1,411	1,397	1,228	928	984	790	**1,215**
Belford, New Jersey	705	822	888	561	532	460	647	578	455	0	**565**
Freeport, New York	612	620	491	324	259	262	207	198	157	104	**323**
Point Lookout, New York	406	880	646	275	281	64	0	0	0	0	**255**
New Bedford, Massachusetts	407	317	215	96	358	158	258	225	147	111	**229**
Cape May, New Jersey	175	329	265	167	276	266	247	151	126	86	**209**
Point Judith, Rhode Island	110	157	163	170	275	250	175	148	297	175	**192**
Barnegat, New Jersey	246	239	146	201	183	268	218	116	177	0	**179**
Montauk, New York	57	162	123	38	47	57	17	71	118	50	**74**
Newport News, Virginia	60	132	100	82	63	46	36	38	24	22	**60**
Atlantic City, New Jersey	35	23	17	26	80	65	107	118	41	35	**55**
Hampton, Virginia	0	0	79	28	15	82	96	84	14	48	**45**
Brooklyn, New York	77	91	63	0	0	0	0	82	0	0	**31**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Beaufort, North Carolina	3	0	8	0	19	42	36	48	70	41	**27**
Shinnecock, New York	81	48	17	30	15	21	13	5	6	24	**26**
Shark River, New Jersey	126	33	32	0	0	0	0	0	17	0	**21**
Hampton Bay, New York	0	8	0	3	22	0	48	21	69	17	**19**
Chincoteague, Virginia	4	0	28	36	29	10	0	29	26	16	**18**
Stonington, Connecticut	31	5	12	0	9	15	12	5	0	13	**10**
Other Ports	141	57	132	13	56	38	38	35	21	0	**53**
All Ports	**4,470**	**5,212**	**4,975**	**3,432**	**3,930**	**3,501**	**3,383**	**2,880**	**2,749**	**1,532**	**3,606**

Source: NMFS 2022b

Table I-37 Number of Commercial Fishing Vessels That Fished in the Combined EW 1 and EW 2 WEAs by Fishing Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	235	178	135	70	215	104	166	148	77	66	**139**
Point Pleasant, New Jersey	131	160	124	104	132	103	99	84	85	70	**109**
Cape May, New Jersey	121	137	119	72	102	91	82	58	30	32	**84**
Point Judith, Rhode Island	49	59	53	65	83	69	71	66	72	67	**65**
Barnegat, New Jersey	58	56	45	43	43	56	43	38	39	0	**42**
Newport News, Virginia	40	74	63	46	43	33	31	30	16	20	**40**
Belford, New Jersey	35	31	29	29	26	14	23	26	29	0	**24**
Hampton, Virginia	0	0	42	11	10	46	47	52	9	25	**24**
Beaufort, North Carolina	3	0	8	0	15	30	31	36	43	29	**20**
Montauk, New York	18	20	26	17	14	15	6	15	21	15	**17**
Point Lookout, New York	20	32	32	15	18	3	0	0	0	0	**12**
Chincoteague, Virginia	4	0	14	22	15	7	0	19	14	16	**11**
Shinnecock, New York	29	21	8	12	12	6	4	3	3	8	**11**
Freeport, New York	21	13	14	9	11	7	7	6	4	4	**10**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Atlantic City, New Jersey	8	10	8	9	14	13	10	7	4	7	**9**
Stonington, Connecticut	12	4	6	0	8	7	9	3	0	8	**6**
Hampton Bay, New York	0	6	0	3	7	0	6	8	9	9	**5**
Wanchese, North Carolina	6	7	0	0	14	0	14	7	0	0	**5**
New London, Connecticut	11	11	9	4	0	3	4	0	0	0	**4**
Ocean City, Maryland	0	0	0	0	0	9	6	8	5	0	**3**
Other Ports	48	17	23	5	15	3	3	3	9	0	**13**
All Ports	**849**	**836**	**758**	**536**	**797**	**619**	**662**	**617**	**469**	**376**	**652**

Source: NMFS 2022b

Table I-38 Commercial Landings (pounds) in the EW 1 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Mackerel/Squid/Butterfish	239,612	134,140	309,699	64,256	181,254	24,318	2,287	13,828	94,081	32,926	**109,640**
Atlantic Herring	128,510	76,076	94,327	50,942	13,989	17,595	32,404	7,694	71,741	26,860	**52,014**
Sea Scallop	99,303	140,662	53,545	30,113	35,465	17,396	15,590	10,844	3,233	2,619	**40,877**
No Federal FMP	30,148	14,322	11,745	18,568	21,556	8,248	16,780	62,820	58,617	4,614	**24,742**
Surfclam/Ocean Quahog	11,255	2,010	0	33,814	0	2,362	47,461	38,084	0	9,046	**14,403**
Summer Flounder/Scup/Black Sea Bass	28,770	14,801	12,864	8,161	10,558	13,832	7,028	9,893	24,655	11,334	**14,190**
Skates	7,090	4,356	6,485	5,813	6,688	6,612	5,372	6,018	6,394	5,717	**6,055**
Small-Mesh Multispecies	3,572	6,119	4,590	2,164	3,452	1,251	301	330	469	1,207	**2,346**
Spiny Dogfish	3,041	5,444	1,494	1,552	1,238	1,468	1,868	3,647	1,932	698	**2,238**
Monkfish	2,509	2,596	1,674	792	1,096	1,536	1,510	412	476	217	**1,282**
American Lobster	880	1,225	1,054	1,339	1,192	1,296	742	583	449	342	**910**
Bluefish	534	1,763	1,289	416	523	356	228	174	195	187	**567**
Jonah Crab	40	35	43	53	103	463	412	103	218	354	**182**
Northeast Multispecies	23	292	192	463	92	27	1	2	4	0	**110**
Golden and Blueline Tilefish	4	2	1	87	2	2	0	0	0	0	**10**
Highly Migratory Species	0	2	3	0	53	0	0	2	14	0	**7**
Total	**555,291**	**403,845**	**499,005**	**218,533**	**277,261**	**96,762**	**131,984**	**154,434**	**262,478**	**96,121**	**269,571**

Source: NMFS 2022b

Table I-39 Commercial Revenue (2019 dollars) in the EW 1 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	$905,270	$1,553,300	$582,889	$382,660	$463,631	$233,020	$190,129	$90,430	$28,614	$24,909	**$445,485**
Mackerel/Squid/Butterfish	$60,872	$192,665	$278,145	$78,853	$195,744	$23,117	$1,938	$9,114	$50,488	$17,558	**$90,849**
Summer Flounder/Scup/Black Sea Bass	$83,531	$36,874	$36,123	$20,883	$29,470	$38,350	$23,320	$28,208	$40,603	$24,604	**$36,197**
No Federal FMP	$14,426	$10,777	$10,458	$21,078	$15,580	$8,878	$16,507	$63,640	$29,265	$4,855	**$19,546**
Surfclam/Ocean Quahog	$8,567	$1,529	$0	$24,181	$0	$1,208	$33,690	$27,189	$0	$7,260	**$10,362**
Atlantic Herring	$14,744	$8,237	$12,140	$11,895	$1,648	$2,485	$3,927	$1,314	$12,439	$5,975	**$7,480**
American Lobster	$4,052	$6,324	$4,639	$6,229	$6,002	$6,480	$3,917	$3,007	$2,266	$1,797	**$4,471**
Monkfish	$6,564	$6,725	$4,946	$1,785	$2,400	$3,135	$2,852	$570	$595	$301	**$2,987**
Small-Mesh Multispecies	$2,570	$6,142	$3,168	$1,460	$2,291	$838	$184	$314	$543	$1,026	**$1,854**
Skates	$1,625	$1,411	$1,067	$800	$1,203	$923	$682	$769	$1,055	$651	**$1,019**
Spiny Dogfish	$630	$1,577	$348	$316	$236	$293	$416	$793	$425	$146	**$518**
Bluefish	$340	$1,310	$818	$304	$375	$213	$169	$129	$194	$103	**$396**
Northeast Multispecies	$61	$424	$247	$883	$209	$59	$4	$2	$10	$0	**$190**
Jonah Crab	$26	$23	$29	$34	$69	$321	$336	$87	$200	$299	**$142**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Golden and Blueline Tilefish	$6	$5	$3	$213	$5	$4	$0	$0	$0	$0	**$24**
Highly Migratory Species	$0	$1	$3	$0	$64	$0	$0	$3	$14	$0	**$9**
Total	**$1,103,282**	**$1,827,320**	**$935,025**	**$551,574**	**$718,928**	**$319,324**	**$278,071**	**$225,570**	**$166,713**	**$89,484**	**$621,529**

Source: NMFS 2022b

Table I-40 Commercial Landings (pounds) in the EW 2 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	177,900	461,243	300,533	97,432	182,820	87,253	77,992	38,252	14,407	12,963	**145,080**
Atlantic Herring	182,604	67,018	312,008	174,456	42,082	26,169	179,426	19,124	85,755	54,178	**114,282**
Mackerel/Squid/Butterfish	251,552	36,413	195,604	16,672	52,020	35,365	4,589	21,826	128,762	61,182	**80,399**
No Federal FMP	16,038	48,754	27,132	16,659	12,717	12,339	64,041	70,453	52,072	18,548	**33,875**
Summer Flounder/Scup/Black Sea Bass	8,167	9,136	9,978	8,697	11,406	13,803	11,316	16,240	81,980	31,468	**20,219**
Surfclam/Ocean Quahog	6,306	0	0	0	0	0	54,771	54,600	0	30,037	**14,571**
Monkfish	8,993	9,408	7,085	3,010	4,119	8,799	15,213	4,784	10,003	851	**7,227**
Skates	2,917	2,550	2,368	976	4,248	4,025	3,791	2,302	6,618	2,029	**3,182**
Spiny Dogfish	1,101	2,614	1,061	592	432	930	349	348	1,083	279	**879**
Small-Mesh Multispecies	1,477	2,239	793	406	877	322	154	224	286	204	**698**
American Lobster	260	528	598	306	1,707	1,223	509	358	253	401	**614**
Bluefish	273	739	544	232	247	330	232	400	1,054	335	**439**
Jonah Crab	6	5	8	77	178	829	179	159	175	794	**241**
Northeast Multispecies	22	169	168	140	45	49	1	0	0	0	**59**
Highly Migratory Species	0	0	0	0	10	1	1	3	131	1	**15**
Golden and Blueline Tilefish	73	4	2	26	3	1	2	3	2	1	**12**
Total	**657,689**	**640,820**	**857,882**	**319,681**	**312,911**	**191,438**	**412,566**	**229,076**	**382,581**	**213,271**	**421,792**

Source: NMFS 2022b

Table I-41 Commercial Revenue (2019 dollars) in the EW 2 WEA by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	$1,587,794	$5,082,223	$3,320,194	$1,255,078	$2,415,258	$1,178,192	$982,485	$346,151	$132,646	$129,895	**$1,642,992**
Summer Flounder/Scup/Black Sea Bass	$21,041	$19,131	$20,872	$17,113	$28,806	$32,929	$30,775	$32,546	$138,362	$61,423	**$40,300**
Mackerel/Squid/Butterfish	$60,721	$52,632	$93,476	$18,928	$56,306	$30,526	$4,268	$9,543	$49,026	$22,756	**$39,818**
No Federal FMP	$3,447	$27,368	$17,703	$13,165	$11,477	$10,132	$48,486	$75,615	$37,552	$20,914	**$26,586**
Atlantic Herring	$22,558	$8,647	$35,524	$41,830	$4,537	$3,326	$21,796	$3,672	$14,592	$11,542	**$16,802**
Monkfish	$21,239	$25,006	$20,480	$6,167	$9,472	$16,223	$26,546	$6,789	$11,330	$1,191	**$14,445**
Surfclam/Ocean Quahog	$4,513	$0	$0	$0	$0	$0	$41,093	$43,055	$0	$27,375	**$11,604**
American Lobster	$1,230	$2,897	$2,813	$1,467	$8,909	$6,523	$2,775	$1,920	$1,257	$2,096	**$3,189**
Skates	$1,584	$1,534	$754	$395	$889	$1,250	$1,187	$715	$2,489	$320	**$1,112**
Small-Mesh Multispecies	$1,065	$3,182	$549	$255	$573	$213	$76	$217	$303	$153	**$659**
Bluefish	$196	$503	$393	$172	$179	$230	$175	$300	$1,110	$217	**$348**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Spiny Dogfish	$231	$711	$237	$108	$80	$162	$71	$72	$242	$54	**$197**
Jonah Crab	$4	$5	$4	$54	$159	$588	$126	$142	$174	$633	**$189**
Northeast Multispecies	$65	$299	$203	$243	$102	$115	$2	$0	$0	$0	**$103**
Golden and Blueline Tilefish	$252	$7	$4	$64	$9	$2	$7	$4	$2	$1	**$35**
Highly Migratory Species	$0	$0	$0	$0	$11	$2	$3	$4	$118	$3	**$14**
Total	**$1,725,942**	**$5,224,143**	**$3,513,209**	**$1,355,042**	**$2,536,768**	**$1,280,414**	**$1,159,872**	**$520,744**	**$389,203**	**$278,573**	**$1,798,391**

Source: NMFS 2022b

Table I-42 Commercial Landings (pounds) in the Combined EW 1 and EW 2 WEAs by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Mackerel/Squid/Butterfish	491,164	170,553	505,303	80,928	233,274	59,683	6,876	35,654	222,843	94,108	**190,039**
Sea Scallop	277,203	601,905	354,078	127,545	218,285	104,649	93,582	49,096	17,640	15,582	**185,957**
Atlantic Herring	311,114	143,094	406,335	225,398	56,071	43,764	211,830	26,818	157,496	81,038	**166,296**
No Federal FMP	46,186	63,076	38,877	35,227	34,273	20,587	80,821	133,273	110,689	23,162	**58,617**
Summer Flounder/Scup/Black Sea Bass	36,937	23,937	22,842	16,858	21,964	27,635	18,344	26,133	106,635	42,802	**34,409**
Surfclam/Ocean Quahog	17,561	2,010	0	33,814	0	2,362	102,232	92,684	0	39,083	**28,975**
Skates	10,007	6,906	8,853	6,789	10,936	10,637	9,163	8,320	13,012	7,746	**9,237**
Monkfish	11,502	12,004	8,759	3,802	5,215	10,335	16,723	5,196	10,479	1,068	**8,508**
Spiny Dogfish	4,142	8,058	2,555	2,144	1,670	2,398	2,217	3,995	3,015	977	**3,117**
Small-Mesh Multispecies	5,049	8,358	5,383	2,570	4,329	1,573	455	554	755	1,411	**3,044**
American Lobster	1,140	1,753	1,652	1,645	2,899	2,519	1,251	941	702	743	**1,525**
Bluefish	807	2,502	1,833	648	770	686	460	574	1,249	522	**1,005**
Jonah Crab	46	40	51	130	281	1,292	591	262	393	1,148	**423**
Northeast Multispecies	45	461	360	603	137	76	2	2	4	0	**169**
Highly Migratory Species	0	2	3	0	63	1	1	5	145	1	**22**
Golden and Blueline Tilefish	77	6	3	113	5	3	2	3	2	1	**22**
All FMPs	**1,212,980**	**1,044,665**	**1,356,887**	**538,214**	**590,172**	**288,200**	**544,550**	**383,510**	**645,059**	**309,392**	**691,363**

Source: NMFS 2022b

Table I-43 Commercial Revenue (2019 dollars) in the Combined EW 1 and EW 2 WEAs by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	$2,493,064	$6,635,522	$3,903,083	$1,637,739	$2,878,889	$1,411,212	$1,172,615	$436,581	$161,259	$154,804	**$2,088,477**
Mackerel/Squid/Butterfish	$121,593	$245,297	$371,622	$97,781	$252,050	$53,644	$6,205	$18,657	$99,514	$40,314	**$130,668**
Summer Flounder/Scup/Black Sea Bass	$104,571	$56,004	$56,995	$37,996	$58,276	$71,280	$54,095	$60,754	$178,964	$86,027	**$76,496**
No Federal FMP	$17,873	$38,145	$28,161	$34,243	$27,057	$19,010	$64,993	$139,255	$66,817	$25,769	**$46,132**
Atlantic Herring	$37,302	$16,884	$47,664	$53,726	$6,184	$5,810	$25,722	$4,986	$27,032	$17,517	**$24,283**
Surfclam/Ocean Quahog	$13,080	$1,529	$0	$24,181	$0	$1,208	$74,783	$70,244	$0	$34,635	**$21,966**
Monkfish	$27,803	$31,730	$25,427	$7,953	$11,872	$19,358	$29,398	$7,359	$11,926	$1,492	**$17,432**
American Lobster	$5,281	$9,221	$7,452	$7,697	$14,911	$13,003	$6,692	$4,927	$3,522	$3,893	**$7,660**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Small-Mesh Multispecies	$3,635	$9,324	$3,717	$1,715	$2,864	$1,051	$260	$531	$847	$1,179	**$2,512**
Skates	$3,209	$2,945	$1,821	$1,196	$2,092	$2,172	$1,869	$1,484	$3,544	$971	**$2,130**
Bluefish	$537	$1,813	$1,211	$476	$554	$443	$344	$429	$1,304	$320	**$743**
Spiny Dogfish	$862	$2,288	$585	$424	$317	$455	$487	$865	$667	$200	**$715**
Jonah Crab	$29	$27	$34	$88	$229	$909	$462	$228	$374	$932	**$331**
Northeast Multispecies	$126	$723	$451	$1,126	$311	$174	$6	$2	$10	$0	**$293**
Golden and Blueline Tilefish	$258	$11	$8	$277	$14	$6	$7	$4	$2	$1	**$59**
Highly Migratory Species	$0	$1	$3	$0	$75	$2	$3	$7	$132	$3	**$23**
All FMPs	**$2,829,224**	**$7,051,463**	**$4,448,234**	**$1,906,616**	**$3,255,695**	**$1,599,738**	**$1,437,943**	**$746,314**	**$555,916**	**$368,057**	**$2,419,920**

Source: NMFS 2022b

Table I-44 Commercial Landings in the EW 1 WEA as a Percentage of Landings in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Mackerel/Squid/Butterfish	0.340%	0.211%	0.566%	0.158%	0.319%	0.051%	0.003%	0.015%	0.094%	0.032%	**0.179%**
Sea Scallop	0.174%	0.240%	0.094%	0.074%	0.105%	0.049%	0.038%	0.021%	0.006%	0.004%	**0.080%**
Summer Flounder/Scup/Black Sea Bass	0.133%	0.051%	0.046%	0.026%	0.041%	0.052%	0.030%	0.043%	0.118%	0.048%	**0.059%**
Atlantic Herring	0.088%	0.043%	0.049%	0.025%	0.007%	0.010%	0.023%	0.007%	0.074%	0.109%	**0.044%**
Surfclam/Ocean Quahog	0.016%	0.003%	0.000%	0.055%	0.000%	0.004%	0.118%	0.108%	0.000%	0.020%	**0.033%**
Bluefish	0.014%	0.054%	0.033%	0.014%	0.019%	0.012%	0.008%	0.008%	0.016%	0.011%	**0.019%**
Skates	0.018%	0.012%	0.018%	0.019%	0.020%	0.021%	0.016%	0.019%	0.020%	0.021%	**0.018%**
Spiny Dogfish	0.028%	0.029%	0.007%	0.012%	0.008%	0.010%	0.008%	0.019%	0.014%	0.005%	**0.014%**
Small-Mesh Multispecies	0.019%	0.033%	0.025%	0.015%	0.020%	0.008%	0.002%	0.003%	0.004%	0.010%	**0.014%**
Monkfish	0.015%	0.014%	0.008%	0.004%	0.006%	0.008%	0.008%	0.002%	0.002%	0.001%	**0.007%**
No Federal FMP	0.004%	0.002%	0.002%	0.003%	0.004%	0.001%	0.003%	0.011%	0.009%	0.001%	**0.004%**
Jonah Crab	0.000%	0.000%	0.000%	0.000%	0.001%	0.003%	0.003%	0.001%	0.001%	0.002%	**0.001%**
American Lobster	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.000%	0.000%	0.000%	0.000%	**0.001%**
Golden and Blueline Tilefish	0.000%	0.000%	0.000%	0.005%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.001%**
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
Northeast Multispecies	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
All FMP Species[1]	**0.080%**	**0.056%**	**0.067%**	**0.029%**	**0.038%**	**0.014%**	**0.018%**	**0.015%**	**0.033%**	**0.017%**	**0.037%**

Source: NMFS 2022a, 2022b
[1] Excludes landings that did not occur under a federal FMP.

Table I-45 Commercial Revenue in the EW 1 WEA as a Percentage of Revenue in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Mackerel/Squid/Butterfish	0.192%	0.428%	0.679%	0.254%	0.523%	0.058%	0.003%	0.016%	0.074%	0.022%	**0.225%**
Summer Flounder/Scup/Black Sea Bass	0.252%	0.095%	0.084%	0.048%	0.074%	0.090%	0.056%	0.072%	0.102%	0.058%	**0.093%**
Sea Scallop	0.201%	0.268%	0.104%	0.082%	0.109%	0.053%	0.039%	0.018%	0.005%	0.004%	**0.088%**
Atlantic Herring	0.069%	0.033%	0.042%	0.037%	0.006%	0.010%	0.014%	0.005%	0.054%	0.066%	**0.033%**
Surfclam/Ocean Quahog	0.018%	0.004%	0.000%	0.054%	0.000%	0.003%	0.107%	0.086%	0.000%	0.019%	**0.029%**

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Bluefish	0.018%	0.060%	0.030%	0.013%	0.019%	0.009%	0.008%	0.007%	0.015%	0.006%	**0.018%**
Small-Mesh Multispecies	0.022%	0.053%	0.028%	0.016%	0.019%	0.008%	0.002%	0.003%	0.005%	0.011%	**0.017%**
Spiny Dogfish	0.027%	0.037%	0.008%	0.015%	0.008%	0.011%	0.008%	0.022%	0.016%	0.005%	**0.016%**
Monkfish	0.034%	0.025%	0.018%	0.010%	0.013%	0.016%	0.014%	0.003%	0.004%	0.002%	**0.014%**
Skates	0.021%	0.016%	0.013%	0.011%	0.013%	0.014%	0.012%	0.012%	0.015%	0.010%	**0.014%**
No Federal FMP	0.003%	0.003%	0.002%	0.005%	0.004%	0.002%	0.003%	0.013%	0.006%	0.001%	**0.004%**
Jonah Crab	0.000%	0.000%	0.000%	0.000%	0.001%	0.003%	0.003%	0.001%	0.001%	0.002%	**0.001%**
American Lobster	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.000%	0.000%	**0.001%**
Golden and Blueline Tilefish	0.000%	0.000%	0.000%	0.004%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
Northeast Multispecies	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
All FMP Species[1]	**0.095%**	**0.137%**	**0.070%**	**0.044%**	**0.055%**	**0.023%**	**0.018%**	**0.012%**	**0.010%**	**0.006%**	**0.047%**

Source: NMFS 2022a, 2022b
[1] Excludes revenue that did not occur under a federal FMP.

Table I-46 Commercial Landings in the EW 2 WEA as a Percentage of Landings in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	0.312%	0.785%	0.528%	0.238%	0.542%	0.245%	0.192%	0.074%	0.025%	0.021%	**0.296%**
Mackerel/Squid/Butterfish	0.357%	0.057%	0.357%	0.041%	0.092%	0.074%	0.007%	0.024%	0.129%	0.059%	**0.120%**
Atlantic Herring	0.125%	0.038%	0.163%	0.085%	0.021%	0.015%	0.130%	0.018%	0.089%	0.219%	**0.090%**
Summer Flounder/Scup/Black Sea Bass	0.038%	0.031%	0.036%	0.028%	0.045%	0.052%	0.048%	0.071%	0.393%	0.133%	**0.087%**
Surfclam/Ocean Quahog	0.009%	0.000%	0.000%	0.000%	0.000%	0.000%	0.136%	0.155%	0.000%	0.067%	**0.037%**
Monkfish	0.055%	0.049%	0.033%	0.016%	0.022%	0.047%	0.077%	0.020%	0.044%	0.004%	**0.037%**
Bluefish	0.007%	0.023%	0.014%	0.008%	0.009%	0.011%	0.008%	0.018%	0.088%	0.020%	**0.021%**
Skates	0.007%	0.007%	0.007%	0.003%	0.013%	0.013%	0.011%	0.007%	0.021%	0.007%	**0.010%**
Spiny Dogfish	0.010%	0.014%	0.005%	0.005%	0.003%	0.006%	0.001%	0.002%	0.008%	0.002%	**0.006%**
No Federal FMP	0.002%	0.007%	0.004%	0.003%	0.002%	0.002%	0.011%	0.012%	0.008%	0.003%	**0.005%**
Small-Mesh Multispecies	0.008%	0.012%	0.004%	0.003%	0.005%	0.002%	0.001%	0.002%	0.002%	0.002%	**0.004%**
Jonah Crab	0.000%	0.000%	0.000%	0.000%	0.001%	0.006%	0.001%	0.001%	0.001%	0.005%	**0.002%**
Golden and Blueline Tilefish	0.004%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.001%**
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.005%	0.000%	**0.001%**
American Lobster	0.000%	0.000%	0.000%	0.000%	0.001%	0.001%	0.000%	0.000%	0.000%	0.000%	**0.000%**
Northeast Multispecies	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
All FMP Species[1]	**0.097%**	**0.085%**	**0.115%**	**0.045%**	**0.044%**	**0.028%**	**0.056%**	**0.026%**	**0.054%**	**0.036%**	**0.059%**

Source: NMFS 2022a, 2022b
[1] Excludes landings that did not occur under a federal FMP.

Table I-47 Commercial Revenue in the EW 2 WEA as a Percentage of Revenue in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	0.352%	0.875%	0.594%	0.269%	0.570%	0.269%	0.202%	0.068%	0.025%	0.023%	**0.325%**
Summer Flounder/Scup/Black Sea Bass	0.064%	0.049%	0.049%	0.039%	0.072%	0.077%	0.074%	0.083%	0.346%	0.144%	**0.100%**
Mackerel/Squid/Butterfish	0.191%	0.117%	0.228%	0.061%	0.150%	0.077%	0.007%	0.017%	0.071%	0.029%	**0.095%**
Monkfish	0.111%	0.094%	0.076%	0.033%	0.051%	0.085%	0.133%	0.037%	0.077%	0.008%	**0.070%**
Atlantic Herring	0.105%	0.034%	0.124%	0.132%	0.016%	0.014%	0.075%	0.014%	0.063%	0.127%	**0.070%**
Surfclam/Ocean Quahog	0.010%	0.000%	0.000%	0.000%	0.000%	0.000%	0.130%	0.137%	0.000%	0.073%	**0.035%**
Bluefish	0.010%	0.023%	0.014%	0.008%	0.009%	0.010%	0.008%	0.016%	0.084%	0.012%	**0.019%**
Skates	0.021%	0.018%	0.009%	0.005%	0.009%	0.019%	0.021%	0.011%	0.034%	0.005%	**0.015%**
Spiny Dogfish	0.010%	0.017%	0.005%	0.005%	0.003%	0.006%	0.001%	0.002%	0.009%	0.002%	**0.006%**
Small-Mesh Multispecies	0.009%	0.027%	0.005%	0.003%	0.005%	0.002%	0.001%	0.002%	0.003%	0.002%	**0.006%**
No Federal FMP	0.001%	0.008%	0.004%	0.003%	0.003%	0.002%	0.009%	0.016%	0.008%	0.004%	**0.006%**
Jonah Crab	0.000%	0.000%	0.000%	0.000%	0.001%	0.006%	0.001%	0.001%	0.001%	0.005%	**0.002%**
Golden and Blueline Tilefish	0.005%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.001%**
American Lobster	0.000%	0.001%	0.001%	0.000%	0.002%	0.001%	0.000%	0.000%	0.000%	0.000%	**0.001%**
Northeast Multispecies	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.000%**
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	**0.000%**
All FMP Species[1]	**0.151%**	**0.391%**	**0.265%**	**0.111%**	**0.197%**	**0.095%**	**0.076%**	**0.033%**	**0.024%**	**0.017%**	**0.136%**

Source: NMFS 2022a, 2022b
[1] Excludes revenue that did not occur under a federal FMP.

Table I-48 Commercial Landings in the Combined EW 1 and EW 2 WEAs as a Percentage of Landings in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	0.486%	1.025%	0.623%	0.311%	0.647%	0.294%	0.231%	0.095%	0.031%	0.026%	0.377%
Mackerel/Squid/Butterfish	0.697%	0.268%	0.923%	0.199%	0.411%	0.125%	0.010%	0.040%	0.223%	0.090%	0.299%
Summer Flounder/Scup/Black Sea Bass	0.170%	0.082%	0.082%	0.054%	0.086%	0.104%	0.077%	0.113%	0.511%	0.182%	0.146%
Atlantic Herring	0.213%	0.081%	0.212%	0.109%	0.028%	0.025%	0.153%	0.025%	0.163%	0.328%	0.134%
Surfclam/Ocean Quahog	0.025%	0.003%	0.000%	0.055%	0.000%	0.004%	0.254%	0.263%	0.000%	0.088%	0.069%
Monkfish	0.070%	0.063%	0.041%	0.020%	0.028%	0.055%	0.084%	0.022%	0.046%	0.005%	0.043%
Bluefish	0.022%	0.077%	0.047%	0.021%	0.028%	0.022%	0.016%	0.025%	0.104%	0.032%	0.039%
Skates	0.025%	0.019%	0.024%	0.022%	0.033%	0.034%	0.028%	0.026%	0.041%	0.028%	0.028%
Spiny Dogfish	0.038%	0.042%	0.012%	0.016%	0.010%	0.016%	0.009%	0.021%	0.022%	0.007%	0.019%
Small-Mesh Multispecies	0.026%	0.045%	0.030%	0.017%	0.025%	0.010%	0.003%	0.004%	0.006%	0.011%	0.018%
No Federal FMP	0.006%	0.009%	0.005%	0.006%	0.006%	0.003%	0.014%	0.022%	0.018%	0.004%	0.009%
Jonah Crab	0.000%	0.000%	0.000%	0.001%	0.002%	0.009%	0.004%	0.001%	0.002%	0.007%	0.003%
Golden and Blueline Tilefish	0.004%	0.000%	0.000%	0.006%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
American Lobster	0.001%	0.001%	0.001%	0.001%	0.002%	0.002%	0.001%	0.001%	0.000%	0.001%	0.001%

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.002%	0.000%	0.000%	0.000%	0.005%	0.000%	0.001%
Northeast Multispecies	0.000%	0.001%	0.001%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
All FMP Species[1]	**0.177%**	**0.141%**	**0.182%**	**0.074%**	**0.082%**	**0.042%**	**0.074%**	**0.042%**	**0.088%**	**0.053%**	**0.095%**

Source: NMFS 2022a, 2022b
[1] Excludes landings that did not occur under a federal FMP.

Table I-49 Commercial Revenue in the Combined EW 1 and EW 2 WEAs as a Percentage of Revenue in the Geographic Analysis Area by FMP and Year, 2010–2019

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Sea Scallop	0.553%	1.143%	0.698%	0.351%	0.680%	0.322%	0.241%	0.086%	0.030%	0.027%	0.413%
Mackerel/Squid/Butterfish	0.383%	0.545%	0.907%	0.315%	0.673%	0.135%	0.010%	0.034%	0.145%	0.051%	0.320%
Summer Flounder/Scup/Black Sea Bass	0.316%	0.144%	0.133%	0.087%	0.146%	0.168%	0.130%	0.154%	0.448%	0.201%	0.193%
Atlantic Herring	0.174%	0.067%	0.166%	0.169%	0.022%	0.024%	0.089%	0.018%	0.117%	0.192%	0.104%
Monkfish	0.145%	0.120%	0.094%	0.043%	0.064%	0.102%	0.148%	0.040%	0.081%	0.010%	0.085%
Surfclam/Ocean Quahog	0.028%	0.004%	0.000%	0.054%	0.000%	0.003%	0.237%	0.223%	0.000%	0.092%	0.064%
Bluefish	0.029%	0.083%	0.044%	0.021%	0.027%	0.019%	0.016%	0.023%	0.099%	0.018%	0.038%
Skates	0.042%	0.034%	0.023%	0.016%	0.022%	0.034%	0.033%	0.023%	0.049%	0.014%	0.029%
Small-Mesh Multispecies	0.031%	0.081%	0.033%	0.018%	0.024%	0.010%	0.002%	0.006%	0.008%	0.013%	0.023%
Spiny Dogfish	0.037%	0.054%	0.013%	0.020%	0.010%	0.018%	0.010%	0.024%	0.026%	0.007%	0.022%
No Federal FMP	0.004%	0.011%	0.006%	0.009%	0.006%	0.004%	0.012%	0.029%	0.014%	0.005%	0.010%
Jonah Crab	0.000%	0.000%	0.000%	0.001%	0.002%	0.009%	0.004%	0.001%	0.002%	0.007%	0.003%
American Lobster	0.001%	0.002%	0.002%	0.002%	0.003%	0.002%	0.001%	0.001%	0.001%	0.001%	0.001%
Golden and Blueline Tilefish	0.005%	0.000%	0.000%	0.005%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Northeast Multispecies	0.000%	0.001%	0.001%	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Highly Migratory Species	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%
All FMP Species[1]	**0.246%**	**0.528%**	**0.334%**	**0.154%**	**0.253%**	**0.118%**	**0.094%**	**0.045%**	**0.034%**	**0.023%**	**0.183%**

Source: NMFS 2022a, 2022b
[1] Excludes revenue that did not occur under a federal FMP.

Table I-50 Commercial Landings (pounds) in the EW 1 WEA by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-bottom	76,893	176,754	311,388	117,492	206,473	43,712	17,400	25,177	92,535	28,874	**109,670**
Trawl-midwater	326,790	71,340	117,275	17,710	0	11,628	21,537	18,350	126,924	48,958	**76,051**
Dredge-scallop	88,519	131,348	50,657	29,485	32,696	17,606	14,115	10,737	3,097	2,611	**38,087**
Dredge-clam	23,505	12,888	6,195	49,595	20,390	9,853	61,403	97,844	0	12,946	**29,462**
Pots	1,038	1,441	1,264	3,984	1,467	1,946	1,244	822	810	1,034	**1,505**
Gillnet-sink	1,960	2,541	1,349	287	811	837	949	338	386	0	**946**
Other gear	36,593	7,598	10,867	352	15,434	11,191	15,345	1,173	38,733	1,744	**13,903**
All gear	**555,298**	**403,910**	**498,995**	**218,905**	**277,271**	**96,773**	**131,993**	**154,441**	**262,485**	**96,167**	**269,624**

Source: NMFS 2022b

Table I-51 Commercial Revenue (2019 dollars) in the EW 1 WEA by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Dredge-scallop	$800,001	$1,443,731	$546,689	$370,243	$423,430	$230,936	$171,461	$89,088	$27,209	$24,483	**$412,727**
Trawl-bottom	$134,540	$271,245	$335,755	$124,499	$246,711	$64,491	$43,885	$36,903	$85,476	$37,961	**$138,147**
Dredge-clam	$18,967	$10,195	$6,642	$42,697	$14,399	$9,230	$48,752	$89,629	$0	$11,129	**$25,164**
Trawl-midwater	$41,013	$7,502	$18,684	$2,371	$0	$1,548	$2,668	$3,405	$21,702	$10,500	**$10,939**
Pots	$4,240	$6,728	$4,952	$10,400	$6,395	$7,275	$4,460	$3,417	$2,781	$2,633	**$5,328**
Gillnet-sink	$2,586	$4,644	$2,686	$407	$1,248	$1,018	$1,173	$385	$376	$0	**$1,452**
Other gear	$101,944	$83,448	$19,620	$2,600	$26,775	$4,864	$5,701	$2,756	$29,178	$2,825	**$27,971**
All gear	**$1,103,291**	**$1,827,493**	**$935,028**	**$553,217**	**$718,958**	**$319,362**	**$278,100**	**$225,583**	**$166,722**	**$89,531**	**$621,729**

Source: NMFS 2022b

Table I-52 Commercial Landings (pounds) in the EW 2 WEA by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-midwater	359,206	52,561	433,746	53,582	0	21,394	143,379	35,081	170,116	102,867	**137,193**
Dredge-scallop	169,903	436,933	279,323	96,705	158,783	87,862	75,511	37,548	14,227	13,057	**136,985**
Trawl-bottom	69,142	73,915	97,730	149,831	83,850	43,519	19,282	25,895	140,609	47,667	**75,144**
Dredge-clam	6,815	47,598	5,333	6,863	10,984	11,230	97,387	122,995	41,537	46,719	**39,746**
Gillnet-sink	8,213	9,293	4,414	1,608	1,979	9,515	0	5,058	13,777	528	**5,439**
Pots	295	534	598	11,442	2,030	2,172	725	577	570	1,340	**2,028**
Other gear	44,134	20,004	36,747	1,055	55,326	15,769	76,309	1,927	1,747	1,114	**25,413**
All gear	**657,708**	**640,838**	**857,891**	**321,086**	**312,952**	**191,461**	**412,593**	**229,081**	**382,583**	**213,292**	**421,949**

Source: NMFS 2022b

Table I-53 Commercial Revenue (2019 dollars) in the EW 2 WEA by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Dredge-scallop	$1,504,244	$4,796,517	$3,061,411	$1,224,532	$2,081,994	$1,154,643	$931,422	$336,320	$129,143	$127,561	**$1,534,779**
Trawl-bottom	$75,993	$148,088	$195,305	$96,005	$255,039	$80,575	$81,400	$40,418	$179,349	$76,306	**$122,848**
Dredge-clam	$5,736	$26,618	$3,291	$5,580	$10,313	$9,054	$87,203	$118,076	$34,449	$46,910	**$34,723**
Trawl-midwater	$42,624	$5,883	$73,509	$7,149	$0	$2,885	$17,266	$6,695	$27,666	$21,218	**$20,490**
Gillnet-sink	$13,881	$20,462	$8,957	$2,218	$3,000	$12,942	$0	$5,964	$12,578	$514	**$8,052**
Pots	$1,200	$2,882	$2,733	$15,806	$9,163	$7,265	$2,955	$2,117	$1,696	$3,031	**$4,885**
Other gear	$82,339	$223,774	$168,012	$10,205	$177,475	$13,123	$39,785	$11,167	$4,332	$3,042	**$73,325**
All gear	**$1,726,017**	**$5,224,224**	**$3,513,218**	**$1,361,495**	**$2,536,984**	**$1,280,487**	**$1,160,031**	**$520,757**	**$389,213**	**$278,582**	**$1,799,101**

Source: NMFS 2022b

Table I-54 Commercial Landings (pounds) in the Combined EW 1 and EW 2 WEAs by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-midwater	685,996	123,901	551,021	71,292	0	33,022	164,916	53,431	297,040	151,825	**213,244**
Trawl-bottom	146,035	250,669	409,118	267,323	290,323	87,231	36,682	51,072	233,144	76,541	**184,814**

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Dredge-scallop	258,422	568,281	329,980	126,190	191,479	105,468	89,626	48,285	17,324	15,668	**175,072**
Dredge-clam	30,320	60,486	11,528	56,458	31,374	21,083	158,790	220,839	41,537	59,665	**69,208**
Gillnet-sink	10,173	11,834	5,763	1,895	2,790	10,352	949	5,396	14,163	528	**6,384**
Pots	1,333	1,975	1,862	15,426	3,497	4,118	1,969	1,399	1,380	2,374	**3,533**
Other gear	80,727	27,602	47,614	1,407	70,760	26,960	91,654	3,100	40,480	2,858	**39,316**
All gear	**1,213,006**	**1,044,748**	**1,356,886**	**539,991**	**590,223**	**288,234**	**544,586**	**383,522**	**645,068**	**309,459**	**691,572**

Source: NMFS 2022b

Table I-55 Commercial Revenue (2019 dollars) in the Combined EW 1 and EW 2 WEAs by Fishing Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Dredge-scallop	$2,304,245	$6,240,248	$3,608,100	$1,594,775	$2,505,424	$1,385,579	$1,102,883	$425,408	$156,352	$152,044	**$1,947,506**
Trawl-bottom	$210,533	$419,333	$531,060	$220,504	$501,750	$145,066	$125,285	$77,321	$264,825	$114,267	**$260,994**
Dredge-clam	$24,703	$36,813	$9,933	$48,277	$24,712	$18,284	$135,955	$207,705	$34,449	$58,039	**$59,887**
Trawl-midwater	$83,637	$13,385	$92,193	$9,520	$0	$4,433	$19,934	$10,100	$49,368	$31,718	**$31,429**
Pots	$5,440	$9,610	$7,685	$26,206	$15,558	$14,540	$7,415	$5,534	$4,477	$5,664	**$10,213**
Gillnet-sink	$16,467	$25,106	$11,643	$2,625	$4,248	$13,960	$1,173	$6,349	$12,954	$514	**$9,504**
Other gear	$184,283	$307,222	$187,632	$12,805	$204,250	$17,987	$45,486	$13,923	$33,510	$5,867	**$101,297**
All gear	**$2,829,308**	**$7,051,717**	**$4,448,246**	**$1,914,712**	**$3,255,942**	**$1,599,849**	**$1,438,131**	**$746,340**	**$555,935**	**$368,113**	**$2,420,829**

Source: NMFS 2022b

Table I-56 Commercial Landings in the EW 1 WEA as a Percentage of Landings in the Geographic Analysis Area by Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-bottom	0.165%	0.197%	0.173%	0.130%	0.367%	0.050%	0.090%	0.020%	0.060%	0.020%	0.127%
Trawl-midwater	0.280%	0.060%	0.100%	0.015%	0.000%	0.010%	0.040%	0.025%	0.210%	0.175%	0.092%
Dredge-scallop	0.170%	0.240%	0.090%	0.070%	0.100%	0.100%	0.053%	0.023%	0.010%	0.007%	0.086%
Dredge-clam	0.030%	0.020%	0.010%	0.070%	0.030%	0.010%	0.090%	0.140%	0.000%	0.020%	0.042%
Pots	0.000%	0.010%	0.000%	0.025%	0.000%	0.010%	0.000%	0.000%	0.000%	0.000%	0.005%
Gillnet-sink	0.000%	0.010%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Other gear	0.090%	0.070%	0.020%	0.000%	0.000%	0.000%	0.003%	0.000%	0.000%	0.000%	0.018%

Source: NMFS 2022b

Table I-57 Commercial Landings in the EW 2 WEA as a Percentage of Landings in the Geographic Analysis Area by Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-bottom	0.080%	0.393%	0.840%	0.285%	1.060%	0.225%	0.333%	0.033%	0.080%	0.020%	0.335%
Dredge-scallop	0.320%	0.790%	0.510%	0.240%	0.500%	0.483%	0.277%	0.097%	0.037%	0.050%	0.330%
Trawl-midwater	0.310%	0.050%	0.360%	0.055%	0.000%	0.030%	0.280%	0.045%	0.295%	0.380%	0.181%
Other gear	0.100%	0.285%	0.280%	0.030%	0.000%	0.000%	0.020%	0.030%	0.000%	0.000%	0.075%
Gillnet-sink	0.020%	0.020%	0.010%	0.010%	0.010%	0.030%	0.000%	0.020%	0.060%	0.000%	0.018%
Pots	0.000%	0.000%	0.000%	0.100%	0.010%	0.010%	0.000%	0.000%	0.000%	0.000%	0.012%

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Dredge-clam	0.010%	0.060%	0.010%	0.010%	0.020%	0.020%	0.140%	0.180%	0.060%	0.080%	0.059%

Source: NMFS 2022b

Table I-58 Commercial Landings in the Combined EW 1 and EW 2 WEAs as a Percentage of Landings in the Geographic Analysis Area by Gear and Year, 2010–2019

Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Trawl-bottom	0.123%	0.295%	0.440%	0.208%	0.713%	0.138%	0.236%	0.028%	0.070%	0.020%	0.227%
Dredge-scallop	0.245%	0.515%	0.300%	0.155%	0.300%	0.292%	0.165%	0.060%	0.023%	0.028%	0.208%
Trawl-midwater	0.295%	0.055%	0.230%	0.035%	0.000%	0.020%	0.160%	0.035%	0.253%	0.278%	0.136%
Dredge-clam	0.020%	0.040%	0.010%	0.040%	0.025%	0.015%	0.115%	0.160%	0.060%	0.050%	0.054%
Gillnet-sink	0.010%	0.015%	0.005%	0.005%	0.005%	0.015%	0.000%	0.010%	0.030%	0.000%	0.010%
Pots	0.000%	0.005%	0.000%	0.063%	0.003%	0.010%	0.000%	0.000%	0.000%	0.000%	0.008%
Other gear	0.094%	0.156%	0.124%	0.020%	0.000%	0.000%	0.010%	0.020%	0.000%	0.000%	0.042%

Source: NMFS 2022b

Table I-59 Commercial Landings (pounds) in the EW 1 WEA by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	151,796	126,301	123,150	21,895	27,295	6,230	19,777	12,286	35,493	16,800	**54,102**
Cape May, New Jersey	161,674	48,866	84,609	18,858	24,945	24,474	15,926	13,261	84,598	19,794	**49,701**
Point Judith, Rhode Island	3,209	42,391	68,836	33,126	134,473	8,830	834	1,172	21,701	6,167	**32,074**
Point Pleasant, New Jersey	49,590	43,591	25,894	11,591	20,665	13,994	20,148	6,887	21,715	12,849	**22,692**
Atlantic City, New Jersey	682	277	2,161	13,891	974	8,815	35,130	59,186	0	3,848	**12,496**
Montauk, New York	3,395	51,920	26,783	5,848	13,204	5,316	0	937	4,567	616	**11,259**
Point Lookout, New York	13,694	24,562	34,570	11,940	8,973	828	641	471	187	193	**9,606**
Belford, New Jersey	14,545	22,982	0	10,431	12,485	0	10,431	11,753	9,598	0	**9,223**
Hampton Roads, Virginia	20,392	18,091	8,785	2,250	3,143	449	499	849	403	222	**5,508**
Barnegat Light, New Jersey	6,800	5,775	4,627	4,501	3,085	5,543	2,154	2,132	875	0	**3,549**
Other ports	129,518	19,148	119,605	84,577	28,034	22,296	26,454	45,506	83,352	35,678	**59,417**
All ports	**555,295**	**403,904**	**499,020**	**218,908**	**277,276**	**96,775**	**131,994**	**154,440**	**262,489**	**96,167**	**269,627**

Source: NMFS 2022b

Table I-60 Commercial Revenue (2019 dollars) in the EW 1 WEA by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	$362,169	$645,817	$239,340	$108,102	$209,475	$46,303	$60,347	$62,892	$18,900	$13,758	**$176,710**
Cape May, New Jersey	$193,362	$358,496	$180,539	$131,993	$91,007	$37,293	$35,265	$5,913	$20,165	$6,429	**$106,046**
Point Pleasant, New Jersey	$202,236	$265,848	$115,287	$64,714	$68,460	$80,373	$63,606	$19,746	$35,199	$26,544	**$94,201**
Hampton Roads, Virginia	$188,265	$192,781	$86,203	$22,146	$40,118	$4,068	$5,528	$6,461	$3,123	$995	**$54,969**
Point Judith, Rhode Island	$4,850	$61,575	$82,994	$41,973	$169,480	$12,289	$3,903	$2,826	$22,901	$7,486	**$41,028**
Barnegat Light, New Jersey	$36,654	$33,763	$38,427	$30,604	$30,581	$61,276	$16,358	$10,832	$3,511	$0	**$26,201**
Point Lookout, New York	$27,189	$51,902	$44,275	$21,794	$16,915	$3,285	$2,276	$1,913	$827	$708	**$17,108**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Montauk, New York	$5,107	$77,020	$36,641	$7,393	$14,611	$7,281	$0	$1,453	$7,399	$953	**$15,786**
Atlantic City, New Jersey	$597	$416	$2,170	$15,042	$480	$8,540	$29,772	$61,591	$0	$3,763	**$12,237**
Belford, New Jersey	$22,592	$28,152	$0	$10,010	$13,290	$0	$13,592	$10,751	$8,514	$0	**$10,690**
Other ports	$60,268	$111,719	$109,151	$99,447	$64,539	$58,650	$47,450	$41,204	$46,185	$28,898	**$66,751**
All ports	**$1,103,289**	**$1,827,489**	**$935,027**	**$553,218**	**$718,956**	**$319,358**	**$278,097**	**$225,582**	**$166,724**	**$89,534**	**$621,727**

Source: NMFS 2022b

Table I-61 Commercial Landings (pounds) in the EW 2 WEA by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	326,182	302,875	470,887	53,828	82,285	19,577	93,970	44,172	47,228	37,144	**147,815**
Cape May, New Jersey	69,503	132,329	144,638	41,946	46,585	55,103	62,471	24,953	108,347	53,839	**73,971**
Point Pleasant, New Jersey	28,913	44,988	73,230	36,149	35,842	41,145	31,636	21,172	86,756	43,180	**44,301**
Barnegat Light, New Jersey	16,720	16,230	29,793	26,929	13,271	20,569	26,054	7,386	7,115	0	**16,407**
Hampton Roads Area, Virginia	18,788	59,284	45,886	5,123	19,926	1,250	1,270	7,100	1,352	655	**16,063**
Point Judith, Rhode Island	3,614	13,937	14,997	10,640	59,402	14,001	3,197	2,022	17,182	8,445	**14,744**
Atlantic City, New Jersey	1,690	2,677	413	3,020	9,170	5,041	41,995	48,749	10,098	8,944	**13,180**
North Kingstown, Rhode Island	55,320	1,912	0	0	0	0	0	0	0	0	**5,723**
Montauk, New York	3,956	13,777	9,806	1,402	6,764	4,790	628	1,374	6,823	1,485	**5,081**
Newport, Rhode Island	0	12,282	0	2,396	0	0	0	0	0	0	**1,468**
Other ports	133,022	40,549	68,238	139,651	39,708	29,982	151,374	72,157	97,685	59,594	**83,196**
All ports	**657,708**	**640,840**	**857,888**	**321,084**	**312,953**	**191,458**	**412,595**	**229,085**	**382,586**	**213,286**	**421,948**

Source: NMFS 2022b

Table I-62 Commercial Revenue (2019 dollars) in the EW 2 WEA by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	$892,645	$2,522,955	$1,162,867	$237,289	$750,844	$170,171	$362,285	$158,705	$58,914	$45,184	**$636,186**
Cape May, New Jersey	$288,977	$1,344,137	$626,297	$304,957	$292,855	$290,801	$81,749	$25,860	$33,313	$20,185	**$330,913**
Point Pleasant, New Jersey	$168,436	$305,867	$714,407	$339,674	$367,369	$442,839	$330,842	$93,447	$160,807	$121,972	**$304,566**
Hampton Roads Area, Virginia	$170,497	$614,799	$474,119	$52,443	$263,103	$10,668	$13,682	$61,894	$11,246	$3,342	**$167,579**
Barnegat Light, New Jersey	$95,396	$107,631	$293,311	$228,107	$152,486	$167,568	$141,716	$31,691	$25,335	$0	**$124,324**
Point Judith, Rhode Island	$6,986	$24,556	$19,128	$19,817	$315,340	$20,106	$14,820	$9,692	$16,236	$9,664	**$45,635**
Atlantic City, New Jersey	$1,292	$2,548	$593	$2,895	$9,118	$5,019	$44,016	$50,481	$10,124	$8,612	**$13,470**
Montauk, New York	$8,385	$22,867	$17,166	$1,710	$7,792	$7,700	$827	$1,984	$9,427	$2,204	**$8,006**
Newport, Rhode Island	$0	$6,160	$0	$32,138	$0	$0	$0	$0	$0	$0	**$3,830**
North Kingstown, Rhode Island	$29,580	$5,829	$0	$0	$0	$0	$0	$0	$0	$0	**$3,541**
Other ports	$63,818	$266,872	$205,327	$142,464	$378,073	$165,614	$170,092	$86,998	$63,814	$67,422	**$161,049**
All ports	**$1,726,012**	**$5,224,221**	**$3,513,215**	**$1,361,494**	**$2,536,980**	**$1,280,486**	**$1,160,029**	**$520,752**	**$389,216**	**$278,585**	**$1,799,099**

Source: NMFS 2022b

Table I-63 Commercial Landings (pounds) in the Combined EW 1 and EW 2 WEAs by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	477,978	429,176	594,037	75,723	109,580	25,807	113,747	56,458	82,721	53,944	**201,917**
Cape May-Wildwood, New Jersey	231,177	181,195	229,247	60,804	71,530	79,577	78,397	38,214	192,945	73,633	**123,672**
Point Pleasant, New Jersey	78,503	88,579	99,124	47,740	56,507	55,139	51,784	28,059	108,471	56,029	**66,994**
Point Judith, Rhode Island	6,823	56,328	83,833	43,766	193,875	22,831	4,031	3,194	38,883	14,612	**46,818**
Atlantic City, New Jersey	2,372	2,954	2,574	16,911	10,144	13,856	77,125	107,935	10,098	12,792	**25,676**
Hampton Roads Area, Virginia	39,180	77,375	54,671	7,373	23,069	1,699	1,769	7,949	1,755	877	**21,572**
Barnegat Light, New Jersey	23,520	22,005	34,420	31,430	16,356	26,112	28,208	9,518	7,990	0	**19,956**
Montauk, New York	7,351	65,697	36,589	7,250	19,968	10,106	628	2,311	11,390	2,101	**16,339**
Belford, New Jersey	17,610	28,684	0	11,768	15,178	0	14,734	11,753	13,983	0	**11,371**
North Kingstown, Rhode Island	76,802	2,915	0	0	0	0	0	0	0	0	**7,972**
Other ports	251,687	89,836	222,413	237,227	74,022	53,106	174,166	118,134	176,839	95,465	**149,290**
All ports	**1,213,003**	**1,044,744**	**1,356,908**	**539,992**	**590,229**	**288,233**	**544,589**	**383,525**	**645,075**	**309,453**	**691,575**

Source: NMFS 2022b

Table I-64 Commercial Revenue (2019 dollars) in the Combined EW 1 and EW 2 WEAs by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
New Bedford, Massachusetts	$1,254,814	$3,168,772	$1,402,207	$345,391	$960,319	$216,474	$422,632	$221,597	$77,814	$58,942	**$812,896**
Cape May-Wildwood, New Jersey	$482,339	$1,702,633	$806,836	$436,950	$383,862	$328,094	$117,014	$31,773	$53,478	$26,614	**$436,959**
Point Pleasant, New Jersey	$370,672	$571,715	$829,694	$404,388	$435,829	$523,212	$394,448	$113,193	$196,006	$148,516	**$398,767**
Hampton Roads Area, Virginia	$358,762	$807,580	$560,322	$74,589	$303,221	$14,736	$19,210	$68,355	$14,369	$4,337	**$222,548**
Barnegat Light, New Jersey	$132,050	$141,394	$331,738	$258,711	$183,067	$228,844	$158,074	$42,523	$28,846	$0	**$150,525**
Point Judith, Rhode Island	$11,836	$86,131	$102,122	$61,790	$484,820	$32,395	$18,723	$12,518	$39,137	$17,150	**$86,662**
Atlantic City, New Jersey	$1,889	$2,964	$2,763	$17,937	$9,598	$13,559	$73,788	$112,072	$10,124	$12,375	**$25,707**
Montauk, New York	$13,492	$99,887	$53,807	$9,103	$22,403	$14,981	$827	$3,437	$16,826	$3,157	**$23,792**
Belford, New Jersey	$30,039	$39,438	$0	$12,072	$17,118	$0	$22,243	$10,751	$13,048	$0	**$14,471**
North Kingstown, Rhode Island	$41,107	$7,261	$0	$0	$0	$0	$0	$0	$0	$0	**$4,837**
Other ports	$132,301	$423,935	$358,753	$293,781	$455,699	$227,549	$211,167	$130,115	$106,292	$97,028	**$243,662**
All ports	**$2,829,301**	**$7,051,710**	**$4,448,242**	**$1,914,712**	**$3,255,936**	**$1,599,844**	**$1,438,126**	**$746,334**	**$555,940**	**$368,119**	**$2,420,826**

Source: NMFS 2022b

Table I-65 Commercial Landings in the EW 1 WEA as a Percentage of Landings in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Belford, New Jersey[1]	--	--	--	0.497%	0.178%	0.000%	0.417%	0.230%	0.196%	0.000%	**0.217%**
Cape May, New Jersey	0.375%	0.124%	0.304%	0.092%	0.050%	0.032%	0.034%	0.013%	0.084%	0.021%	**0.113%**
Point Pleasant, New Jersey	0.237%	0.285%	0.136%	0.075%	0.085%	0.057%	0.077%	0.018%	0.050%	0.034%	**0.106%**
Montauk, New York	0.026%	0.399%	0.181%	0.045%	0.112%	0.046%	0.000%	0.009%	0.040%	0.005%	**0.086%**
Point Judith, Rhode Island	0.009%	0.104%	0.148%	0.061%	0.235%	0.019%	0.002%	0.003%	0.046%	0.013%	**0.064%**
Atlantic City, New Jersey	0.003%	0.001%	0.008%	0.051%	0.003%	0.034%	0.145%	0.240%	0.000%	0.016%	**0.050%**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Barnegat Light, New Jersey	0.080%	0.065%	0.060%	0.052%	0.043%	0.088%	0.030%	0.028%	0.014%	0.000%	**0.046%**
New Bedford, Massachusetts	0.114%	0.108%	0.086%	0.017%	0.019%	0.005%	0.019%	0.011%	0.031%	0.015%	**0.042%**
Hampton Roads, Virginia	0.127%	0.099%	0.065%	0.014%	0.021%	0.004%	0.004%	0.005%	0.003%	0.001%	**0.034%**
Other ports	0.018%	0.002%	0.015%	0.013%	0.004%	0.003%	0.004%	0.007%	0.012%	0.005%	**0.008%**
All ports	**0.053%**	**0.033%**	**0.043%**	**0.021%**	**0.026%**	**0.009%**	**0.013%**	**0.015%**	**0.025%**	**0.010%**	**0.025%**

Source: NMFS 2022a, 2022b
[1] NOAA coastwide landings for Belford, New Jersey are unavailable from 2010–2012.

Table I-66 Commercial Revenue in the EW 1 WEA as a Percentage of Revenue in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	0.887%	0.992%	0.409%	0.280%	0.265%	0.285%	0.198%	0.056%	0.109%	0.075%	**0.356%**
Belford, New Jersey[1]	--	--	--	0.556%	0.475%	0.000%	0.453%	0.398%	0.448%	0.000%	**0.333%**
Cape May, New Jersey	0.239%	0.349%	0.252%	0.374%	0.154%	0.052%	0.042%	0.007%	0.030%	0.007%	**0.151%**
Barnegat Light, New Jersey	0.142%	0.100%	0.128%	0.121%	0.119%	0.238%	0.061%	0.044%	0.014%	0.000%	**0.097%**
Point Judith, Rhode Island	0.015%	0.153%	0.195%	0.090%	0.336%	0.027%	0.007%	0.005%	0.036%	0.011%	**0.087%**
Montauk, New York	0.029%	0.410%	0.173%	0.042%	0.086%	0.046%	0.000%	0.010%	0.043%	0.005%	**0.084%**
Hampton Roads, Virginia	0.250%	0.218%	0.134%	0.042%	0.077%	0.007%	0.009%	0.011%	0.006%	0.002%	**0.076%**
Atlantic City, New Jersey	0.003%	0.002%	0.010%	0.070%	0.002%	0.044%	0.151%	0.331%	0.000%	0.022%	**0.064%**
New Bedford, Massachusetts	0.118%	0.175%	0.058%	0.029%	0.064%	0.014%	0.018%	0.016%	0.004%	0.003%	**0.050%**
Other ports	0.020%	0.028%	0.024%	0.022%	0.013%	0.010%	0.008%	0.007%	0.008%	0.005%	**0.015%**
All ports	**0.121%**	**0.159%**	**0.078%**	**0.051%**	**0.065%**	**0.027%**	**0.022%**	**0.018%**	**0.013%**	**0.006%**	**0.056%**

Source: NMFS 2022a, 2022b
[1] NOAA coastwide landings for Belford, New Jersey, are unavailable from 2010–2012.

Table I-67 Commercial Landings in the EW 2 WEA as a Percentage of Landings in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Barnegat Light, New Jersey	0.197%	0.182%	0.387%	0.313%	0.187%	0.326%	0.362%	0.097%	0.113%	0.000%	**0.216%**
Point Pleasant, New Jersey	0.138%	0.294%	0.383%	0.235%	0.148%	0.169%	0.120%	0.056%	0.200%	0.116%	**0.186%**
Cape May, New Jersey	0.161%	0.335%	0.520%	0.206%	0.093%	0.071%	0.134%	0.025%	0.107%	0.057%	**0.171%**
New Bedford, Massachusetts	0.245%	0.260%	0.329%	0.041%	0.059%	0.016%	0.088%	0.040%	0.042%	0.032%	**0.115%**
Hampton Roads Area, Virginia	0.117%	0.324%	0.340%	0.031%	0.136%	0.011%	0.010%	0.046%	0.009%	0.004%	**0.103%**
Atlantic City, New Jersey	0.007%	0.012%	0.002%	0.011%	0.031%	0.019%	0.173%	0.197%	0.041%	0.038%	**0.053%**
Montauk, New York	0.031%	0.106%	0.066%	0.011%	0.057%	0.041%	0.005%	0.014%	0.060%	0.013%	**0.040%**
Point Judith, Rhode Island	0.010%	0.034%	0.032%	0.019%	0.104%	0.030%	0.006%	0.005%	0.036%	0.018%	**0.029%**
Newport, Rhode Island	0.000%	0.219%	0.000%	0.030%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.025%**
Other ports	0.019%	0.005%	0.009%	0.022%	0.006%	0.004%	0.023%	0.011%	0.015%	0.009%	**0.012%**
All ports	**0.061%**	**0.060%**	**0.080%**	**0.033%**	**0.030%**	**0.018%**	**0.042%**	**0.022%**	**0.036%**	**0.021%**	**0.040%**

Source: NMFS 2022a, 2022b
[1] NOAA coastwide landings for North Kingstown, Rhode Island are unavailable from 2010.

Table I-68 Commercial Revenue in the EW 2 WEA as a Percentage of Revenue in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	0.739%	1.141%	2.533%	1.470%	1.424%	1.570%	1.031%	0.265%	0.496%	0.345%	**1.101%**
Barnegat Light, New Jersey	0.370%	0.318%	0.978%	0.902%	0.596%	0.652%	0.527%	0.128%	0.104%	0.000%	**0.457%**
Cape May, New Jersey	0.357%	1.309%	0.873%	0.864%	0.496%	0.406%	0.097%	0.032%	0.050%	0.022%	**0.451%**
Hampton Roads Area, Virginia	0.226%	0.696%	0.740%	0.100%	0.505%	0.019%	0.022%	0.107%	0.021%	0.006%	**0.244%**
New Bedford, Massachusetts	0.292%	0.684%	0.283%	0.063%	0.228%	0.053%	0.111%	0.041%	0.014%	0.010%	**0.178%**
Point Judith, Rhode Island	0.022%	0.061%	0.045%	0.042%	0.626%	0.044%	0.027%	0.017%	0.025%	0.015%	**0.092%**
Atlantic City, New Jersey	0.007%	0.015%	0.003%	0.014%	0.041%	0.026%	0.223%	0.271%	0.056%	0.050%	**0.071%**
Montauk, New York	0.047%	0.122%	0.081%	0.010%	0.046%	0.048%	0.005%	0.013%	0.054%	0.012%	**0.044%**
Newport, Rhode Island	0.000%	0.082%	0.000%	0.225%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	**0.031%**
Other ports	0.022%	0.070%	0.048%	0.033%	0.079%	0.029%	0.028%	0.016%	0.012%	0.011%	**0.035%**
All ports	**0.194%**	**0.475%**	**0.307%**	**0.130%**	**0.236%**	**0.108%**	**0.093%**	**0.042%**	**0.031%**	**0.020%**	**0.164%**

Source: NMFS 2022a, 2022b
[1] NOAA coastwide revenue for North Kingstown, Rhode Island are unavailable from 2010

Table I-69 Commercial Landings in the Combined EW 1 and EW 2 WEAs as a Percentage of Landings in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	0.376%	0.579%	0.519%	0.310%	0.234%	0.226%	0.197%	0.075%	0.251%	0.150%	**0.292%**
Cape May-Wildwood, New Jersey	0.536%	0.459%	0.825%	0.298%	0.143%	0.103%	0.168%	0.038%	0.191%	0.078%	**0.284%**
Belford, New Jersey	--	--	--	0.560%	0.217%	0.000%	0.589%	0.230%	0.285%	0.000%	**0.269%**
Barnegat Light, New Jersey	0.277%	0.247%	0.447%	0.365%	0.230%	0.414%	0.392%	0.125%	0.127%	0.000%	**0.263%**
New Bedford, Massachusetts	0.358%	0.368%	0.415%	0.058%	0.078%	0.021%	0.107%	0.051%	0.073%	0.047%	**0.158%**
Hampton Roads Area, Virginia	0.243%	0.423%	0.405%	0.045%	0.157%	0.015%	0.014%	0.051%	0.012%	0.005%	**0.137%**
Montauk, New York	0.057%	0.505%	0.247%	0.055%	0.169%	0.087%	0.005%	0.023%	0.101%	0.018%	**0.127%**
Atlantic City, New Jersey	0.010%	0.013%	0.009%	0.062%	0.034%	0.053%	0.317%	0.437%	0.041%	0.054%	**0.103%**
Point Judith, Rhode Island	0.019%	0.138%	0.181%	0.080%	0.338%	0.049%	0.008%	0.007%	0.082%	0.030%	**0.093%**
Other ports	0.036%	0.012%	0.030%	0.036%	0.011%	0.008%	0.026%	0.018%	0.027%	0.015%	**0.022%**
All ports	**0.112%**	**0.095%**	**0.126%**	**0.056%**	**0.057%**	**0.027%**	**0.056%**	**0.037%**	**0.061%**	**0.031%**	**0.066%**

Source: NMFS 2022a, 2022b

Table I-70 Commercial Revenue in the Combined EW 1 and EW 2 WEAs as a Percentage of Revenue in the Geographic Analysis Area by Port and Year, 2010–2019

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Point Pleasant, New Jersey	1.626%	2.133%	2.942%	1.751%	1.689%	1.855%	1.229%	0.321%	0.605%	0.420%	**1.457%**
Cape May-Wildwood, New Jersey	0.595%	1.658%	1.125%	1.238%	0.651%	0.458%	0.138%	0.039%	0.081%	0.030%	**0.601%**
Barnegat Light, New Jersey	0.512%	0.418%	1.106%	1.023%	0.715%	0.890%	0.588%	0.172%	0.119%	0.000%	**0.554%**
Belford, New Jersey	--	--	--	0.671%	0.611%	0.000%	0.741%	0.398%	0.687%	0.000%	**0.444%**
Hampton Roads Area, Virginia	0.476%	0.915%	0.874%	0.142%	0.582%	0.026%	0.031%	0.118%	0.026%	0.008%	**0.320%**
New Bedford, Massachusetts	0.410%	0.859%	0.341%	0.091%	0.292%	0.067%	0.129%	0.057%	0.018%	0.013%	**0.228%**
Point Judith, Rhode Island	0.037%	0.214%	0.240%	0.132%	0.962%	0.070%	0.034%	0.022%	0.061%	0.026%	**0.180%**
Atlantic City, New Jersey	0.011%	0.017%	0.013%	0.084%	0.043%	0.069%	0.375%	0.603%	0.056%	0.072%	**0.134%**

Port and State	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Annual Average
Montauk, New York	0.076%	0.531%	0.254%	0.051%	0.133%	0.094%	0.005%	0.023%	0.097%	0.018%	**0.128%**
Other ports	0.045%	0.109%	0.081%	0.067%	0.095%	0.039%	0.035%	0.024%	0.020%	0.016%	**0.059%**
All ports	**0.316%**	**0.638%**	**0.389%**	**0.182%**	**0.303%**	**0.135%**	**0.115%**	**0.060%**	**0.044%**	**0.027%**	**0.221%**

Source: NMFS 2022a, 2022b

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Table I-71 For-Hire Recreational Fishing Effort in Terms of Angler Trips and Vessel Trips in the EW 1 WEA, 2008–2018

Year	Angler Trips			Vessel Trips		
	New York Ports	New Jersey Ports	All Ports	New York Ports	New Jersey Ports	All Ports
2008	229	43	272	11	1	12
2009	21	0	21	3	0	3
2010	373	5	378	48	1	49
2011	174	26	200	7	2	9
2012	79	152	231	4	5	9
2013	108	0	108	5	0	5
2014	330	59	389	11	3	14
2015	253	32	285	9	2	11
2016	201	91	292	9	3	12
2017	330	22	352	13	2	15
2018	1,792	116	1,908	70	6	76
Average	**354**	**50**	**403**	**17**	**2**	**20**

Source: NMFS 2022b
Notes: Angler trips is the number of passengers reported on Vessel Trip Reports for party and charter vessels.

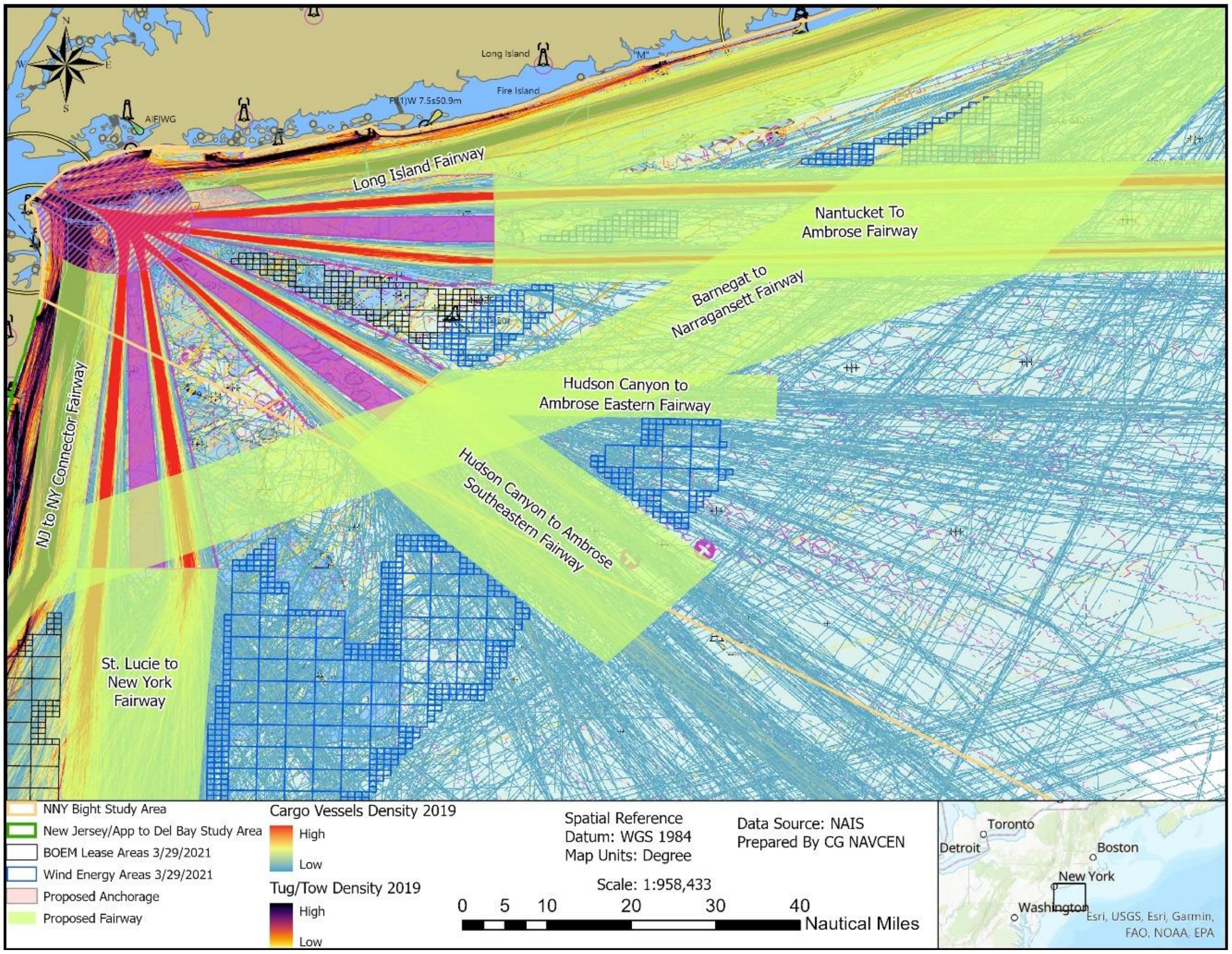
Table I-72 For-Hire Recreational Fishing Effort in Terms of Angler Trips and Vessel Trips in the EW 2 WEA, 2008–2018

Year	Angler Trips			Vessel Trips		
	New York Ports	New Jersey Ports	All Ports	New York Ports	New Jersey Ports	All Ports
2008	29	0	29	1	0	1
2009	4	0	4	1	0	1
2010	41	144	185	3	4	7
2011	204	18	222	12	1	13
2012	0	0	0	0	0	0
2013	219	277	496	7	15	22
2014	94	17	111	2	2	4
2015	78	14	92	6	1	7
2016	94	0	94	4	0	4
2017	22	93	115	1	4	5
2018	806	23	829	19	3	22
Average	**145**	**53**	**198**	**5**	**3**	**8**

Source: NMFS 2022b
Notes: Angler trips is the number of passengers reported on Vessel Trip Reports for party and charter vessels.

I.5. Navigation and Vessel Traffic

The recently published *Northern New York Bight Port Access Route Study: Final Report* (USCG 2021) analyzed an area that includes the approaches to the Port of New York and New Jersey and based on Marine Planning Guidelines and recommended that multiple shipping fairways and one federal anchorage be established within the PARS area. USCG is pursuing a rulemaking to establish the shipping safety fairways and the Northern New York Bight PARS final report will be considered during that process.



Source: USCG 2021

Figure I-6 U.S. Coast Guard Proposed Fairways and Anchorage Area

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Appendix J. Overview of Acoustic Modeling Reports

J.1. Introduction

This appendix is focused on providing an overview of the methods, assumptions, and results of the technical acoustic modeling reports prepared for the Projects (COP Appendices M-1 and M-2; Empire 2022). Readers who may be less familiar with acoustic terminology are recommended to refer to Section M-1.1.1, *Acoustic Concepts and Terminology*, in Appendix M-1 of the COP (Empire 2022), Appendix A, *Glossary*, to Appendix M-2 of the COP (Empire 2022), and Appendix D, *Underwater Acoustics*, to Appendix M-2 of the COP (Empire 2022).

The 2,076-MW Projects, which encompass EW 1 and EW 2, would consist of up to 147 WTGs, up to two OSS, and interarray and export cables. The Projects would be on the OCS offshore New York in BOEM Lease Area OCS-A 0512. The primary underwater noise-producing activity for the Projects would be impact pile driving during construction. Other modeled noise-producing activities include drilling during WTG foundation installation and vibratory pile driving during cofferdam installation. This appendix focuses on the quantitative underwater noise modeling conducted for Project activities (i.e., impact pile driving and vibratory pile driving). Qualitative assessments of lower noise-level activities, including cable laying (i.e., operation of dynamic positioning thrusters by the cable-laying vessel), WTG operation, and marina activities (including bulkhead repairs and the removal of berthing piles) are also provided in Appendices M-1 and M-2 of the COP (Empire 2022).

For the quantitative modeling assessment for impact pile driving for foundation installation, predicted sound fields were generated for 31.5-foot (9.6-meter) diameter[1] monopiles, 36.1-foot (11-meter) diameter R3 monopiles, 36.1-foot (11-meter) diameter T1 monopiles, and 36.1-foot (11-meter) diameter U3 monopiles for WTG foundations and 8.2-foot (2.5-meter) diameter pin piles for jacketed OSS foundations. Modeling scenarios included two representative locations each for the R3, T1, and U3 monopile foundations; three representative locations for the 31.5-foot (9.6-meter) monopile foundations; and two locations for the jacket foundations with pin piles to represent the types of piles and range of water depths in the Project area (COP Appendix M-2, Figure 2; Empire 2022). For each of their respective monopile foundation locations, modeling was conducted at a maximum hammer energy of 2,000 kJ for R3 monopiles, 2,500 kJ for the T1 monopiles, and 1,300 kJ for the U3 monopiles. At each 31.5-foot (9.6-meter) monopile location, modeling was conducted for a typical scenario, with a maximum hammer energy of 2,300 kJ, and a difficult-to-drive scenario, with a maximum hammer energy of 5,225 kJ. Modeling scenarios included one or two monopiles driven per day, two to three pin piles driven per day, and all possible combinations of monopiles and pin piles driven per day. Sound field predictions were made for both summertime and wintertime conditions to account for variation in sound propagation caused by water temperature, as well as different levels of noise attenuation, including 0 (i.e., no mitigation), 6, 10, and 15 dB. In addition to impact pile driving for foundation installation, predicted sound fields for impact pile driving for goal post installation (as an alternative to the use of cofferdams for cable landfalls) at one representative location were also calculated.

For the quantitative modeling assessment for vibratory pile driving associated with cofferdam installation, predicted sound fields were generated for five locations: the anticipated EW 1 export cable landfall site, three representative locations for the EW 2 export cable landfall site, and one representative location for the western approach to EW 2 Landfall C. The representative locations for EW 2 export cable landfall sites include a location representative of EW 2 Landfalls A, B, and E; a location representative of a

[1] The diameter provided for tapered monopiles is the diameter at the expected waterline.

shallow-water option for EW 2 Landfall C; and a location representative of a deep-water option for EW 2 Landfall C. Additional predicted sound fields were generated for vibratory pile driving associated with marina activities: one representative location for sheetpile installation at the EW 2 Onshore Substation C, and one representative location for berthing pile removal at the EW 2 Onshore Substation C marina. Sound field predictions were made for the conditions that resulted in the greatest sound propagation (i.e., maximum underwater noise impacts).

The predicted sound fields for impact pile driving and vibratory pile driving were used to predict ranges to isopleths associated with acoustic criteria for injury and behavioral impacts. These ranges were then used to estimate the number of marine animals that could be exposed to sound levels exceeding acoustic criteria for each modeled noise source.

J.2. Acoustic Models and Assumptions

The quantitative assessments of noise-producing activities rely upon a variety of acoustic models to predict the potential effect of Project activities on marine animals. The models used in the quantitative analyses include:

1. GRL Wave Equation Analysis Program (GRLWEAP) Model: to model the force applied to the pile by the impact hammer
2. Finite Difference Model: to compute pile vibration and near-field sound radiation after the impact hammer strikes the pile to calculate source levels
3. Full Waveform Range-dependent Acoustic Model (FWRAM): to calculate the time-dependent sound field, SPL, and sound exposure level (SEL) metrics for impact pile driving
4. dBSea Parabolic Equation (dBSeaPE) Method: to calculate one-third octave band noise levels for drilling and vibratory pile driving in the 12.5- to 800-Hz frequency range
5. dBSea Ray Tracing (dBSeaRay) Method: to calculate one-third octave band noise levels for drilling and vibratory pile driving in the 1,000- to 20,000-Hz frequency range
6. JASMINE Model: the JASCO Applied Sciences animat[2] movement and exposure model used to estimate the number of animals exposed to sound levels exceeding regulatory criteria (Section J.5)

FWRAM, dBSeaPE, and dBSeaRay predict the propagation of the source signal through the physical environment. As such, these models require accurate descriptions of ocean bathymetry, seafloor sediment properties, and sound speed profile (SSP) in the water column. The assumptions of these models and their inputs are critical to the accuracy of the model output.

J.2.1 Physical Environment

The bathymetry information used to model impact pile driving was compiled from the Shuttle Radar Topography Mission data (Becker et al. 2009). Bathymetry data used to model drilling and vibratory pile driving were obtained from the National Geographic Data Center’s U.S. Coastal Relief Model. A simplified geoacoustic profile of the sediment properties for modeling was developed based on site-specific geotechnical data collected by Empire. SSPs used to model impact pile driving were extracted from the U.S. Navy’s Generalized Digital Environmental Model (Naval Oceanographic Office 2003). Site-specific water column properties (i.e., water temperature, salinity, and depth) were used to generate site-specific monthly SSPs to model vibratory pile driving. Water temperatures and density change seasonally and vertically within the water column; therefore, representative summer and winter SSPs were used for modeling. For the impact pile driving assessment, seasonal SSPs were calculated by averaging monthly SSPs for the summer months (i.e., May through September) and the winter months

[2] Animat = simulated animal

(i.e., December through March). For the drilling and vibratory pile driving assessments, a seasonal monthly SSP was selected to represent the maximum underwater noise impacts. A sensitivity analysis identified the December SSP as having the greatest sound propagation. Therefore, the December SSP was used for assessment of these activities.

J.2.2 Sound Source Details

J.2.2.1. Impact Pile Driving for Foundation Installation

Pile dimensions, hammer energy, and number of strikes are required inputs for the modeling of impact pile driving for foundation installation (Table J-1).

Typical installation of the 78.5-meter-long WTG foundation 9.6-meter diameter monopiles with an IHC S-5500 hammer was expected to begin with 450-kJ hammer strikes that would be scaled up to 2,300 kJ at the end of the pile installation. A total of 5,497 strikes were expected per pile, and the strike rate was estimated at 30 strikes per minute. A difficult installation of the 78.5-meter-long WTG foundation 9.6-meter diameter monopiles with an IHC S-5500 hammer was expected to begin with 450-kJ hammer strikes that would be scaled up to 5,225 kJ at the end of the pile installation. A total of 7,165 strikes were expected per pile, and the strike rate was estimated at 30 strikes per minute. Installation of the 75.3-meter-long WTG foundation 11-meter diameter R3 monopiles with an IHC S-5500 hammer was expected to begin with 500-kJ hammer strikes that would be scaled up to 2,000 kJ at the end of the pile installation. A total of 4,025 strikes were expected per pile, and the strike rate was estimated at 30 strikes per minute. Installation of the 84.1-meter-long WTG foundation 11-meter diameter T1 monopiles with an IHC S-5500 hammer was expected to begin with 500-kJ hammer strikes that would be scaled up to 2,500 kJ at the end of the pile installation. A total of 4,919 strikes were expected per pile, and the strike rate was estimated at 30 strikes per minute. Installation of the 97.5-meter-long WTG foundation 11-meter diameter U3 monopiles with an IHC S-5500 hammer was expected to begin with 450-kJ hammer strikes that would be scaled up to 1,300 kJ at the end of the pile installation. A total of 7,335 strikes were expected per pile, and the strike rate was estimated at 30 strikes per minute. Installation of the 57- to 66-meter-long pin piles for the OSS jacket foundations with an IHC S-4000 hammer was expected to scale from 500 to 3,200 kJ during pile installation. For the EW 1 OSS, 4,340 strikes were predicted for each pin pile, with a strike rate of 30 strikes per minute. For the EW 2 OSS, 3,711 strikes were predicted for each pin pile, with a strike rate of 30 strikes per minute. No simultaneous pile driving was included in the modeling assumptions.

J.2.2.2. Impact Pile Driving for Goal Post Installation

The source level of the impact pile driver for goal post installation was assumed to be 184 dB referenced to 1 micropascal (re 1 µPa), with a peak-to-peak level of 200 dB re 1 µPa. A total of 2,000 strikes are expected per pile, and anticipated drive time is 2 hours per pile.

Table J-1 Key Assumptions Used in the Underwater Acoustic Modeling of Impact Pile Driving

Foundation type	Scenario	Modeled maximum impact hammer energy (kJ)	Number of Strikes	Strike Rate (min^{-1})	Pile diameter (m)	Pile wall thickness (mm)	Maximum Seabed penetration (m)	Piles per day
Monopile	Typical	2,300	5,497	30	9.6	73–101	38	1–2
Monopile	Difficult-to-Drive	5,225	7,165	30	9.6	73–101	38	1-2
R3 Monopile	Typical	2,000	4,025	30	11	8.5	55	1-2
T1 Monopile	Typical	2,500	4,919	30	11	8.5	55	1-2
U3 Monopile	Typical	1,300	7,335	30	11	8.5	55	1-2
Jacket	Typical	3,200	3,711/4,340[1]	30	2.5	50	56	2–3

[1] Number of strikes for OSS2/OSS1
min = minute; m = meter; mm = millimeter

J.2.2.3. Vibratory Pile Driving

The source level of the vibratory pile driver was assumed to be 195 dB referenced to 1 micropascal squared (re 1 µPa^2) SEL with an 1,800-kilonewton vibratory force over a 24-hour assessment period for cofferdam installation; for vibratory pile driving associated with sheetpile installation, the source level was assumed to be 160 dB re 1 µPa^2 SEL; and for pile driving associated with berthing pile removal, the source level was assumed to be 165 dB re 1 µPa^2 SEL.

J.2.3 Noise Attenuation

No specific noise-attenuation system was identified for the assessment of impact pile-driving noise associated with foundation installation. However, a minimum sound-source attenuation of 10 dB was assumed to model impact pile driving. This level of attenuation was selected as an achievable reduction in sound levels when one noise-attenuation system is in use (Empire 2022 citing Austin and Li 2016; Empire 2022 citing Bellman 2014; Empire 2022 citing Buehler et al. 2015; Empire 2022 citing Koschinski and Lüdemann 2013). An attenuation of 10 dB produces a 90-percent reduction in sound levels. Additional levels of attenuation (0, 6, and 15 dB) were also modeled for comparison. These results are presented in Appendix H, *Acoustic Ranges*, and Appendix I, *Animal Movement and Exposure* Modeling, to Appendix M-2 of the COP (Empire 2022).

The use of noise attenuation is not anticipated for vibratory pile driving associated with cofferdam installation, sheetpile installation, or removal of berthing piles, or for impact driving of goal post piles. Therefore, noise attenuation was not included in the analysis of these activities.

J.3. Methodology

J.3.1 Noise Propagation Modeling

J.3.1.1. Impact Pile Driving for Foundation Installation

To model the sound from impact pile driving, including WTG foundation monopiles, OSS jacket foundation pin piles, and goal post piles, the force of the pile-driving hammers was computed using the GRLWEAP 2010 wave equation model (Pile Dynamics 2010). The forcing functions from GRLWEAP were used as inputs to the Finite Difference model to compute the resulting pile vibrations. The sound radiating from the pile was simulated using a vertical array of discrete point sources. Their amplitudes and phases were derived using an inverse technique, such that their collective particle velocity, calculated using a near-field wave-number integration model, matched the particle velocity in the water at the pile wall. The sound field propagating away from the vertical array was calculated using the FWRAM, which utilizes an array starter method to accurately model sound propagation from a spatially distributed sound source (Empire 2022 citing MacGillivray and Chapman 2012).

FWRAM was used to model synthetic pressure waveforms over a 10- to 1,024-Hz frequency range. Pressure wave forms were computed as a function of range and depth using Fourier synthesis of transfer functions. The modeled pressure waveforms were post-processed to calculate SPL and SEL metrics moving away from the sound source, both vertically (i.e., with depth) and horizontally (i.e., over range). A 20-dB-per-decade decay rate was used to extend the sound field frequency range up to 65,000 Hz.

J.3.1.2. Impact Pile Driving for Goal Post Installation

Modeling of goal post installation utilized the formulaic spreadsheet developed by NMFS, which generates estimated distances to cumulative and peak sound exposure thresholds based on user-provided sound source characteristics.

J.3.1.3. Vibratory Pile Driving

Vibratory pile-driving activities include cofferdam installation, sheetpile installation for bulkhead repairs, and berthing pile removal. dBSea software was used to model vibratory pile-driving by calculating noise levels throughout the Project area in one-third octave bands. To analyze vibratory pile-driving noise, a split solver was used to cover frequencies from 12.5 to 20,000 Hz. dBSeaPE was used for frequencies from 12.5 to 800 Hz, and dBSeaRay was used for frequencies from 1,000 to 20,000 Hz.

J.3.2 Ranges to Regulatory Thresholds

A maximum-over-depth approach was used to calculate distances to acoustic thresholds associated with injury and behavioral effects on marine animals (i.e., isopleths) (Section J.5). For this approach, the maximum received sound level that occurs within the water column at a given range was used as the sound level at that distance. The 95th percentile of all isopleth distances from the source ($R_{95\%}$) was used to represent the range to regulatory thresholds for the determination of ensonified areas (Figure J-1). As shown on Figure J-1, 95 percent of the area exceeding a specific acoustic threshold occurs within this range from the source.

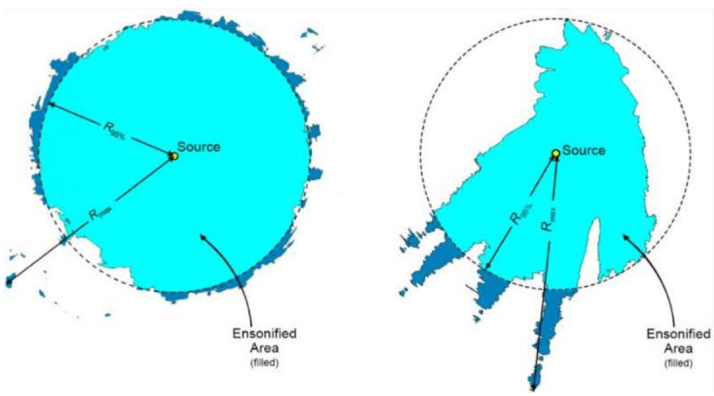

Figure J-1 Illustration of Ensonified Areas Based on $R_{95\%}$, which Was Calculated from Maximum Isopleth Ranges (R_{max})

J.3.3 Animal Movement Modeling

Predicted animal movements, in combination with predicted ensonified areas, are needed to estimate animal exposures to underwater noise during Project construction. Models using simulated animals, called "animats," are generally used to predict animal movements (Dean 1998; Frankel et al. 2002). Such modeling is typically conducted for individual species but may be conducted for representative species groups if sufficient data are not available. Animat models require input data describing a variety of species-specific behavioral parameters, such as the range of swimming speeds, dive depths, and course changes. Animat models simulate four-dimensional movements of the animat across latitude, longitude, depth, and time.

The JASMINE animat modeling program was used to simulate animal movement through predicted ensonified areas modeled for the Projects to estimate the probability of exposure to sound levels exceeding regulatory thresholds (Section J.5). As the input parameters for the model are based on observations of swimming behavior collected over relatively short periods (i.e., hours to days) and do not include large-scale movements over relatively long periods (e.g., migration patterns), a simulation period of 7 days was selected for this modeling effort. The simulation area was limited to a maximum distance of 38 miles (70 kilometers) of the Lease Area. All simulations were seeded with an animat density of 0.5

animat per km^2 over the entire simulation area to generate statistically reliable probability density functions.

Within each simulation, the animat served as a sound receiver, sampling sound levels within the predicted ensonified area as the animat moved. For each simulation, JASMINE provided output quantifying the exposure history (i.e., received sound levels over the course of the simulation period) for each animat as it moved through the environment during noise-producing Project activities. Each animat's exposure history was used to identify maximum received SPLs, and exposure levels were summed over a 24-hour period to determine received SELs. These SPLs and SELs were then compared to regulatory thresholds.

To estimate the number of marine animals likely to be exposed to sound levels exceeding the regulatory thresholds over the duration of the Projects, four different construction schedules occurring over a 2-year period were modeled, with 96 monopiles and 24 pin piles being installed in Year 1 and 51 monopiles and no pin piles being installed in Year 2 (COP Volume 2, Appendix M-2, Section 1.2.2; Empire 2022). In construction schedule 1, one monopile and two pin piles are driven per day; in construction schedule 2, one monopile and three pin piles are driven per day; in construction schedule 3, two monopiles and 2 pin piles are driven per day; and in construction schedule 4, two monopiles and three pin piles are driven per day.

Behavioral aversion to sound sources was modeled for a subset of scenarios for comparison purposes only. Parameters determining aversion at specified sound levels were implemented for two species: NARW (*Eubalaena glacialis*) and harbour porpoise (*Phocoena phocoena*). NARW was selected due to its critically endangered status, and harbour porpoise was selected based on its documented strong aversive response to loud sounds. Aversion for these two marine mammal species was implemented by allowing the animats to change course away from the sound source, with heading changes determined by received sound levels. Aversion thresholds were based on the Wood et al. (2012) step function (COP Appendix M-2, Tables I-1 and I-2; Empire 2022). Animats remained in the aversive state for a specified amount of time based on received sound levels before returning to a normal state.

J.4. Marine Species Present in the Project Area

Thirty-nine marine mammal stocks (38 species) and four species of sea turtles potentially occur near the Project area. All four sea turtle species and six marine mammal species are listed under the ESA; all marine mammals are protected under the MMPA. Species with common or uncommon occurrence (Table J-2) were selected for quantitative movement modeling and exposure estimates. Rare species were not modeled because acoustic impacts on these species would approach zero due to their low densities.

Table J-2 Marine Mammal and Sea Turtle Species Quantitatively Analyzed

Species	Stock	Abundance
Mysticetes		
Fin whale *Balaenoptera physalus*	Western North Atlantic	6,802
Humpback whale *Megaptera novaeangliae*	Gulf of Maine	1,396
Minke whale *B. acutorostrata*	Canadian Eastern Coastal	21,968
NARW *E. glacialis*	Western	368
Sei whale *B. borealis*	Nova Scotia	6,292

Species	Stock	Abundance
Odontocetes		
Atlantic spotted dolphin *Stenella frontalis*	Western North Atlantic	39,921
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Western North Atlantic	93,233
Bottlenose dolphin *Tursiops truncatus*	Western North Atlantic Offshore	62,851
	Western North Atlantic Northern Migratory Coastal	6,639
Harbour porpoise *P. phocoena*	Gulf of Maine/Bay of Fundy	95,543
Long-finned pilot whale *Globicephala melas*	Western North Atlantic	39,215
Risso's dolphin *Grampus griseus*	Western North Atlantic	35,493
Short-beaked common dolphin *Delphinus delphis*	Western North Atlantic	172,974
Short-finned pilot whale *G. macrorhynchus*	Western North Atlantic	28,924
Sperm whale *Physeter macrocephalus*	North Atlantic	4,349
Pinnipeds		
Gray seal *Halichoerus grypus*	Western North Atlantic	27,300
Harbor seal *Phoca vitulina*	Western North Atlantic	61,336
Harp seal *Pagophilus groenlandicus*	Western North Atlantic	Unknown
Sea Turtles		
Green sea turtle *Chelonia mydas*	--	--
Kemp's ridley sea turtle *Lepidochelys kempii*	--	--
Leatherback sea turtle *Dermochelys coriacea*	--	--
Loggerhead sea turtle *Caretta caretta*	--	--

Source: COP Volume 2, Section 3.15, and COP Appendix M-2; Empire 2022

J.4.1 Marine Mammal Densities

J.4.1.1. Lease Area

To estimate marine mammal exposures for impact pile driving for foundation installation, estimates of mean monthly density (animals per 100 km^2) for all common and uncommon marine mammal species occurring in the Project area (Table J-2) were obtained from the Duke University Marine Geospatial Ecology Laboratory (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b), including the recently updated model results for the NARW. These densities are provided in Table J-3. The updated model includes new NARW abundance estimates for Cape Cod Bay in December. The modeling used the most recent 2010 to 2018 density predictions for the NARW.

Densities were calculated for a 3.4-mile (5.5-kilometer) buffered polygon around the Lease Area perimeter. This buffer size was selected as the largest 10 dB-attenuated exposure range, rounded up to the nearest 0.5 kilometer. All species, scenarios, and threshold criteria were included in this calculation.

Mean density for each month was determined by calculating the unweighted mean density of all grid cells partially or fully within the buffered polygon. Grid cells were 6.2 by 6.2 miles (10 by 10 kilometers), except for NARW, which were 3.1 by 3.1 miles (5 by 5 kilometers). Densities were computed monthly, annually, and for the May through December period to coincide with proposed pile-driving activities for the Projects. In cases where monthly densities were unavailable, annual mean densities were used instead.

Although long-finned and short-finned pilot whales were modeled separately, only one density model was available for pilot whales that encompasses both pilot whale species (Roberts et al. 2016a, 2016b, 2017). Densities for each species were calculated by estimating the total pilot whale densities in the buffered polygon and then scaling by relative abundance of both species.

J.4.1.2. Cable Landfall Area

To estimate marine mammal exposures for vibratory pile driving for cofferdam installation, average seasonal densities in the cable landfall area were obtained from the Duke University Marine Geospatial Ecology Laboratory (Roberts et al. 2016b, 2017, 2018, 2020, 2021a). These densities are provided in Table J-4.

Table J-3 Mean Monthly Marine Mammal Density Estimates for Impact Pile Driving for Foundation Installation

Species	Monthly Densities (animals per 100 km^2)												Annual Mean Density
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fin whale	0.099	0.095	0.115	0.189	0.236	0.258	0.232	0.172	0.163	0.189	0.105	0.084	0.161
Humpback whale	0.061	0.031	0.020	0.044	0.042	0.048	0.020	0.013	0.062	0.129	0.054	0.065	0.049
Minke whale	0.036	0.044	0.045	0.148	0.148	0.080	0.012	0.013	0.062	0.035	0.018	0.026	0.051
NARW	0.479	0.548	0.645	0.726	0.122	0.007	0.002	0.002	0.002	0.005	0.031	0.230	0.233
Sei whale	0.001	0.001	0.001	0.021	0.018	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.004
Atlantic spotted dolphin	0.005	0.002	0.003	0.011	0.027	0.114	0.283	0.148	0.263	0.146	0.145	0.015	0.097
Atlantic white sided dolphin	0.755	0.501	0.588	1.537	2.533	2.111	0.741	0.260	0.495	1.158	1.012	1.254	1.079
Bottlenose dolphin	0.629	0.045	0.018	0.305	0.705	2.442	2.679	2.941	2.240	1.318	1.284	0.651	1.271
Harbour porpoise	7.573	11.683	11.252	6.946	2.059	0.037	0.051	0.079	0.072	0.157	2.874	6.549	4.111
Long-finned pilot whale	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098
Risso's dolphin	0.006	0.003	0.001	0.001	0.003	0.003	0.014	0.030	0.012	0.003	0.006	0.014	0.008
Short-beaked common dolphin	7.494	1.434	0.573	0.947	1.038	0.930	0.863	2.235	3.413	5.013	4.336	11.713	3.332
Short-finned pilot whale	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072
Sperm whale	0.001	0.001	0.001	0.001	0.006	0.027	0.042	0.029	0.027	0.009	0.007	0.001	0.013
Seals	5.941	11.886	10.158	8.808	6.431	0.266	0.017	0.008	0.022	0.095	0.318	3.984	3.994

Sources: Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b

Table J-4 Mean Seasonal Marine Mammal Density Estimates for Vibratory Pile Driving for Cofferdam Installation

Species	Seasonal Densities (animals per 100 km²)	
	EW 1 Cofferdams	EW 2 Cofferdams
NARW	0.29	0.029
Humpback whale	0.07	0.07
Fin whale	0.17	0.17
Sei whale	0.01	0.01
Sperm whale	0.02	0.02
Minke whale	0.08	0.08
Bottlenose dolphin (Western North Atlantic Northern Migratory Coastal Stock)	6.6	6.6
Atlantic spotted dolphin	0.14	0.14
Short-beaked common dolphin	4.94	4.94
Atlantic white-sided dolphin	1.02	1.02
Risso's dolphin	0.01	0.01
Pilot whale spp.	0.11	0.11
Harbour porpoise	9.07	9.07

Sources: Roberts et al. 2016b, 2017, 2018, 2020, 2021a

J.4.2 Sea Turtle Densities

Density estimates for sea turtles in the Project area are limited. Aerial survey data collected by the New York State Energy Research and Development Authority (Normandeau Associates and APEM 2018, 2019a, 2019b, 2019c, 2020) were used to develop seasonal density estimates for quantitative analysis of acoustic impacts on sea turtles. Maximum seasonal abundance for each species was extracted from the aerial survey data and corrected to represent the Project area. Corrected abundance was scaled by the Project area to obtain species density in units of animals per km^2 (Table J-5).

Table J-5 Mean Seasonal Sea Turtle Density Estimates for All Modeled Sea Turtle Species

Species	Seasonal Densities (animals per 100 km²)			
	Spring	Summer	Fall	Winter
Green sea turtle	0.000	0.000	0.000	0.000
Kemp's ridley sea turtle	0.001	0.010	0.002	0.000
Leatherback sea turtle	0.000	0.003	0.008	0.000
Loggerhead sea turtle	0.003	0.268	0.002	0.000

J.5. Acoustic Impact Criteria

J.5.1 Marine Mammals

Marine mammal acoustic criteria used for the modeling effort were derived from the current U.S. regulatory acoustic criteria. Peak SPLs (L_{pk}) and frequency-weighted accumulated SELs ($L_{E,24h}$) were taken from the NOAA Technical Guidance (NMFS 2018) for marine mammal injury thresholds (Table

J-6). SPL (L_p) for marine mammal behavioral thresholds were based on the unweighted NMFS (2005) (Table J-6) and the frequency-weighted Wood et al. (2012) criteria (Table J-7).

Table J-6 NMFS Regulatory Acoustic Criteria for Marine Mammals

Functional Hearing Group	Sound Source Type				
	Impulsive			Non-Impulsive	
	Level A $L_{E,\,24h}$[1]	Level A L_{pk}[2]	Level B L_p[2]	Level A $L_{E,\,24h}$[1]	Level B L_p[2]
LFC	183	219	160	199	120
MFC	185	230		198	
HFC	155	202		173	
Phocid pinnipeds in water	185	218		201	

Sources: NMFS 2005, 2018
[1] Measured in dB re 1 μPa^2 second
[2] Measured in dB re 1 μPa

Table J-7 Frequency-Weighted Acoustic Criteria for Probabilistic Behavioral Response to Impulsive Noise Sources in Marine Mammals

Marine Mammal Group	Probabilistic Response			
	L_p[1] > 120	L_p[1] > 140	L_p[1] > 160	L_p[1] > 180
Beaked whales and harbour porpoises	50%	90%	--	--
Migrating mysticetes	10%	50%	90%	--
All other species	--	10%	50%	90%

[1] Measured in dB re 1 μPa

J.5.2 Sea Turtles

Peak SPLs and frequency-weighted accumulated SELs from Finneran et al. (2017) were used for the onset of PTS and TTS in sea turtles (Table J-8). Behavioral response thresholds for sea turtles were obtained from McCauley et al. (2000).

J.5.3 Fish

Injury thresholds (L_{pk} and $L_{E,\,24hr}$) for different sized fish (i.e., less than 2 grams or 2 grams and larger) were based on the Fisheries Hydroacoustic Working Group (2008) and Stadler and Woodbury (2009). Injury thresholds (L_{pk} and $L_{E,\,24hr}$) for fish with different hearing capabilities (i.e., without swim bladder, with swim bladder not involved in hearing, and with swim bladder involved in hearing) were obtained from Popper et al. (2014). Behavioral thresholds for fish were developed by the NMFS Greater Atlantic Regional Fisheries Office (Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007) (Table J-8).

Table J-8 Acoustic Metrics and Thresholds for Fish and Sea Turtles

Faunal Group	Injury		Impairment		Behavior
	PTS		TTS		
	L_{pk}[1]	$L_{E,\,24hr}$[2]	L_{pk}[1]	$L_{E,\,24hr}$[2]	L_p[1]
Fish equal to or greater than 2 grams	206	187	--	--	150
Fish less than 2 grams		183	--	--	
Fish without swim bladder	213	216	--	--	--

Faunal Group	Injury		Impairment		Behavior
	PTS		TTS		
	L_{pk}[1]	$L_{E,\ 24hr}$[2]	L_{pk}[1]	$L_{E,\ 24hr}$[2]	L_p[1]
Fish with swim bladder not involved in hearing	207	203	--	--	--
Fish with swim bladder involved in hearing	207	203	--	--	--
Sea turtles	232	204	226	189	175

Sources: Andersson et al. 2007; Finneran et al. 2017; Fisheries Hydroacoustic Working Group 2008; McCauley et al. 2000; Mueller-Blenkle et al. 2010; Popper et al. 2014; Purser and Radford 2011; Stadler and Woodbury 2009; Wysocki et al. 2007
[1] Measured in dB re 1 μPa
[2] Measured dB re 1 μPa^2 second

J.6. Results

J.6.1 Ranges to Acoustic Regulatory Thresholds

J.6.1.1. Impact Pile Driving for Foundation Installation

The complete results of acoustic modeling for impact pile driving of monopiles and pin piles presented in Appendix M-2 (Empire 2022) for the multiple combinations of the two modeled seasons, four modeled locations (two locations for monopiles and two locations for pin piles), varying levels of attenuation, pile-driving scenarios (i.e., typical and difficult-to-drive), and driving schedules are too numerous to replicate here. Instead, summaries of exposure ranges ($ER_{95\%}$) for marine mammals and sea turtles are presented herein (Table J-9 through Table J-22). Additionally, summaries of ranges to acoustic thresholds for sea turtles and fish are presented herein and are based on the maximum acoustic range to the 95th maximum percentile ($R_{95\%}$) among the modeled scenarios for marine mammals and on the maximum acoustic range (R_{max}) among the modeled scenarios for sea turtles and fish (Table J-23 through Table J-29).

Table J-9 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Impact Pile Driving of One 9.6-meter Monopile WTG Foundation per Day with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	Typical Scenario						Difficult-to-Drive Scenario					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p
LFC	0.00	3.07	7.35	0.01	0.88	3.40	0.05	4.28	8.97	<0.01	1.80	5.24
MFC	0.00	0.00	7.09	0.00	0.00	3.40	0.00	0.00	8.82	0.00	0.00	5.14
HFC	0.22	0.00	7.04	0.00	0.00	3.15	0.57	0.02	8.71	0.08	0.00	5.04
PW	<0.01	0.11	7.37	0.00	0.00	3.54	<0.01	0.54	9.09	0.00	0.00	5.35

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-10 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Impact Pile Driving of Two 9.6-meter Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	Typical Scenario						Difficult-to-Drive Scenario					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p
LFC	0.02	3.14	7.10	0.00	1.01	3.46	0.05	4.46	8.79	0.00	1.95	4.87
MFC	<0.01	0.00	6.86	0.00	0.00	3.32	<0.01	0.00	8.56	0.00	0.00	4.92
HFC	0.27	<0.01	6.80	<0.01	0.00	3.22	0.55	0.04	8.56	0.04	0.00	4.75
PW	0.03	0.13	7.22	0.00	0.00	3.50	0.07	0.52	8.96	0.00	<0.01	5.19

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-11 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Typical Impact Pile Driving of One and Two 11-meter U3 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	1 Monopile per Day						2 Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p
LFC	<0.01	2.70	5.61	<0.01	0.90	2.71	0.02	2.30	5.55	0.00	0.82	2.59
MFC	0.00	0.00	5.55	0.00	0.00	2.63	0.00	0.00	5.40	0.00	0.00	2.53
HFC	0.20	0.00	5.39	0.00	0.00	2.53	0.24	0.00	5.32	<0.01	0.00	2.51
PW	0.00	0.08	5.79	0.00	0.00	2.70	<0.01	0.04	5.71	<0.01	<0.01	2,67

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling,* to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-12 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Typical Impact Pile Driving of One and Two 11-meter T1 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	1 Monopile per Day						2 Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E,\ 24h}$	Level B L_p
LFC	<0.01	2.87	7.20	0.00	0.87	3.56	0.01	2.66	6.99	0.00	0.83	3.53
MFC	0.00	0.00	6.87	0.00	0.00	3.48	<0.01	0.00	6.76	0.00	0.00	3.35
HFC	0.22	0.00	6.87	0.00	0.00	3.41	0.24	0.00	6.64	<0.01	0.00	3.35
PW	<0.01	0.12	7.30	0.00	0.00	4.98	<0.01	0.14	7.20	0.00	0.00	3.66

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling,* to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-13 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Typical Impact Pile Driving of One and Two 11-meter R3 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	1 Monopile per Day						2 Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p
LFC	<0.01	2.73	6.41	0.00	0.87	3.17	0.01	2.50	6.42	<0.01	0.48	3.14
MFC	<0.01	0.00	6.42	0.00	0.00	3.10	<0.01	0.00	6.25	0.00	0.00	4,21
HFC	0.23	0.00	6.27	0.00	0.00	3.07	0.26	0.00	6.23	<0.01	0.00	3.09
PW	<0.01	0.12	6.46	0.00	0.00	3.25	0.01	0.04	6.42	0.00	0.00	3.25

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-14 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Impact Pile Driving of OSS1 Jacket Foundations with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	Two Pin Piles per Day						Three Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p
LFC	0.00	0.46	2.49	0.00	0.00	0.90	0.00	0.55	2.45	0.00	0.00	0.85
MFC	0.00	0.00	2.56	0.00	0.00	0.88	0.00	0.00	2.41	0.00	0.00	0.87
HFC	0.00	0.00	2.50	0.00	0.00	0.86	0.00	0.00	2.47	0.00	0.00	0.79
PW	0.00	0.00	2.62	0.00	0.00	0.99	0.00	0.00	2.60	0.00	0.00	0.99

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-15 Exposure Ranges ($ER_{95\%}$) to MMPA Level A (Injury) and Level B (Behavioral Disturbance) Thresholds for Marine Mammals Due to Sound from Impact Pile Driving of OSS2 Jacket Foundations with 0 and 10 dB of Noise Attenuation

Functional Hearing Group	Range (kilometers)											
	Two Pin Piles per Day						Three Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p	Level A L_{pk}	Level A $L_{E, 24h}$	Level B L_p
LFC	0.00	0.86	2.58	0.00	0.00	0.84	0.00	0.85	2.53	0.00	0.00	0.84
MFC	0.00	0.00	2.40	0.00	0.00	0.83	0.00	0.00	2.39	0.00	0.00	0.78
HFC	0.00	0.00	2.34	0.00	0.00	0.71	0.00	0.00	2.43	0.00	0.00	0.71
PW	0.00	0.00	2.68	0.00	0.00	0.79	0.00	0.00	2.67	0.00	0.00	0.78

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
PW = phocid pinniped in water

Table J-16 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of One 9.6-meter Monopile WTG Foundation per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	Typical Scenario						Difficult-to-Drive Scenario					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Kemp's ridley turtle	0.00	0.41	1.96	0.00	0.00	0.51	0.00	0.97	3.37	0.00	0.10	1.29
Leatherback turtle	0.00	0.79	2.37	0.00	0.00	0.73	0.00	1.54	3.87	0.00	0.15	1.60
Loggerhead turtle	0.00	0.00	1.99	0.00	0.00	0.38	0.00	0.48	3.19	0.00	0.00	1.24
Green turtle	0.00	0.39	2.13	0.00	0.00	0.36	0.00	1.44	3.61	0.00	0.17	1.67

Source: Summarized from Appendix I, *Animal Movement and Exposure Modeling,* to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-17 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of Two 9.6-meter Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	Typical Scenario						Difficult-to-Drive Scenario					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Kemp's ridley turtle	0.00	0.37	1.90	0.00	0.00	0.67	<0.01	0.96	3.36	0	0.12	0.67
Leatherback turtle	0.00	0.80	2.35	0.00	0.06	0.75	0	1.57	3.85	0	0.31	0.82
Loggerhead turtle	0.00	0.45	1.89	0.00	0.00	0.49	0	0.56	2.91	0	0.03	0.55
Green turtle	0.00	0.50	2.11	0.00	0.00	0.66	0	1.48	3.61	0	0.19	0.67

Source: Summarized from Tables I-47 through I-54, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-18 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of One and Two 11-meter U3 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	One Monopile per Day						Two Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Kemp's ridley turtle	0	0.15	1.41	0	0	0.45	0	0.21	1.45	0	0	0.33
Leatherback turtle	0	0.68	1.65	0	0	0.15	0	0.70	1.76	0	0	0.58
Loggerhead turtle	0	0	1.37	0	0	0.44	0	0.03	1.38	0	0	0.21
Green turtle	0	0.17	1.75	0	0	0.35	0	0.36	1.60	0	0	0.38

Source: Summarized from Tables I-55 through I-58, Appendix I, *Animal Movement and Exposure Modeling* , to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-19 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of One and Two 11-meter T1 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	One Monopile per Day						Two Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p
Kemp's ridley turtle	0	0.34	2.21	0	0	0.44	0	0.38	1.99	0	0	0.59
Leatherback turtle	0	0.70	2.50	0	0	0.74	0	0.76	2.47	0	0	0.81
Loggerhead turtle	0	0	2.00	0	0	0.39	0	0.45	2.02	0	0	0.59
Green turtle	0	0.16	2.32	0	0	0.81	0	0.64	2.29	0	0	0.75

Source: Summarized from Tables I-59 through I-62, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-20 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of One and Two 11-meter R3 Monopile WTG Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	One Monopile per Day						Two Monopiles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E,\,24h}$	Beh. L_p
Kemp's ridley turtle	0	0.37	1.79	0	<0.01	0.53	0	0.34	1.84	0	0	0.51
Leatherback turtle	0	0.57	2.20	0	0	0.71	0	0.51	2.15	0	0	0.75
Loggerhead turtle	0	0	1.66	0	0	0.39	0	0.14	1.81	0	0	0.45
Green turtle	0	0.16	2.05	0	0	0.61	0	0.47	1.99	0	0	0.58

Source: Summarized from Tables I-63 through I-66, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-21 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of OSS1 Jacket Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	Two Pin Piles per Day						Three Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Kemp's ridley turtle	0	0	0.35	0	0	0.11	0	0	0.35	0	0	0.10
Leatherback turtle	0	0	0.52	0	0	0	0	0	0.57	0	0	0
Loggerhead turtle	0	0	0.38	0	0	0	0	0	0.37	0	0	0
Green turtle	0	0	0.46	0	0	0	0	0	0.45	0	0	0

Source: Summarized from Tables I-67 through I-70, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-22 Exposure Ranges ($ER_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Sea Turtles Due to Sound from Impact Pile Driving of OSS2 Jacket Foundations per Day with 0 and 10 dB of Noise Attenuation

Species	Range (kilometers)											
	Two Pin Piles per Day						Three Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Kemp's ridley turtle	0	0	0.37	0	0	0.07	0	0	0.40	0	0	0.07
Leatherback turtle	0	0	0	0	0	0	0	0	0	0	0	0
Loggerhead turtle	0	0	0.20	0	0	0	0	0	0.19	0	0	0
Green turtle	0	0	0.27	0	0	0	0	0	0.30	0	0	0

Source: Summarized from Tables I-71 through I-74, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
Beh. = behavior; Inj. = injury

Table J-23 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of Typical 9.6-meter Monopile WTG Foundations with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	0.19	7.22	14.36	0.05	2.78	5.90
Fish less than 2 grams	0.19	9.24	14.36	0.05	3.87	5.90
Fish without swim bladder	0.09	0.37	--	--	0.07	--
Fish with swim bladder not involved in hearing	0.16	1.95	--	0.05	0.50	--
Fish with swim bladder involved in hearing	0.16	1.95	--	0.05	0.50	--
Sea turtles	--	1.78	2.42	--	0.44	0.72

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)

Table J-24 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving-of-Difficult to Drive 9.6-meter Monopile WTG Foundations with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	0.46	9.34	17.00	0.11	5.20	9.28
Fish less than 2 grams	0.46	12.03	17.00	0.11	6.64	9.28
Fish without swim bladder	0.15	0.85	--	0.02	0.16	--
Fish with swim bladder not involved in hearing	0.41	3.39	--	0.09	1.27	--
Fish with swim bladder involved in hearing	0.41	3.39	--	0.09	1.27	--
Sea turtles	--	3.06	4.01	--	1.08	1.67

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)

Table J-25 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of 11-meter (R3, T1, and U3) Monopile WTG Foundations with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	0.30	6.53	12.24	0.07	3.18	7.51
Fish less than 2 grams	0.30	8.46	13.72	0.07	4.39	7.51
Fish without swim bladder	0.11	0.34	--	0.01	0.07	--
Fish with swim bladder not involved in hearing	0.19	1.83	--	0.06	0.52	--
Fish with swim bladder involved in hearing	0.19	1.83	--	0.06	0.52	--
Sea turtles	--	1.67	2.57	--	0.44	0.87

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)

Table J-26 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of OSS1 Jacket Foundations (One Pin Pile per Day) with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	0.02	2.87	6.31	0.01	0.92	2.67
Fish less than 2 grams	0.02	4.24	6.31	0.01	1.57	2.67
Fish without swim bladder	0.01	0.05	--	--	--	--
Fish with swim bladder not involved in hearing	0.02	0.42	--	0.01	0.11	--
Fish with swim bladder involved in hearing	0.02	0.42	--	0.01	0.10	--
Sea turtles	--	0.34	0.44	--	0.10	0.12

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)

Table J-27 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of OSS1 Jacket Foundations (Two and Three Pin Piles per Day) with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)											
	2 Pin Piles per Day						3 Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p	Inj. L_{pk}	Inj. $L_{E, 24h}$	Beh. L_p
Fish ≥ 2 grams	0.02	3.91	6.31	0.01	1.41	2.66	0.02	4.51	6.31	0.01	1.72	2.66
Fish < 2 grams	0.02	5.35	6.31	0.01	2.19	2.66	0.02	6.08	6.31	0.01	2.59	2.66
Fish without swim bladder	0.01	0.11	--	--	0.01--		0.01	0.13	--	--	0.02	--
Fish with swim bladder not involved in hearing	0.02	0.64	--	0.01	0.16		0.02	0.82	--	0.01	0.20	--
Fish with swim bladder involved in hearing	0.02	0.64	--	0.01	0.16		0.02	0.82	--	0.01	0.20	--
Sea turtles	--	0.54	0.44	--	0.13	0.12	--	0.70	0.44	--	0.18	0.12

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)
≥ = greater than or equal to; < = less than; Beh. = behavior; Inj. = injury

Table J-28 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of OSS2 Jacket Foundations (One Pin Pile per Day) with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p	Injury L_{pk}	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	0.02	3.01	6.78	--	0.93	2.60
Fish less than 2 grams	0.02	4.64	6.78	--	1.60	2.66
Fish without swim bladder	--	0.05	--	--	--	--
Fish with swim bladder not involved in hearing	--	0.39	--	--	0.06	--
Fish with swim bladder involved in hearing	--	0.39	--	--	0.06	--

Faunal Group	Range (kilometers)					
	0 dB			10 dB		
	Injury L_{pk}	Injury $L_{E,\ 24h}$	Behavior L_{p}	Injury L_{pk}	Injury $L_{E,\ 24h}$	Behavior L_{p}
Sea turtles	--	0.35	0.42	--	0.06	0.10

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)

Table J-29 Acoustic Ranges (R_{max}) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Impact Pile Driving of OSS2 Jacket Foundations with 0 and 10 dB of Noise Attenuation

Faunal Group	Range (kilometers)											
	2 Pin Piles per Day						3 Pin Piles per Day					
	0 dB			10 dB			0 dB			10 dB		
	Inj. L_{pk}	Inj. $L_{E,\ 24h}$	Beh. L_{p}	Inj. L_{pk}	Inj. $L_{E,\ 24h}$	Beh. L_{p}	Inj. L_{pk}	Inj. $L_{E,\ 24h}$	Beh. L_{p}	Inj. L_{pk}	Inj. $L_{E,\ 24h}$	Beh. L_{p}
Fish ≥ 2 grams	0.02	4.25	6.78	--	1.41	2.60	0.02	4.97	6.78	--	1.74	2.66
Fish < 2 grams	0.02	6.01	6.78	--	2.28	2.66	0.02	6.95	6.78	--	2.73	2.66
Fish without swim bladder	--	0.09	--	--	--	--	--	0.11	--	--	0.02	--
Fish with swim bladder not involved in hearing	0.02	0.61	--	--	0.13	--	0.02	0.79	--	--	0.18	--
Fish with swim bladder involved in hearing	0.02	0.61	--	--	0.13	--	0.02	0.79	--	--	0.18	--
Sea turtles	--	0.50	0.42	--	0.11	0.10	--	0.66	0.42	--	0.15	0.10

Source: Summarized from Appendix H, *Acoustic Ranges*, to COP Appendix M-2 (Empire 2022)
≥ = greater than or equal to; < = less than; Beh. = behavior; Inj. = injury

J.6.1.2. Vibratory Pile Driving for Cofferdam Installation

The results of acoustic modeling for vibratory pile driving are presented in Appendix M-1 of the COP (Empire 2022) for the multiple modeled locations. Summaries of ranges to acoustic thresholds for marine mammals, sea turtles, and fish are presented herein and are based on the maximum acoustic range to the 95th maximum percentile ($R_{95\%}$) among the modeled scenarios (Table J-30 and Table J-31).

Table J-30 Maximum Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Marine Mammals Due to Sound from Vibratory Pile Driving without Noise Attenuation

Functional Hearing Group	Range (meters)	
	Level A $L_{E, 24h}$	Level B L_p
LFC	122	1,985
MFC	0	
HFC	44	
PW	62	

Source: Summarized from Tables M-1-8 and M-1-12 in COP Appendix M-1 (Empire 2022).
PW = phocid pinniped in water

Table J-31 Acoustic Ranges (R_{95}%) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Vibratory Pile Driving without Noise Attenuation

Faunal Group	Range (meters)	
	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	260	268
Fish less than 2 grams	304	
Fish without swim bladder	0.00	
Fish with swim bladder not involved in hearing	56	
Fish with swim bladder involved in hearing	56	
Sea turtles	56	53

Source: Summarized from Tables M-1-9 through M-1-12 in COP Appendix M-1 (Empire 2022).

J.6.1.3. Impact Pile Driving for Goal Post Installation

The results of acoustic modeling for goal post pile driving are presented in Appendix M-1 of the COP (Empire 2022) for the multiple modeled locations. Summaries of ranges to acoustic thresholds for marine mammals, sea turtles, and fish are presented herein and are based on the maximum acoustic range to the 95th maximum percentile ($R_{95\%}$) among the modeled scenarios (Table J-32 and Table J-33).

Table J-32 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Marine Mammals Due to Sound from Goal Post Pile Driving without Noise Attenuation

Functional Hearing Group	Range (meters)	
	Level A $L_{E, 24h}$	Level B 160 L_p
LFC	632.1	398.1
MFC	22.5	

Functional Hearing Group	Range (meters)	
	Level A $L_{E, 24h}$	Level B 160 L_p
HFC	752.9	
PW	338.3	

Source: Summarized from Tables M-1-14 and M-1-17 in COP Appendix M-1 (Empire 2022)
PW = phocid pinniped in water

Table J-33 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Goal Post Pile Driving without Noise Attenuation

Faunal Group	Range (meters)	
	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	631	1,847.8
Fish less than 2 grams	342	
Sea turtles	18.3	39.8

Source: Summarized from Tables M-1-15 and M-1-16 in COP Appendix M-1 (Empire 2022)

J.6.1.4. Vibratory Pile Driving for Sheetpile Installation and Berthing Pile Removal

The results of acoustic modeling for vibratory pile driving associated with marina bulkhead repairs and berthing pile removal are presented in Appendix M-1 of the COP (Empire 2022). Summaries of ranges to acoustic thresholds for marine mammals, sea turtles, and fish are presented herein and are based on the maximum acoustic range to the 95th maximum percentile ($R_{95\%}$) among the modeled scenarios (Table J-34 through Table J-37).

Table J-34 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Marine Mammals Due to Sound from Vibratory Pile Driving for Marina Bulkhead Repairs without Noise Attenuation

Functional Hearing Group	Range (meters)	
	Level A $L_{E, 24h}$	Level B 160 L_p
LFC	43.2	1,000
MFC	3.8	
HFC	63.8	
PW	26.2	

Source: Summarized from Tables M-1-18 and M-1-21 in COP Appendix M-1 (Empire 2022)
PW = phocid pinniped in water

Table J-35 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Vibratory Pile Driving for Marina Bulkhead Repairs without Noise Attenuation

Faunal Group	Range (meters)	
	Injury $L_{E, 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	37.2	46.4
Fish less than 2 grams	68.8	

Faunal Group	Range (meters)	
	Injury $L_{E,\ 24h}$	Behavior L_p
Sea turtles	2.0	1.0

Source: Summarized from Tables M-1-19 through M-1-21 in COP Appendix M-1 (Empire 2022)

Table J-36 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Marine Mammals Due to Sound from Vibratory Pile Driving for Marina Berthing Pile Removal without Noise Attenuation

Functional Hearing Group	Range (meters)	
	Level A $L_{E,\ 24h}$	Level B 160 L_p
LFC	43.5	1,600
MFC	3.9	
HFC	64.3	
PW	26.5	

Source: Summarized from Tables M-1-18 and M-1-21 in COP Appendix M-1 (Empire 2022)
PW = phocid pinniped in water

Table J-37 Acoustic Ranges ($R_{95\%}$) to Injury and Behavioral Disturbance Thresholds for Fish and Sea Turtles Due to Sound from Vibratory Pile Driving for Marina Berthing Pile Removal without Noise Attenuation

Faunal Group	Range (meters)	
	Injury $L_{E,\ 24h}$	Behavior L_p
Fish greater than or equal to 2 grams	84.0	90.0
Fish less than 2 grams	45.5	
Sea turtles	2.4	1.9

Source: Summarized from Tables M-1-23 and M-1-24 in COP Appendix M-1 (Empire 2022)

J.6.2 Animal Exposure Estimates

J.6.2.1. Marine Mammals

The numbers of individual marine mammals predicted to receive sound levels above threshold criteria during impact pile driving for foundation installation were determined using animal movement modeling, as described in Section J.3.3. The modeled results for impact pile driving, with 0 and 10 dB of noise attenuation, for four 2-year construction schedules are presented in Table J-38 through Table J-41.

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Table J-38 Number of Marine Mammals Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 1 (one monopile per day/two pin piles per day)

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
LFC																
Fin whale	0.0	7.66	36.81	34.87	0	1.63	12.19	14.09	0	3.62	18.53	17.55	0	0.74	5.75	6.95
Minke whale	0.02	2.91	16.74	59.19	0	0.42	7.10	30.57	0.01	1.94	11.09	35.72	0	022	4.79	19.25
Humpback whale[3]	<0.01	1.81	13.60	59.12	<0.01	0.23	5.10	28.15	0	0.99	7.69	35.84	0	0.10	2.86	16.60
NARW	0.00	3.28	24.04	123.85	0	0.38	9.27	52.54	0	2.40	18.91	89.03	0	0.24	7.23	39.55
Sei whale	<0.01	0.19	1.06	4.20	<0.01	0.04	0.41	2.14	<0.01	0.14	0.82	3.12	0	0.03	0.30	1.60
MFC																
Atlantic white sided dolphin	0.00	0.00	453.10	159.80	0	0	179.81	61.88	0	0	261.87	86.48	0	0	103.87	35.11
Atlantic spotted dolphin	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0.00	0.00	2202.9	839.14	0	0	937.74	305.77	0	0	1392.62	520.43	0	0	581.15	184.17
Bottlenose dolphin	0.00	0.00	430.90	166.36	0	0	182.59	60.82	0	0	216.30	81.55	0	0	91.59	29.67
Risso’s dolphin	0.00	0.00	3.73	1.39	0	0	1.30	0.51	0	0	2.18	0.80	0	0	0.71	0.29
Long-finned pilot whale	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-finned pilot whale	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0.00	0.00	4.42	1.61	0	0	1.55	0.53	0	0	2.3	0.81	0	0	0.78	0.26
HFC																
Harbour porpoise	9.63	0.15	656.15	7850.26	0.15	0	220.61	2318.93	5.80	0	484.13	5524.89	0	0	153.84	1667.90
PW																
Gray seal	0.23	0.55	129.97	95.97	0	0.04	42.26	32.26	0.22	0.44	107.04	77.37	0	0	33.92	26.16
Harbor seal	0.52	1.12	313.14	216.93	0	0	92.53	74.04	0.50	0.50	254.28	170.71	0	0	69.71	58.27

Source: Summarized from Table I-3 and Table I-4, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
[1] Unweighted criterion from NMFS 2005
[2] Frequency-weighted criteria from Wood et al. 2012.
[3] Given protected species observer sightings in the Project area from 2018 to 2021, behavioral exposure estimates for this species are likely underestimates. Therefore, this value was adjusted based on protected species observer data, and Empire requested take of 86 humpback whales by Level B harassment in its Letter of Authorization application.
PW = phocid pinniped in water

Table J-39 Number of Marine Mammals Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 2 (one monopile per day/three pin piles per day)

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
LFC																
Fin whale	0	7.69	36.57	34.43	0	1.63	12.18	13.97	0	3.62	18.53	17.55	0	0.74	5.75	6.95
Minke whale	0.02	2.92	16.95	58.74	0	0.42	7.17	30.47	0.01	1.94	11.09	35.72	0	0.22	4.79	19.25
Humpback whale	<0.01	1.81	13.73	57.91	<0.01	0.23	5.15	28.05	0	0.99	7.69	35.84	0	0.10	2.86	16.60
NARW	0	3.28	24.27	123.07	0	0.38	9.32	52.69	0	2.40	18.91	89.03	0	0.24	7.23	39.55
Sei whale	<0.01	0.20	1.07	4.16	<0.01	0.04	0.41	2.13	<0.01	0.14	0.82	3.12	0	0.03	0.30	1.60

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
MFC																
Atlantic white sided dolphin	0	0	452.5	159.05	0	0	179.82	61.85	0	0	261.87	86.48	0	0	103.87	35.11
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	2227.21	849.12	0	0	945.64	308.78	0	0	1392.62	520.43	0	0	581.15	184.17
Bottlenose dolphin	0	0	429.53	165.33	0	0	182.91	60.64	0	0	216.30	81.55	0	0	91.59	29.67
Risso's dolphin	0	0	3.74	1.38	0	0	1.31	0.51	0	0	2.18	0.80	0	0	0.71	0.29
Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	4.42	1.60	0	0	1.56	0.53	0	0	2.30	0.81	0	0	0.78	0.26
HFC																
Harbour porpoise	9.63	0.15	661.97	7712.44	0.15	0	222.30	2294.06	5.80	0	484.13	5524.89	0	0	153.84	1667.90
PW																
Gray seal	0.23	0.55	129.30	93.71	0	0.04	42.23	31.86	0.22	0.44	107.04	77.37	0	0	33.92	26.16
Harbor seal	0.52	1.12	312.29	212.97	0	0	92.62	73.46	0.50	0.50	254.28	170.71	0	0	69.71	58.27

Source: Summarized from Table I-5 and Table I-6, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
[1] Unweighted criterion from NMFS 2005
[2] Frequency-weighted criteria from Wood et al. 2012
PW = phocid pinniped in water

Table J-40 Number of Marine Mammals Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 3 (two monopiles per day/two pin piles per day)

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
LFC																
Fin whale	0.03	7.59	28.72	24.98	0	1.58	11.17	10.92	0.02	3.65	14.52	12.30	0	0.68	5.45	5.33
Minke whale	0.02	2.97	16.2	47.58	0	0.35	6.84	26.13	<0.01	1.97	10.45	27.14	0	0.16	4.51	15.72
Humpback whale	<0.01	1.95	14.23	51.38	<0.01	0.18	5.36	26.60	0	1.09	7.95	30.45	0	0.07	2.93	15.26
NARW	0	3.34	23.66	114.79	0	0.37	9.28	49.32	0	2.49	17.96	71.46	0	0.20	7.12	34.19
Sei whale	<0.01	0.19	0.89	3.20	<0.01	0.03	0.37	1.67	<0.01	0.14	0.64	1.93	0	0.02	0.27	1.06
MFC																
Atlantic white sided dolphin	0	0	397.32	147.02	0	0	171.14	55.69	0	0	224.05	9.68	0	0	98.24	30.79
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0.73	0	2037.33	784.12	0	0	866.31	299.54	0.53	0	1228.35	456.45	0	0	522.05	175.52
Bottlenose dolphin	0	0	385.79	144.60	0	0	159.12	57.47	0	0	192.88	69.86	0	0	78.97	27.68
Risso's dolphin	<0.01	0	3.13	1.18	0	0	1.27	0.45	<0.01	0	1.77	0.65	0	0	0.70	0.24
Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	3.86	1.37	0	0	1.46	0.49	0	0	2.00	0.67	0	0	0.74	0.24

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
HFC																
Harbour porpoise	13.22	0.69	559.88	6319.98	0.89	0	203.99	1868.04	9.02	0.54	396.87	3476.65	0.64	0	141.46	1100.75
PW																
Gray seal	0.12	0.28	105.61	69.68	0	0.12	36.46	24.31	0.11	0.22	85.34	53.09	0	0.11	28.49	18.61
Harbor seal	036	1.48	261	171.76	0	0	97.72	65.06	0.25	0.74	204.39	129.78	0	0	76.19	49.65

Source: Summarized from Table I-7 and Table I-8, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
[1] Unweighted criterion from NMFS 2005
[2] Frequency-weighted criteria from Wood et al. 2012
PW = phocid pinniped in water

Table J-41 Number of Marine Mammals Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 4 (two monopiles per day/three pin piles per day)

Marine Mammal Species	Year 1								Year 2							
	0 dB				10 dB				0 dB				10 dB			
	Level A		Level B		Level A		Level B		Level A		Level B		Level A		Level B	
	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]	L_{pk}	$L_{E, 24h}$	L_p[1]	L_p[2]
LFC																
Fin whale	0.03	7.62	28.45	24.50	0	1.58	11.15	10.78	0.02	3.65	14.52	12.30	0	0.68	5.45	5.33
Minke whale	0.02	2.98	16.17	46.16	0	0.35	6.84	25.53	<0.01	1.97	10.45	27.14	0	0.16	4.51	15.72
Humpback whale	<0.01	1.95	14.21	50.69	<0.01	0.18	5.37	26.40	0	1.09	7.95	30.45	0	0.07	2.993	15.26
NARW	0	3.34	23.60	108.26	0	0.37	9.27	48.01	0	2.49	17.96	71.46	0	0.20	7.12	34.19
Sei whale	<0.01	0.20	0.88	2.97	<0.01	0.03	0.37	1.58	<0.01	0.14	0.64	1.93	0	0.02	0.27	1.06
MFC																
Atlantic white sided dolphin	0	0	395.42	145.67	0	0	170.84	55.49	0	0	224.05	79.68	0	0	98.24	30.79
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0.73	0	2031.30	775.97	0	0	866.80	298.06	0.53	0	1228.35	456.45	0	0	522.05	175.52
Bottlenose dolphin	0	0	383.89	143.29	0	0	159.35	57.21	0	0	192.88	69.86	0	0	78.97	27.68
Risso's dolphin	<0.01	0	3.11	1.16	0	0	1.26	0.44	<0.01	0	1.77	0.65	0	0	0.70	0.24
Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-finned pilot whale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	3.84	1.36	0	0	1.46	0.49	0	0	2.00	0.67	0	0	0.74	0.24
HFC																
Harbour porpoise	13.22	0.69	558.14	5706.38	0.89	0	204.03	1738.98	9.02	0.54	396.87	3476.65	0.64	0.11	141.46	1100.75
PW																
Gray seal	0.12	0.28	103.91	67.37	0	0.12	36.30	23.77	0.11	0.22	85.34	53.09	0	0	28.49	18.61
Harbor seal	0.36	1.48	257.19	167.54	0	0	97.18	63.82	0.25	0.74	204.39	129.78	0	0	76.19	49.65

Source: Summarized from Table I-9 and Table I-10, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)
[1] Unweighted criterion from NMFS 2005
[2] Frequency-weighted criteria from Wood et al. 2012
PW = phocid pinniped in water

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J.6.2.2. Sea Turtles

The numbers of individual sea turtles predicted to receive sound levels above threshold criteria were also determined using animal movement modeling. The model results for impact pile driving, with 0 and 10 dB of noise attenuation are presented in Table J-42 through Table J-45.

Table J-42 Number of Sea Turtles Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 1 (one monopile per day/two pin piles per day)

Sea Turtle Species	Year 1						Year 2					
	0 dB			10 dB			0 dB			10 dB		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p
Kemp’s ridley sea turtle	2.69	0	21.81	0.33	0	5.48	1.01	0	11.84	0.14	0	2.74
Leatherback sea turtle	1.70	0	14.61	0.03	0	1.65	0.53	0	7.49	0	0	0.42
Loggerhead sea turtle	4.99	0	292.48	0	0	29.57	0	0	160.11	0	0	11.72
Green sea turtle	0.08	0	0.67	<0.01	0	0.10	0.03	0	0.36	0	0	0.04

Source: Summarized from Table I-11 and Table I-12, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)

Table J-43 Number of Sea Turtles Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 2 (one monopile per day/three pin piles per day)

Sea Turtle Species	Year 1						Year 2					
	0 dB			10 dB			0 dB			10 dB		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p
Kemp’s ridley sea turtle	2.69	0	21.81	0.33	0	5.48	1.01	0	11.84	0.14	0	2.74
Leatherback sea turtle	1.70	0	14.62	0.03	0	1.65	0.53	0	7.49	0	0	0.42
Loggerhead sea turtle	4.99	0	293.70	0	0	29.57	0	0	160.11	0	0	11.72
Green sea turtle	0.08	0	0.67	<0.01	0	0.10	0.03	0	0.36	0	0	0.04

Source: Summarized from Table I-13 and Table I-14, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)

Table J-44 Number of Sea Turtles Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 3 (two monopiles per day/two pin piles per day)

Sea Turtle Species	Year 1						Year 2					
	0 dB			10 dB			0 dB			10 dB		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p	$L_{E,24h}$	L_{pk}	L_p
Kemp’s ridley sea turtle	3.35	0.02	21.15	0.05	0	5.14	1.65	<0.01	11.91	<0.01	0	2.67

Sea Turtle Species	Year 1						Year 2					
	0 dB			10 dB			0 dB			10 dB		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p
Leatherback sea turtle	1.70	0	12.42	0.04	0	1.26	0.63	0	6.15	0	0	0.32
Loggerhead sea turtle	9.52	0	334.58	0.46	0	62.83	7.91	0	202.22	0	0	32.77
Green sea turtle	0.14	0	0.74	<0.01	0	0.16	0.08	0	0.43	0	0	0.09

Source: Summarized from Table I-15 and Table I-16, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)

Table J-45 Number of Sea Turtles Predicted to Receive Sound Levels Above Regulatory Criteria for Impact Pile Driving Construction Schedule 4 (two monopiles per day/three pin piles per day)

Sea Turtle Species	Year 1						Year 2					
	0 dB			10 dB			0 dB			10 dB		
	Injury		Behavior	Injury		Behavior	Injury		Behavior	Injury		Behavior
	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p	$L_{E, 24h}$	L_{pk}	L_p
Kemp’s ridley sea turtle	3.35	0.02	21.16	0.05	0	5.14	1.65	0	11.91	<0.01	0	2.67
Leatherback sea turtle	1.70	0	12.42	0.04	0	1.26	0.63	0	6.15	0	0	0.32
Loggerhead sea turtle	9.52	0	335.80	0.46	0	62.83	1.91	0	202.22	0	0	32.77
Green sea turtle	0.14	0	0.74	<0.01	0	0.16	0.08	0	0.43	0	0	

Source: Summarized from Table I-17 and Table I-18, Appendix I, *Animal Movement and Exposure Modeling*, to COP Appendix M-2 (Empire 2022)

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Appendix K. List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

This EIS is available in electronic form for public viewing at https://www.boem.gov/renewable-energy/state-activities/empire-wind. Hard copies and digital copies of the EIS can be requested by contacting the Program Manager, Office of Renewable Energy in Sterling, Virginia. Publication of this draft EIS initiates a 60-day comment period where government agencies, members of the public, and interested stakeholders can provide comments and input. BOEM will accept comments in any of the following ways:

- In hard copy form, delivered by hand or by mail, enclosed in an envelope labeled “Empire Wind COP Draft EIS” and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.
- Through the regulations.gov web portal by navigating to http://www.regulations.gov and searching for docket number “BOEM-2022-0053.” Click the “Comment Now!” button to the right of the document link. Enter your information and comment, then click “Submit.”
- By attending one of the EIS public hearings listed in the notice of availability and providing written or verbal comments.

BOEM will use comments received during the public comment period to inform its preparation of the final EIS, as appropriate. EIS notification lists for the Project are provided in Table K-1 through Table K-4.

K.1. Notification List

Table K-1 Federal Agencies

Agency	Contact
ACHP	Christopher Daniel, Program Analyst Blythe Semmer, Assistant Director for Special Initiatives Christopher Koeppel, Assistant Director
BSEE	Cheri Hunter, Renewable Energy Program Coordinator Ramona Sanders, FAST-41 Coordinator Juliette Giordano, Environmental Compliance Program TJ Broussard, Office of Environmental Compliance Andrea Heckman, Office of Environmental Compliance, NEPA Coordinator Graham Tuttle, Marine Protected Species Program National Lead Shawn Arnold, Historic Preservation Program National Lead
DOD	Steven Sample, Executive Director, DOD Siting Clearinghouse Scott Kiernan, Deputy Director, Military Aviation and Installation Assurance Siting Clearinghouse Mike Lignowski, Analyst, DOD Siting Clearinghouse
DON	Matthew Senska, Director, Marine Resources and At-Sea Policy

Agency	Contact
MARAD	Kris Gilson, Director, Office of Environmental Compliance Kelly O'Reilly, Environmental Protection Specialist
NMFS	Sue Tuxbury, Fishery Biologist/Wind Coordinator, GARFO HESD Keith Hanson, Marine Habitat Resource Specialist, GARFO HESD Julie Crocker, Chief, ESA Fish, Energy, and Ecosystems Branch, GARFO Protected Resources Division Jaclyn Daly, Fishery Biologist, Office of Protected Resources Dale Youngkin, FAST-41
NPS	Mary Krueger, Energy Specialist Lindsay Gillham, FAST-41
USACE	Chris Minck, New York District, Regulatory, Project Manager Robert Vietri, New York District, Regulatory, Project Manager Stephan Ryba, New York District, Regulatory, Branch Chief Naomi Handell, North Atlantic Division, Regulatory Program Manager Ann Marie Dilorenzo, North Atlantic Division, Section 408 Coordinator
USCG	George Detweiler, Headquarters John Stone, Headquarters, Navigation Standards Division Maureen Kallgren, Marine Transportation Specialist Michele Desautels, District 1 Chris Sparkman, District 1, Marine Information Specialist Commander John Singletary, Chief, Waterways Management Division, Sector New York Lieutenant Natasha Hope, Waterways Management Division, Sector Long Island Sound Allen M. Garneau, Bridge Program Matthew Robertson, FAST-41 Coordinator
USEPA	Mark Austin, NEPA Program Coordinator, Region 2 Anne Rosenblatt, Region 2 Viorica Petriman, Environmental Engineer, Air and Radiation Division, Region 2 Neha Sareen, Air and Radiation Division, Region 2 Scott Bowles, FAST-41 Coordinator Prasad Chumble, FAST-41
USFWS	David Stilwell, Field Supervisor Steve Papa, Fish and Wildlife Biologist Jane Ledwin, Infrastructure Streamlining Coordinator Frankie Green, FAST-41 Coordinator

DON = Department of the Navy; FAST-41 = Title 41 of Fixing America's Surface Transportation Act; GARFO = Greater Atlantic Regional Fisheries Office; HESD = Habitat and Ecosystems Services Division; MARAD = U.S. Maritime Administration; NPS = National Park Service

Table K-2 State and Local Agencies

Agency	Contact
NYSERDA	Tom King, Senior Counsel Sherryl Huber, Project Manager for Offshore Wind
NYSDEC	Lisa Covert, Climate Change Section Chief, Bureau of Climate, Air & Energy Karen Gaidasz, Offshore Wind Section Chief, Division of Environmental Permits Tyler Hepner, Senior Attorney, Bureau of Climate, Air & Energy
NYSDOS	Laura McLean, Coastal Energy Review Specialist Matthew Maraglio, Coastal Resources Specialist Michael Snyder, Program Manager Kari Gathen, Counsel's Office Terra Haight
City of New York	Max Taffet, Vice President, Transportation, PortNYC Planning Hilary Semel, Director and General Counsel, Mayor's Office of Environmental Coordination

NYSDOS = New York State Department of State

Table K-3 Tribal Nations

Tribal Nation	Contact
Delaware Tribe of Indians	Susan Bachor, Archaeologist, Deputy Tribal Historic Preservation Officer Brad KillsCrow, Chief
The Delaware Nation	Deborah Dotson, President of Executive Committee Carissa Speck, Tribal Historic Preservation Director
The Shinnecock Indian Nation	Bryan Polite, Chairman Shavonne Smith, Director, Shinnecock Environmental Department
Wampanoag Tribe of Gay Head (Aquinnah)	Cheryl Andrews-Maltais, Chairwoman Bettina Washington, Tribal Historic Preservation Officer

Table K-4 Section 106 Consulting Parties

Government or Organization	Participating Consulting Parties	Contact
SHPOs and State Agencies	NJDEP, Historic Preservation Office	Katherine Marcopul, Administrator and Deputy Historic Preservation Officer Jesse West-Rosenthal, Historic Preservation Specialist 2
	New Jersey Office of Planning Advocacy	Lisa Avichal, Area Planner Donna Rendeiro, Executive Director
	New York SHPO	R. Daniel Mackay, Deputy Commissioner for Historic Preservation

Government or Organization	Participating Consulting Parties	Contact
	New York State Parks, Recreation and Historic Preservation	Erik Kullesaid, Commissioner, SHPO
	New York State Parks, Recreation and Historic Preservation, Long Island State Parks Region 9	George Gorman, Jr., Regional Director (Primary) Kevin Connelly, Assistant Region Director (Alternate)
	New York State Parks, Recreation and Historic Preservation, Region 9, Gilgo State Park	Kevin Boone, Park Director
	New York State Parks, Recreation and Historic Preservation, Region 9, Jones Beach State Park	Jeffery Mason, Park Director
	New York State Parks, Recreation and Historic Preservation, Region 9, Robert Moses State Park	Kevin Boone, Park Director
Federal Agencies	ACHP	Christopher Koeppel, Federal Property Management Section, Assistant Director Christopher Daniel, Federal Property Management Section, Program Analyst
	BSEE	Shawn Arnold, Historic Preservation Program National Lead
	U.S. Maritime Administration	Kris Gilson, Director, Office of Environmental Compliance
	National Park Service	Mary Krueger, Energy Specialist for the Northeast Region
	USACE	Chris Minck, New York District, Regulatory, Project Manager
	USEPA	Viorica Petriman, Environmental Engineer, Air and Radiation Division, Region 2
Federally Recognized Tribes	The Delaware Nation	Deborah Dotson, President of Executive Committee Carissa Speck, Tribal Historic Preservation Director
	Delaware Tribe of Indians	Susan Bachor, Archaeologist, Deputy Tribal Historic Preservation Officer Brad KillsCrow, Chief
	The Shinnecock Indian Nation	Bryan Polite, Chairman Shavonne Smith, Director, Shinnecock Environmental Department

Government or Organization	Participating Consulting Parties	Contact
	Wampanoag Tribe of Gay Head (Aquinnah)	Cheryl Andrews-Maltais, Chairwoman Bettina Washington, Tribal Historic Preservation Officer
Local Government	Atlantic Highlands Borough	Blake Deakin, Chairman Environmental Commission Adam Hubeny, Administrator
	City of Long Beach	Scott Kemins, Building Commissioner Joe Febrizio, Commissioner of Public Works
	Highlands Borough	Michael F. Muscillo, Borough Administrator
	Lake Como Borough	Kevin Higgins, Mayor Christopher D'Antuono, Councilman
	Long Branch	Nicholas Graviano, PP, AICP, JD, Planning Director George Jackson, Business Administrator
	Nassau County	Kendra Armstead, Special Assistant for Economic Development, Office of the Nassau County Executive David Viana, Planner II, Nassau County Department of Public Works - Planning Division
	New York City Landmarks Commission	Gina Santucci, Director of Environmental Review Timothy Frye, Director of Special Projects and Strategic Planning
	Ocean County	Nicole Leaf, Environmental Specialist I Anthony Agliata, Department of Planning, Director
	Sea Girt Borough	Robert Walker, Planning Board Representative Karen Brisben, Planning Board Secretary
	Suffolk County	Dorian Dale, Director of Sustainability Sarah Lansdale, Director of Planning
	Town of Babylon	Marwa Fawaz, Comprehensive Planning and Downtown Revitalization Rachel Scelfo, Office of Planning and Development
	Town of Hempstead	Christine Grillo Douglas Tuman, Commissioner
	Town of Islip	George Munkenbeck, Town Historian
	Village of Amityville	Dennis M. Siry, Mayor Kevin Smith, Deputy Mayor
	Village of Bellport	Stephen Musolino, Planning Board Chair
Nongovernmental Organizations or Groups	Bay Shore Historical Society	Barry R. Dlouhy, President
	Equinor Wind US LLC	Laura Morales, Head of Permitting - New York
	Historical Society of Highlands	Shelia Weinstock, President
	Point O'Woods Association	William J. Cook, Special Counsel Jessica Krauss, Special Counsel

Government or Organization	Participating Consulting Parties	Contact
	The League of Historical Societies of New Jersey	Tim Hart, President

Appendix L. Other Impacts

L.1. Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(2)) require that an EIS evaluate the potential unavoidable adverse impacts associated with a Proposed Action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. Table L-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Chapter 3 provides additional information on the potential impacts listed below.

All impacts from planned activities are still expected to occur as described in the No Action Alternative analysis in this EIS, regardless of whether the Proposed Action is approved.

Table L-1 Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, vehicle traffic, construction activities, and equipment operation
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Benthic Resources	• Suspension and re-settling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alterations • Disturbance, displacement, and avoidance behavior due to habitat loss/ alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities
Birds	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Coastal Habitat and Fauna	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collision with vehicles or equipment during clearing and grading activities, particularly species with limited mobility
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction of offshore Project elements • Disruption of harvesting activities during operations of offshore wind facility • Changes in vessel transit and fishing operation patterns • Changes in risk of gear entanglement or availability of target species
Cultural Resources	• Visual impacts on viewsheds of historic properties • Physical impacts on known submerged archaeological resources • Physical impacts on known ancient submerged landforms with archaeological or TCP potential

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Demographics, Employment, and Economics	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreational businesses during offshore construction and cable installation • Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Compounded health issues of local environmental justice communities near ports resulting from increased air emissions and noise associated with vessel traffic, construction activities, and equipment operation • Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to coastal visibility and subsistence fishing due to offshore construction and operation of the offshore wind facility
Finfish, Invertebrates, and Essential Fish Habitat	• Suspension and re-settling of sediments due to seafloor disturbance • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, and EMF • Individual mortality due to construction activities • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor surface alterations • Conversion of soft-bottom habitat to new hard-bottom habitat
Land Use and Coastal Infrastructure	• Conversion of undeveloped areas to utility right-of-way or easement • Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays • Potential for accidental releases during construction
Marine Mammals	• Increased risk of injury (TTS or PTS) to individuals due to underwater noise from pile-driving activities during construction • Disturbance (behavioral effects) and acoustic masking due to underwater noise from pile driving, shipping and other vessel traffic, aircraft, geophysical surveys (HRG surveys), WTG operation, cable laying, and drilling during construction and operations • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality associated with fisheries gear
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the offshore Wind Farm Development Area • Potential for disruption to marine radar on vessels operating within or near the Projects, increasing navigational complexity • Hindrances to SAR missions within the offshore Wind Farm Development Area • Submerged export cable risk to vessel anchors
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the Wind Farm Development Area • Changes to aviation and air traffic navigational patterns

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation
Sea Turtles	• Increased risk of for individual injury and mortality due to vessel strikes during construction, O&M, and decommissioning • Increased risk for individual injury and mortality associated with fisheries gear • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction • Migratory impacts on navigation associated with EMF from transmission cables
Scenic and Visual Resources	• Alterations to the seascape, open ocean, and landscape character units' character and effects on viewer experience due to construction, O&M, and decommissioning of the wind farm, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, O&M, and decommissioning
Wetlands	• Temporary wetland alterations, including increased sedimentation deposition and removal of vegetation

L.2. Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table L-2 provides a listing of potential irreversible and irretrievable impacts by resource area. EIS Chapter 3 provides additional information on the impacts summarized below.

Table L-2 Irreversible and Irretrievable Commitment of Resources by Resource Area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities and would be limited to the Project lifetime for O&M activities. To the extent that the Proposed Action displaces fossil-fuel energy generation, overall regional improvement of air quality would be expected.
Bats	Yes	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Projects would reverse the impacts of bat displacement from foraging habitat.
Benthic Resources	No	No	Although local mortality of benthic fauna and habitat alteration is likely to occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	Yes	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Projects would reverse the impacts of bird displacement from foraging habitat.
Coastal Habitat and Fauna	No	No	Although limited removal of natural habitat associated with clearing and grading for construction of the onshore export cable and substation are likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas, and after decommissioning activities in other areas.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries. The Projects could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the conceptual decommissioning of the Projects would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Cultural Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts. Physical impacts on cultural resources that would be irreversible include impacts caused by activities that result in ground disturbance, which has the potential to disturb or destroy terrestrial archaeological resources; seafloor disturbance, which has the potential to damage or destroy marine archaeological resources or ancient submerged landforms; and construction activities that could damage, destroy, or diminish the integrity of buildings, structures, objects, and historic districts onshore.
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor needs, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by Project decommissioning or by other employment, but income lost during Project operations would be irretrievable.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates and habitat alteration and loss of SAV habitat could occur, BOEM does not anticipate population-level impacts on finfish, invertebrates, and essential fish habitat. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.
Land Use and Coastal Infrastructure	No	Yes	Land use for construction and operation of the Projects could result in a minor irreversible impact due to the temporary or long-term loss of use of the land for otherwise typical activities. Other land uses could be restored upon Project decommissioning.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Marine Mammals	No	Yes	Irreversible impacts on marine mammal populations could occur if one or more individuals of an ESA-listed species were injured or killed or if those populations experienced behavioral effects of high severity. With implementation of mitigation measures, developed in consultation with NMFS (e.g., timing windows, vessel speed restrictions, safety zones), the potential for an ESA-listed species to experience high-severity behavioral effects or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from Project activities are anticipated, as described in Section 3.15; however, due to the uncertainties from lack of information that are outlined in Appendix D, these effects are still possible. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear, or due to displacement from the Project area.
Navigation and Vessel Traffic	No	No	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on vessel traffic to result in irreversible or irretrievable impacts.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities.
Recreation and Tourism	No	No	Construction activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, the implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on listed species. Irreversible impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear caught on the structures, or due to displacement from the Project area.
Scenic and Visual Resources	No	Yes	Long-term (until post-decommissioning) alterations to the seascape, open ocean, and landscape character units' character and effects on viewer experience due to construction, O&M, and decommissioning of the wind farm, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity impacts in marine and coastal environments would be temporary.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Wetlands	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland wetlands.

L.3. Relationship Between the Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(3)) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in EIS Chapter 3, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction activities and would be short term in nature and minor to moderate in severity/intensity. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security, combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean;
- Delivery of power to the electric grid to contribute to New York State's renewable energy goals; and
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this document and the Draft EIS that could occur during Proposed Action construction, O&M, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table L-2 would be long term. After completion of the Proposed Action's operations and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

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